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WILLIAM SPOTTISWOODE

ENGLISH science is still staggering under the blow it received last week in the death of the universally respected President of its leading scientific society. The world is always the poorer for the sudden withdrawal from its many activities of a man *sans peur et sans reproche*, but there is always an inner world where the loss is more keenly felt, and in this case it is the turn of the world of science to mourn one who has made her name so honoured while he has made his own so loved. It is not too much to say that the death of William Spottiswoode is felt as a personal loss by every real student of any department of natural knowledge who ever came within his influence or had the opportunity of knowing anything of the pure and earnest nature of the man. As is but natural, those who have been working along those lines of thought—and they are many—which he had made or almost made his own, will feel the loss most keenly, not merely because the so precious sympathy is gone, but because of the swift insight, valuable criticisms, and happy suggestions as to future work always so freely at the disposal of any one who would consult him either in difficulties or success.

We should however entirely fail in our duty and in our estimate of what he has done for science did we lay too great stress either upon the special work which he did himself or that which he in a greater or less degree influenced in the manner we have just indicated. How much he has personally done we stated some little time ago, little thinking, alas! that what we gave as the results he had achieved and the honours which had followed upon them was anything more than an earnest of what was to follow. It has proved to be the full tale, but it is still one which places him high in the ranks of scientific workers. But, as we have said, high as his place in science would be from this point of view, we doubt whether it is on that that the greatest stress must be laid.

Some men of science of first class working power are so constituted that the less interest they take in the general conduct of affairs connected with science or scientific bodies the better. A man of this kind helps the affairs on very little and he loses his own time. Spottiswoode was exactly the opposite of such a man. In council every word he uttered was pure gold, and when we remember that it is now twenty-two years since he began his council work as Treasurer of the British Association, and that it has never been interrupted till the time of his death, we get an idea of his influence on our national scientific activity. No effort was too great for him, no time spent too long, no margin of time too short, if anything worth doing had to be done; the personal force and the personal example were both there; dullards became enthusiasts if doing was in question, while enthusiasts were checked at times when action was impolitic or premature.

It can easily be imagined that so cultured a man with such qualities as those to which we have referred was a large figure in other than scientific activities; and that both on the ground of [illegible]rsonal merit, and as representing the Royal [illegible]ident, he was a marked figure in our F[illegible]

Hence it is that th[illegible] which his remains are bei[illegible]bey to-day was one not at [illegible]c world, nor was the claim embodie[illegible] the Dean of Westminster made simply o[illegible]unds. As remarked in the *Times*, "no more di[illegible]ned body of men, none more thoroughly representative of the community, ever united for a similar object." When we consider that their names were obtained within two days, the quickness of the sympathy and the unanimity of the feeling indicated among the most prominent and gifted sections of our society were certainly remarkable.

The Dean's letter granting the prayer of the memorialists is one again which does such honour to Spottiswoode that we give it in this place:—

"I am deeply sensible of the loss which the country has sustained in the death of the President of the Royal Society. The names appended to the weighty memorial which you have just laid before me are sufficient evidence of the widespread desire that the highest public honours should be paid to the memory of one whose peculiar claims have been urged so forcibly. In addition to that memorial, I have this morning received one expressing the same desire, and bearing the signatures of many hundreds of working men, with whom he was brought in daily intercourse. Although in consideration of the limited space yet remaining for interment within the Abbey I should have myself suggested a monument rather than a grave, yet I cannot but assent, after much anxious consideration, to the wish that your memorial expresses. I recognise in the late Mr. Spottiswoode, not merely a man of special scientific attainments, but one who from his interest in and sympathy with all the many branches and departments of scientific knowledge was peculiarly fitted to represent English science in its widest aspect, and who was at the moment of his death the chosen and the honoured President of the Royal Society. I recognise in him also a man of the very highest and most stainless character—one whose great gifts were only equalled by the purity and attractiveness, and, I may be allowed to add, the devoutness and humility, of his daily life. And, not least of all, I feel that in honouring him we are not only honouring one whose name is dear to men of science and of literature, and of eminence in every sphere of public and of social life, but one whose memory will long be treasured by the working classes, to whose highest interests and welfare he was so deeply devoted."

William Spottiswoode then is buried in Westminster Abbey to-day, by the side of his ancestor, an Archbishop of St. Andrews'; and his remains will be followed to the grave by representatives of the scientific bodies and other interests with which he was connected; nor will sympathy for the widow be wanting to fill up the cup of sadness. English science sorrows, and will long sorrow for the heavy loss, but still she is the richer for Spottiswoode's life and work, not least because his life was so good and so pure, and because, as President of the Royal Society, he has set an example which whoever succeeds him will be proud to follow.

It must not be forgotten that the Presidency of the Royal Society is the highest honour which it is in the power of the Fellows of that Society to bestow. How worthily and how well it was bestowed in the case of Spottiswoode is patent to all. A great responsibility

therefore, now rests upon them, for he upon whom their choice falls will not be merely the representative of English science in London, he will represent it on the Continent and in America; the choice must bear the criticism of scientific men in other lands. EDITOR

SIR EDWARD SABINE

SPOTTISWOODE, round whose grave in Westminster Abbey so many men, great in so many ways, have stood to-day, is not the only President of the Royal Society, and not the only man of science whose loss we have to deplore. While one, however, was cut off in the full tide of his life, and while there seemed to be a rich promise of many years of valuable work in store, the other had far outlived his working powers, and by many years exceeded those of his activity.

A reference to the life-work of Sabine will clearly show how justly his high position and reputation were accorded to him, how nobly he has worked in the cause of science, and how imperishable a record of his life remains in the existence of a whole branch of scientific research, the foundation of which was mainly due to his untiring industry.

Coming of an old family said to be of Italian origin, which early settled in Normandy, and removed thence to our own country, Edward Sabine was born in Dublin on October 14, 1788, being the son of Mr. Joseph Sabine of Tewin. He received his early education at the Royal Military Colleges of Marlow and Woolwich, obtaining a commission as second lieutenant when but fifteen years of age, and receiving his captaincy eleven years later.

Very early in life indeed, his interest became centred in physical science, and especially in magnetism, the study of which he pursued with indefatigable zeal and marked success. The result of his work in this and other fields is to be found in the many papers which issued from his pen. In 1818, six years before Spottiswoode was born, he was elected a member of the Royal Society, and in the same year was appointed astronomer to the expedition under the command of Sir John Ross which left England in search of the North-west Passage. The careful observations which he made whilst with the expedition were of great value. His published papers begin from this date, commencing with a contribution to the *Transactions of the Linnean Society*, on the birds of Greenland, the result of observations made during the voyage; they range from that date down to the year 1872, thus extending over a period of no less than fifty-four years.

During this long period of active work he contributed to the *Transactions* and *Proceedings* of various societies and contemporary magazines upwards of one hundred papers, some of great length and many of considerable value and importance. Although a large number of these deals with the subject of terrestrial magnetism, many other branches of science are included in them, the voluminous nature of his published works being not less remarkable than the wide fields of study over which they range.

A considerable number are to be found in the *Philosophical Transactions*, to which he contributed upwards of forty. To the *Proceedings of the Royal Society* he made numerous contributions during his long association with it; in the *Quarterly Journal of Science* he published twelve papers, in the *Reports of the British Association* we find ten, to the *Philosophical Magazine* he made eight contributions, the remainder of his published works being scattered among the *Edinburgh Journal of Science*, *Journal of the Geographical Society*, the *Proceedings* of one or two foreign societies, and the pages of foreign scientific magazines.

As we have already said, his scientific contributions date from his voyage to the Arctic regions with Sir John Ross in 1818. Next year he again went to the Arctic regions, this time with an expedition under the command of Sir Edward Parry. As the result of his observations there, he made two communications to the Royal Society, published in the *Philosophical Transactions*, dealing, the one with the irregularities observed in the direction of the compass needle consequent upon the attraction of the iron of the ships, the other with the variations of the magnetic needle, and the intensity of the magnetic force during the voyage, and calling attention for the first time to the extreme importance of founding a widely extended series of observations of those strange magnetical disturbances, the origin of which is still mysterious. With this object in view he left England two years later on a long voyage in H.M.S. *Pheasant*, making numerous observations and bringing many new facts to light. At the same time at several equatorial stations on the coasts of Africa and America he made observations with regard to the swinging of the pendulum, with the object of determining the true figure of the earth, publishing the results in the *Philosophical Transactions*. When on the American coast during this voyage he took up amongst other subjects the question of deep-sea temperatures, and in the *Philosophical Transactions* for 1823, he at that early period published a paper on the temperature at great depths in the Caribbean Sea, whilst in the same year his busy pen was giving an account of the barometrical measurement of the height of the Sugarloaf Mountain at Sierra Leone, and the Pico Ruivo in the Island of Madeira. Three years later he published in the *Quarterly Journal of Science* an account of the ocean currents met by H.M.S. *Pheasant* during the voyage from Sierra Leone to Bahia, and thence to New York, in which he records that the Amazon stream was crossed at a distance of 300 miles from the mouth of the river. In this year (1823) he proceeded on another voyage, going this time in H.M.S. *Griper* to Norway, Greenland, and Spitzbergen, to continue his magnetical observations, and to extend the series of pendulum experiments. Whilst at the latter place he again took up the question of barometrical measurement of heights, publishing in the *Philosophical Transactions* for 1824 a comparison of that method of measurement with the trigonometrical determinations. Then in the *Edinburgh Journal of Science* in 1825 he dealt with the presence of the Gulf Stream on the coasts of Europe as determined by his observations in the year 1822, and proceeded to discuss the question of depression over the region occupied by the Stream.

In 1826 an account of his magnetical observations at Spitzbergen appeared in *Poggendorff's Annalen*.

Continuing his pendulum swingings in 1827, he set about determining by direct observation the difference in

he lengths of the seconds pendulum at Paris and London. The results of these experiments were published in a paper of some length which appeared in the *Philosophical Transactions* for 1828. At the same time he also experimented with the object of ascertaining the ratio of the magnetic forces acting on a needle horizontally suspended in London and in Paris. In 1829, in the *Philosophical Transactions*, he wrote on the reduction to a vacuum of the vibrations of an invariable pendulum; and in the *Quarterly Journal of Science* for the same year he gave an account of experiments concerning the force of the earth's magnetism, and on the then recent magnetical observations in Siberia of M. Hanstein. In the *Philosophical Transactions* for 1831 he describes some experiments made with the object of determining the length of the seconds pendulum at Greenwich.

For many years from this date he worked mainly at that science on which he had most deeply set his mark, that of terrestrial magnetism. In 1835, in conjunction with Lloyd, Humphrey, and J. C. Ross, he contributed to the *Reports of the British Association* (of which he was an early and active member, filling the post of General Secretary for twenty-one years) an account of the terrestrial magnetic force in Ireland. In the following year he himself published in the *Reports* of that Association an account of the magnetic force in Scotland. As an indication of his range of subjects we may here remark that at this time he published in *Froriep Notizen* a paper concerning the volcanoes of the Sandwich Islands. Then in 1837 we find him again contributing to the *British Association Reports*, this time a paper on magnetic intensity, dealing with the variations it exhibits at different parts of the earth's surface. He also wrote on the same subject two years later in *Froriep Notizen*, *L'Institut*, and *Quetelet's Mathematical Correspondence*. In 1838 a memoir on the magnetic isoclinal and isodynamic lines in the British Isles appeared in the *British Association Reports*, being prepared from observations made by Prof. H. Lloyd, J. Phillips, R. W. Fox, Capt. J. C. Ross, and the indefatigable Sabine. In 1840 he continued his papers on terrestrial magnetism in the *Philosophical Transactions*, now taking for his subject the consideration of lines of equal inclination and intensity in the Atlantic Ocean, and on lines of magnetic intensity between the Cape of Good Hope and Australia. He added to this series in the following year by contributing an account of the observations made by Capt. Belcher on the west coast of America and adjacent islands, and the new determination of magnetic elements at Otaheite. Writing in 1838 Sabine had so conclusively demonstrated the importance of magnetical observations being made in every part of the globe, that Capt. James Ross was sent with the *Erebus* and *Terror* to make a magnetical survey of the Antarctic regions. Sabine of course accompanied the expedition. In extension of the work of the magnetic observatory which he had established in England, and which was carried on entirely by his influence, Sabine had induced the authorities to promote the establishment of observatories in the colonies. On the voyage out, therefore, not only were numerous observations made, but magnetical and meteorological observatories were founded at St. Helena, the Cape, and Van Diemen's Land, thus permitting a great increase in the number of possible observations, and a consequent more rapid advance of the science which Sabine had so much at heart. These observatories —to our disgrace be it said, some have now been abolished —were placed under the superintendence of Sabine, and at this period a general magnetic survey of the globe was commenced by him under the direction of the Admiralty, although from what has gone before it is easy to see that the initiative of such a gigantic task had come from himself.

In 1842 he yet further added to his contributions to terrestrial magnetism, publishing in the *Philosophical Transactions* an account of observations made during the voyage of the *Erebus* and *Terror* from England to the Cape, and from thence to Kerguelen Island. Then in 1843 he wrote concerning the extension of these observations from Kerguelen Island to Van Diemen's Island, giving an account also of the various observations made in the Antarctic circle itself during the summer of 1840 and 1841, adding in the year following (1844) an account of the observations from June, 1841, to August, 1842, in the same region. In 1844 and 1845 he made contributions to the *British Association Reports* concerning the meteorology of Toronto and Bombay. During 1846 he again made contributions to meteorological literature, discussing the winter storms of the United States, and the cause of the mild winters which occur sometimes in our own country.

With reference to the survey of the globe to which we have referred, we find him next giving an account of a magnetic survey of a considerable portion of the North American continent, and of the southern hemisphere between the meridian of 0° and 125° east, and parallels of − 20° and − 70°. In 1849, in another contribution, he gave a map of the magnetic declination for 1840 in the Atlantic Ocean, between the parallels of 60° N. and 60° S. latitude. In this year it was that Humboldt's *Cosmos*, for the author of which Sabine had a profound admiration, began to be issued in England, being translated by Mrs. Sabine, and edited by her husband, it being completed in 1858. In the year following he became vice-president of the Royal Society, with which he had been so long connected.

The colonial observatories were, as we have said, under the control of Sabine, and remained so for many years. In 1851 and 1852, and again in 1856, he continued his papers on the magnetism of the earth.

It had been observed (first by Lamont) that the mean of the larger magnetic disturbances gave signs of being bound by some law, and of having a definite but long-period variation. Previously to this it had been shown by Schwabe that the number of spots on the surface of the sun increased and decreased in obedience to regular law, the cycle occupying nearly eleven years for its completion. The results of the observations at the colonial observatories led Sabine to the discovery that magnetical disturbances were intimately bound up with this solar spot period; that the connection between them was of such a nature, that a year of large declination coincided with a year of maximum sunspots, whereas those years when the range in declination was small corresponded with years when there were but few spots on the sun. In the same year the same fact was independently determined by Dr. Rudolf Wolf and M. Gautier.

In 1853, at the meeting of the British Association at Belfast, Sabine occupied the presidential chair. In this year he turned to a consideration of the moon's influence on terrestrial magnetism, writing concerning the effect of that body on the magnetic declination at Toronto, St. Helena, and Hobarton; and taking up the subject again in 1856, he then discussed the lunar diurnal variation at Toronto. At a later period, in the *Proceedings of the Royal Society*, he contributed a paper on the lunar diurnal magnetic declination obtained from the Kew photograms. In 1857 he made another contribution to the *British Association Reports*, discussing the amount and frequency of the magnetic disturbances and of the aurora at Point Barrow, on the shores of the Polar Sea. In the *Philosophical Transactions* for the same year he discussed the question of the existence of the decennial period in the solar diurnal magnetic variations and its non-existence in the lunar diurnal variation of the declination at Hobarton, as M. Kreil seemed to think was the case. He then stated, as the result of a re-examination of the question by the light thrown upon it by the Hobarton observations, that he was as entirely convinced of the existence of this period in the former case as he was convinced of its non-existence in the latter.

Continuing the investigation of this subject, he contributed to the *Royal Society Proceedings* for 1859-60 a paper on the solar diurnal variation of the declination at Pekin. In the same volume of the *Royal Society Proceedings* he also wrote concerning the laws of the phenomena of the larger disturbances of the magnetical declination at Kew Observatory. In 1861, at the request of the General Committee of the British Association, he prepared a report on the repetition of the magnetic survey of England. In this year he succeeded Sir Benjamin Brodie in the presidency of the Royal Society, which position he occupied for the next ten years. In the *Philosophical Magazine* for 1862 he entered into a discussion concerning the cosmical origin of terrestrial magnetism. Two years later, both in the *Philosophical Magazine* and the *Proceedings of the Royal Society*, he published a comparison of the most notable disturbances of the declination at Kew and Nertschinsk during 1858 and 1859. During the next few years, notably in 1866 and 1871, records of the magnetical observations at Kew were published by him. The chief work, however, of this period of his life consisted in concluding his contributions to the *Philosophical Transactions* by reports and reductions of the work done during the Antarctic expedition. In a lengthy contribution in 1866 he resumed the discussion and co-ordination of the various observations, continuing and concluding this in another paper, which is to be found in the *Transactions* for 1868. His last contribution appeared in 1872, when he gave a magnetical survey of the North Polar regions to serve as a companion to the survey of the South Polar regions which had already appeared. It was his earnest wish that he might be spared to complete this, but the infirmities of age were then stealing over him, and it is doubtful whether it would ever have appeared had it not been for the able assistance of Captain, now Sir Frederic Evans, the Hydrographer of the Admiralty, assistance which the author gracefully acknowledges in a postscript to the memoir.

From this date the work of Sabine may be said to have ceased. He had resigned the presidency of the Royal Society the previous year, and he now sought to spend the evening of his life in that retirement and rest to which his advanced age and great works so fairly gave him a claim. He had received the Copley Medal of the Royal Society in 1821, and the Royal Medal of the same society in 1849. In 1869 he was made K.C.B. He possessed also the Prussian Order *pour le mérite*, and was either an honorary or corresponding member of many foreign societies. We mention these facts to show that he retired from his active life full of well-earned honours. In 1879 he lost his wife, who for more than half a century was the close companion of his labours. In the history of the Royal Society his name will ever be valued as that of one who, both as member and as President, was ever foremost in guarding its honour and maintaining its dignity, whilst the kindness and courtesy which as President he displayed to all, not excluding the younger members, will be always gratefully remembered.

It is chiefly by his pendulum observations and by his magnetic determinations and reductions that, as may be gathered from what has been said, his name is so well known in science. The degree of accordance which some of the early determinations of the former kind exhibited was so much in advance of what was at that time thought likely, that they were received with incredulity in some quarters. The discussion which Sir George Airy made long ago, in his article on the figure of the earth, published in the "Encyclopædia Metropolitana," of the pendulum observations then available for that purpose, shows how large a share belonged to the labours of Sir Edward (then Captain) Sabine.

His own magnetic observations were marked by his wonted accuracy; and his discussion of the results obtained at the colonial magnetic observatories led to new and unexpected results. The most striking, perhaps, of these was the discovery of the relation between magnetic perturbations and the more or less spotted condition of the sun's surface, to which we have already referred. Dissimilar as are these phenomena, and difficult as it then at least was to imagine any possible cause for a connection between them, subsequent observations have fully confirmed the conclusion at which he arrived, that connected they are, though what the precise nature of the connection may be is still a matter of discussion.

Though from the nature of the case the work was one of compilation rather than of original observation, his determination of the magnetic state of the earth at a particular epoch, with its accompanying maps of the isoclinal, isogonal, and isodynamic lines was most noteworthy. The search for the original authorities and the application of the corrections requisite to render the observed results comparable with one another occupied a long time, and the results, as we have pointed out, appeared in instalments, as the various regions into which as a matter of convenience the earth's surface was divided were successively completed.

The establishment of the colonial observatories, too, was the direct result of his exertions; and his name will go down to posterity as that of the man who more than any other laboured for the proper establishment of the science of terrestrial magnetism, interesting and important

in its scientific aspect, and pregnant with so many benefits to mankind at large.

He was buried on Saturday, his remains being placed beside those of his wife in the family vault at Tewin; the funeral, in accordance with his own wish, being of the simplest character. In addition to the members of his family and private friends, the funeral was attended by the Secretary and Treasurer of the Royal Society, the Hydrographer to the Admiralty, and representatives of the other Government services with which he had been so long connected.

A MINISTER OF PUBLIC INSTRUCTION

WE are a longsuffering, patient people. The call of Luther to those around him to educate their children and make men of them, as well as provide them with arms—a call at once answered in Germany—is only just now being answered among ourselves.

One of the most beautiful and one of the most touching sights in London now, and one which in our view is a standing disgrace to the politicians who have held sway during the last hundred years, is the gradual rising above dingy roofs and millions of chimneys of the red brick Board schools. The children in London at all events are now being educated, and our future masters are receiving the first rudiments of their instruction, and this much more on account of the intention of their fathers to have it for them, than on account of any farseeing policy of those who are popularly supposed to look in any and every direction for anything that may conduce to the well-being of our country. We have at last got a public instruction, and it is already in the air that that instruction will in time be as free as it is now compulsory. It is a heartbreaking thing to look back and think what might have been had these all too recently built schools overtopped the squalid dwellings of the poor a century ago. How much less squalid those dwellings would be now. The monumental and extensive prisons would probably be less occupied in their every cell than they are now, but the well-being of the country, the output of the country would have been greater, and the struggle with penury, and dirt, and crime would have been less.

This is only one aspect of education, but yet it seems that in this country at all events it is the mainspring of public opinion with regard to the general question. The cry—on many grounds the mistaken cry—for technical instruction has grown from the work of the Board schools, it has gone along the same line at a higher level, and it will go on still further. The enormous development of the Government Science and Art Classes will also go on, and to the credit of the late Sir Henry Cole be it said here that he was wiser than the politicians, and his clear sight and singlemindedness influenced the head of the department with which he was connected, so that the quiet, slow work in science and art began in 1851, long before the present notions of the importance of education really began to take root in our land.

Now that compulsory education is in our midst, now that the importance of science and of art to the national industries is universally acknowledged, now that it is recognised that the education of our workmen must no longer be so disgracefully neglected as it has been, it is again suggested that there should be a Minister to look after these matters.

Ten years ago, as it was well put, the Kinderpest was the care of the Government side by side with the Rinderpest. Both were practically on the same level, both were acknowledged to be nuisances, both might require a public department to look after them, and then money would have to be spent. This was quite a sufficient argument with "statesmen" to let things go on in the old harum-scarum way; for the policy of a Government is to keep money in its purse, honestly if it can, but in any case to do so, as if England were a miser, acknowledging no responsibilities, spurning all delights, and wishing to live a sordid life like the burghers, caring only for their dykes and pikes, whom Luther shamed out of their indifference centuries ago.

There has again, this week, been a suggestion made that there should be a Minister of Public Instruction, who should be responsible for the preparedness of the country in this respect, just as the Minister of War is responsible for the preparedness of it in another direction. Sir John Lubbock must be congratulated upon the way in which he brought the motion forward last Friday. It was a mild, pleading story. As long ago as 1856, he pointed out, the late Lord Derby said:—

"It appeared to him well worthy of consideration whether it would not be well to have a Minister, or the head of a department, who should have no other duties to perform, and who should be, in fact, responsible for the education of the people. . . . He had a strong feeling that the institution of a Minister of Instruction was desirable, that the subject should be altogether separated from the Privy Council."

But that did no good. In 1862 there was another resolution put to the House calling on it to affirm that for the education estimates and for the expenditure of all moneys for the promotion of education, science, and art a Minister of the Crown should be responsible to the House. That also did no good. In 1865 a Select Committee was moved for to inquire into the constitution of the Committee of the Council on Education. It was then urged that education and science and art were beginning to be considered of such importance that—

"The great duty of superintending the various branches connected with the Department of Education should be intrusted to some one responsible Minister, some Minister who should be regarded as a State officer of high authority who should have the sole conduct of that department, and be solely responsible."

And that was shelved.

Nine years later, in 1874, the same view was urged, and the present Prime Minister then admitted "that there was much to be said in favour of the general principle that the expenditure of money for the promotion of education in science and in art should be placed under the control of a single responsible Minister." It is true he said this, but he supported the previous question, so that again came to nothing.

Now that education and science are the great things of the day, not only in this but in all countries, England enjoys the proud preeminence of being the only country—civilised country, we know nothing of Timbuctoo—in which there is not a Minister of Public Instruction. It is lamentable, terrible, to read the debate of last Friday,

and to see the way in which the question was discussed. Mr. Gladstone was impressed by the condition of the House at nine o'clock, but it does not appear that he was impressed with anything else; the importance of education, the importance of science, the importance of art, the daily, almost hourly, increasing importance of these things does not seem to have entered into the question. To a large extent it was merely a question of Cabinet convenience and Parliamentary tweedledum and tweedledee. How can there be made room in the Cabinet for a Minister of Public Instruction? Are not the affairs of the Duchy of Lancaster of much greater importance, and would not the recognition of the importance of education make the Cabinet unwieldy and give rise to difficulties in Parliamentary procedure? And then there is the Scotch business that must be looked after first, and so on, and so on. Education is evidently not in the region of practical politics.

Heaven knows changes sufficiently great have been made of late years, and it is not absolutely certain that the fundamental bearings of the nature of the changes to be made have in all cases been fully considered; but it seems as though they are to be most carefully considered before any change is made touching the matter of education.

Still it is acknowledged that the question is, after all, one that deserves the attention of Parliament, but Mr. Gladstone had, as usual, three objections to make. In the first place he expressed very great doubt whether, if he had a plan ready to alter the present arrangement, it would be wise to make any declaration on the subject by way of motion. Secondly, he admitted that there was no plan, and he did not think the time had arrived for one; and lastly, he considered that the subject ought to be a great deal more examined before the House committed itself to a final opinion whether there should be a plan or not.

With reference to his first objection he stated that the House knew perfectly well that administrative changes are made piecemeal, and must continue to be so; and he remarked that there was a good deal to be said in favour of what was called a patched house, because most of us found it the most comfortable sort of house to live in. A Minister of Public Instruction would be a new patch, and as there is patching going on elsewhere he objects to this; and so on and so on.

The argument which he used in favour of the second objection was, we imagine, the strongest he could have used against it, namely, that the business of the Council Office in respect to education has been in an almost incessant state of flux and change. Of this there can be no doubt that the flux and change will get more pronounced as time goes on. That is the very reason why everything should be brought to a focus.

We may gather from Mr. Gladstone's speech that the Universities should ever, in his opinion, remain divorced from the general question of education; but if so, what is to become of Prof. Huxley's ladder from the gutter to the university? We think, too, if Mr. Gladstone had been fully informed on the subject he could have urged as an additional objection that a great many questions referring to education are never now touched by the Education Department at all.

Several of the speeches might, if we had more space at our disposal, be noticed at some length. Still, we think it worth while to cull the following from the speech of Mr. Forster, an old Vice-President of the Committee of the Council on Education:—

"The Committee of the Council for Trade, or Agriculture, or Education meant nothing whatever. Persons might imagine that the Privy Council occasionally met for the transaction of business, but they never did so either in England or Ireland. The Minister for Agriculture was the President of the Committee of the Council on Agriculture, but he greatly doubted whether that Committee ever met, or ever would meet. . . . The real objection (to Sir John Lubbock's proposal) probably was that it was undesirable to make too much of education, that if we were to have a Minister of Education he might be pushing things on too quickly. . . . There might be a fear that under one Minister too much money would be spent. . . . What was complained of now was that there was no really defined responsibility. The man who moved the estimates and did the work was not the head of a department, and he ought to be. The work was done by a Minister who was controlled by another, and the latter was scarcely seen by the public. He did not see why we should continue that Japanese mode of managing affairs."

It is satisfactory to see that the House of Commons is gradually getting into a better position to discuss such questions as these, but we have felt that the main point is, that the head of the Government does not yet consider that the question of education is one of an importance sufficient to be discussed side by side with what in his opinion is the much larger questions of Parliamentary procedure, and the saving of so many pounds, shillings, and pence. It is true a Select Committee has been agreed to, but we fear that after Mr. Gladstone's speech very little will come of it, as has happened before.

It would be ungraceful not to state that the debate brought out in the clearest possible way the valuable services rendered under great difficulties by the present Vice-President of the Committee of the Council on Education, Mr. Mundella.

But the result remains that we are not to have a Minister of Education. There is agricultural business, including the Rinderpest, and other matters, and these are larger questions than that of national education! Therefore national education must wait. As we said before, we are a longsuffering and patient people. There is, however, little doubt that in some political programme of the future this question will find a place; equal electoral districts and the payment of members are not the only things to be cared for. F.R.S.

EVOLUTION AND CREATION

A Few Words on Evolution and Creation; A Thesis maintaining that the World was not made of Matter by the Development of one Potency, but by that of Innumerable Specific Powers. By Henry S. Boase, M.D., F.R.S., &c. (London: John Leng and Co., 1882.)

Notes on Evolution and Christianity. By J. F. Yorke. (London: Kegan Paul, Trench, and Co., 1882.)

THE first of these works is, as may be inferred from its title, a most curious production. The chief aim of its author is that of sustaining the Biblical Cosmology against what he regards as the fallacious inroads of the theory of Evolution. In carrying out his design he

devotes the first part of his book to a general criticism of the Evolution theory, and the second part to a consideration of the first chapters of Genesis, which he regards as justifying his view that the world "was made by the development of innumerable specific powers." Our readers must not suppose from this form of expression that Mr. Boase seeks to develop a system of Polytheism; on the contrary he is a Monotheist of the most orthodox type, and by his "innumerable specific powers" means only the properties with which matter has been endowed by its Creator. This, at least, is the only meaning which we have found ourselves able, after a somewhat hasty perusal of his book, to attach to this term, which constitutes the core of his "thesis." But if this is his meaning we fail to appreciate the speculative importance which he somewhat ostentatiously attaches to his opinions. For the great distinction which he draws between these opinions and those which are held by evolutionists consists, as he says, in their making "no assumption of an unknown matter endowed with an imaginary all-becoming potency." But so far as physical causation is concerned the two statements amount to exactly the same thing; the only difference between them is the old and well-worn distinction between theism and non-theism—viz. as to whether the observed "potencies" of matter are or are not God-endowed. We cannot see that Mr. Boase has contributed anything new to this question, and therefore regard his work as lost labour. There is a simplicity about some of his remarks which appeals to us as almost pathetic. For instance:—"From my point of view, the occurrence of some of the same kinds of organisms in the rocks of adjoining formations may arise from the remains of the older rocks being transported into the newer formations, or from the older organisms being created anew as a part of the more recent series. . . . It may here be noticed that such an alternate destruction and reproduction of living creatures is set forth in the civ. Psalm—'Thou takest away their breath, they die, and return to their dust. Thou sendest forth Thy spirit, they are created; and Thou renewest the face of the earth.' This verbal coincidence is curious, but, of course, cannot be adduced to prove that the doctrine of Creation and science are in accord with one another." If the "point of view" in question is to be thus calmly attributed to "science," the concluding sentence of this passage is one of the very few in the book with which we are able cordially to agree.

Again, speaking of the creation of Eve, our author remarks:—"It may also have served as an occasion for the important lesson, that the Lord God was the Creator of these living creatures (animals), for immediately after this, God gave Adam a practical proof of His power to create a living being." Practical proof, no doubt, but we should have thought almost more startling than could have been justified for the purpose suggested. Seriously, however, the absurdity which such passages as these display might be amusing from the mouth of a street-preacher; from a man of cultivation they are, as we have said, pathetic.

The other work which we have to notice stands in every way at the opposite pole of thinking from the one which we have just considered. For the object of Mr. Yorke is to show that the principles of evolution are alone sufficient, without any hypothesis of supernaturalism, to explain the origin and development of Christianity. The book is, therefore, mainly of an historical character, and although its views cannot fail to be obnoxious to orthodox opinion, the temperate manner in which they are stated ought everywhere to commend the approval of good taste. Moreover, whatever his readers may severally be inclined to think of his arguments, they can scarcely fail to agree that Mr. Yorke has written a highly interesting book. His object being, as already stated, to trace in the antecedents of Christianity the natural causes of its rise and progress, he has given a selection of quotations from the Jewish writings about the time or shortly before the commencement of the Christian era, and also of the Buddhistic writings long before it, in order that a just estimate may be formed of the extent to which the world is indebted to Christ as a moral reformer. In our opinion Mr. Yorke has shown a sound critical judgment in making this estimate. On the one hand, he is careful to sift out all the elements of the moral teaching which were, so to speak, in the air at the time when Christ taught; and, on the other hand, he is equally careful to distinguish the points wherein the "originality of Christ" was shown. Here we meet with what appears to us a more full appreciation of this "originality" than is shown by most of the other and some of the more eminent writers of the same school.

We shall conclude this notice by quoting two brief passages, one to show the high development of moral feeling which obtained among the Jews immediately anterior to the teaching of Christ, and the other to show the degradation of moral feeling which now obtains in the Roman Catholic ministry of the Christian Church.

"Wear mourning for the Egyptians, suppress the prayer of glorification on the seventh day of the Passover. It is the anniversary of the day when your enemies perished in the Red Sea, and God desires not to be glorified because his creatures have been drowned beneath the waves."

In painful contrast to the singular beauty of this passage, our other quotation is selected from several pages in the same strain which are republished by Mr. Yorke from two pamphlets written expressly for children by a Reverend Father, whose name is, with a singular appropriateness, Mr. J. Furniss. As Mr. Yorke remarks, the Rev. Father Furniss evidently feels that in these degenerate days "Hell is not pictured vividly enough for purposes of practical terrorism, and has accordingly done his imaginative best to supply this great want. And he deserves every credit for his work, for anything better calculated to drive a sensitive child mad with fright it would be impossible to conceive."

After describing the "*Dress of Fire*," and the "*Red-hot Floor*," in one of which there is represented a girl of eighteen, and in the other a girl of sixteen with the Devil taunting their agonies, "The Sight of Hell" goes on to describe—

"'*The Red-hot Oven.*'—See! it is a pitiful sight. The little child is in this red-hot oven. Hear how it screams to come out. See how it turns and twists itself about in the fire. It beats its head against the roof of the oven. It stamps its little feet upon the floor of the oven. You can see on the face of this little child what you see on the face of all in Hell—despair, desperate and horrible."

The only corrective of immoral publications of this description is to be found in reproducing them before public opinion of another kind from that of the unfortunates whose eyes alone they are intended to meet; and it is partly this consideration that has led us to review Mr. Yorke's essay, which, although excellent in itself, is hardly in close enough contact with natural science to demand notice in these pages.

GEORGE J. ROMANES

OUR BOOK SHELF

Iconographie der schalentragenden europäischen Meeresconchylien. Von Dr. W. Kobelt. 4to. Heft 1. (Cassel: Theodor Fischer, 1883.)

THE object of this work is to supply a want which is continually felt by conchologists, and it deserves the greatest success. Dr. Kobelt is well known to science as the editor of the *Jahrbucher* and *Nachrichtsblatt der deutschen Malakozoologischen Gesellschaft*, which has now been published for between fifteen and sixteen years, and as one of the editors of the new *Conchylien-Cabinet* of Martini and Chemnitz; and he is also the author of several works and papers on conchological subjects. It appears from the prospectus of the present work that its scope will be confined to the coasts of Europe, including the English Isles, the Faroes, and Scotland, and bounded by the north coast of Africa, but excluding not only tropical and subtropical species of Mollusca, but those Arctic species from Spitzbergen and the north of Iceland which are not found on the coasts of Upper Norway. This scope, although extensive, is not very definite; and it scarcely accords with our usual notion of the European seas. We do not know what may be the author's limit of depth, whether it is the line of soundings or 100 fathoms; nor whether he will even take the Mollusca now about to be published from the *Triton* cruise between the Faroes and Scotland. The expeditions of the *Josephine*, *Lightning*, *Porcupine*, *Challenger*, *Vöringen*, *Travailleur*, *Washington*, *Knight Errant*, and several others, have of late years done much to aid in the exploration of the European seas at various depths; and the number of species thereby added to the Mollusca has been very considerable and is still increasing. Some additions have likewise been made from time to time to the Mediterranean Mollusca, especially by myself during the present month. Taking into account all these discoveries, I am inclined to reckon the number of species hitherto described as inhabiting the littoral zone and moderate depths in the European seas as not less than 1000; probably 1200 would be nearer the mark.

The first part of the present work, which has now appeared, gives figures of four species only and their varieties, one of which species (*Murex gibbosus*) is Senegalese, and has never (to the best of my knowledge and belief) been found in any part of the European seas. This reduces the number of figured species to 3. Perhaps the species will not be so profusely illustrated in the next and following parts. The published prospectus does not give any idea of the extent of the work. But assuming even that twenty species (large and small) may on an average be figured in each part, the entire work would take not less than from fifty to sixty parts, and would cost for an uncoloured copy 10*l.* to 12*l.*, and for a coloured copy 15*l.* to 18*l.* If all the species known to inhabit the European seas, including the abyssal and benthal zones, are to be figured—and I think this ought to be done—the extent and cost of the publication must be increased by probably a fourth more.

However, such calculations have doubtless been considered by the author or his publisher. The work will assuredly be far more scientific and valuable than the very irregular but expensive *Conchologia Iconica* of the late Mr. Reeve, and be not merely an "ouvrage de luxe."

The family *Muricidæ*, which is the first selected for publication, does not seem to be placed in the usual order of classification. All the figures are admirable. The descriptions are in Latin, the text in German. The geographical, hydrographical, and geological distribution, as well as the odontophore and synonymy, are carefully worked out.

J. GWYN JEFFREYS

LETTERS TO THE EDITOR

[*The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, or to correspond with the writers of, rejected manuscripts, No notice is taken of anonymous communications.*

[*The Editor urgently requests correspondents to keep their letters as short as possible. The pressure on his space is so great that it is impossible otherwise to insure the appearance even of communications containing interesting and novel facts.*]

Sand

I HAVE recently been favoured with a reprint of Mr. J. G. Waller's paper upon sand, read before the Quekett Microscopical Society. The subject is so full of interest that I trust I may be allowed to give it a wider publicity in your columns. To render the study of practical use to geologists and physicists, the first step appears to me to ascertain whether it is possible to distinguish with certainty, by aid of the microscope, sand that has been worn by action of wind from sand that has been for long exposed to surf, and this again from sand brought down by torrents. The degree of rounding and the average size of the grains would be, I presume, among the chief characteristics, and it is to be hoped that naturalists abroad will kindly forward examples of undoubted blown and torrential sand, so that this point at least may be settled.

If it should prove that the origin of sand can be pronounced upon with any degree of certainty, from a microscopical examination, we should come into possession of a most valuable aid to the study of at least Tertiary geology. It is well known that marine and freshwater deposits succeed each other repeatedly throughout our Eocene formations, and where deposits of sand are in juxtaposition, it is at present impossible to draw any line between them. It is only possible to surmise that they are of different origin and therefore age, when pebble or oyster beds on the one hand, or films of clay with plant impressions on the other, are accidentally included in them. So far as our own Eocenes go, it appears from Mr. Waller's results that their sands, when of marine origin, possess a percentage of flint grains, but that purely fluviatile sands do not possess any. Marine and freshwater sands are in direct contact in very many of our Eocene sections, and I hope Mr. Waller's researches will enable us to distinguish them and apportion the proper thickness to each.

With regard to the relative rarity of flint-grains and preponderance of quartz, in all the Tertiary and recent sands hitherto examined, it appears just possible that the concussion the flint grains must undergo when beaten for ages in the surf, might induce a molecular change from the colloid to crystalline state, but in the absence of any fact or argument to support such a theory it cannot be seriously entertained. It is however possible that quartz grains reach a final state of subdivision, and then suffer relatively little by attrition, and are therefore almost indestructible, while flint grains become rapidly degraded into mud. This appears to be very much the opinion Mr. Waller has formed. It does seem at first sight matter for surprise that the grinding of flint should not more largely affect the composition of our sea sand; but we must on the other hand reflect on the indestructible nature of the quartz grains that chiefly compose it, that it may have been accumulating since palæozoic times, and the enormous bulk of the quartzose rocks that must have been ground down to supply it during such vast ages, and then compare the sources with flints which in comparison only appeared yesterday, and then but as scattered segregations in a limited portion of a single formation. Flints and flint beaches, recent and ancient, are at our gates, and are continuously renewed by the wearing away of the chalk of which so much of our part of England is composed, and their aggregate mass therefore astounds us; but they after all occur over only a

limited area, and mostly in unconsolidatad beds, and it is quite probable that they would not outlast the destructive influences to which they are subjected if these were continued throughout a geological period. The coast-line occupied by flint-shingle is almost limited to portions of Western Europe, and is relatively insignificant. J. S. GARDNER

Science Club

The Great Comet *b* 1882

M. RAOUL GAUTIER, of Geneva, has recently published, in *Astronomische Nachrichten*, No. 2519, three sets of elements of this comet, calculated from a few observations before perihelion. He says that, as it is possible to represent with the same curve, either a parabola or an ellipse, the nearest observations before and after perihelion, he believes "que si la comète a subi une perturbation dans son mouvement lorsqu'elle a passé à son périhélie, cette perturbation a dû être insensible."

As I am not so far advanced with my calculations, for I have begun a thorough discussion of the movement of that comet, I do not know whether there has been or not any considerable perturbation during the passage near the sun; but can the simple fact alluded to by M. Gautier give us much information on that point?

In fact, we can easily understand that although the orbit after perihelion might be quite different from the orbit before that point, still the positions of the comet at a short distance from perihelion may be pretty well represented, within the limits of the errors of observations, by a single curve, which of course will be of second order, but which will not certainly give the calculated positions of the comet at a certain distance from perihelion agreeing with the observations. If we could prove that the orbits calculated, for instance, from observations between September 7 and 12 and between the 22nd and the 30th of the same month agree together, and give the positions of the comet immediately before and after perihelion according to the observations, then we could say that the movement of the comet was not perturbated during the passage near the sun. But this fact is not proved at all, and instead it seems that the passage through the corona has had some effect upon the movement of that remarkable comet. E. RISTORI

13, Pembridge Crescent, Bayswater, June 16

THIS comet was visible here with the naked eye up to February 28. I also saw it myself on the evening of that day. Owing partly to cloudy weather, partly to moonlight, I had not seen it for ten days or a fortnight previously, but found it on that evening with little difficulty and without any optical help. In my telescope (4-in.) it appeared, roughly, like a long, flat-sided, oval nebula, the central part of the major axis being the brightest of the whole. Two cloudy evenings intervened, and on the following night (March 3) I could not see it with the naked eye, even after finding it with the telescope and knowing exactly where to look, and though the optical condition of the air seemed the same. During April I saw it, with the same telescope, on sixteen evenings, cloudy weather and moonlight interfering on the others. In the present month (May) I saw it five times, that is, up to the 6th certainly, and I believe I saw it on the 9th, but decreasing visibility and increasing moonlight prevented verification. I have just received a somewhat larger instrument (5-in.), with which after the moon has passed I hope to see it again. A. S. ATKINSON

Nelson, N.Z., May 19

Sun Pillar seen in Jamaica

AT sunset on May 15 I saw for the first time in my life the phenomenon called the *Sun Pillar*. A few days later the mail-packet arrived from England, and in NATURE I found much correspondence on its appearance on April 6 at several places in England and Wales between Hull and St. David's.

Major Gibney's admirable description of its general appearance on April 6 (vol. xxvii. p. 605) was so fully confirmed on May 15 in Jamaica that a very brief description may here suffice.

At 6h. 30m. p.m. Kempshot mean time it appeared as a bright ray of light of a faint roseate hue, 2° in width and 30° in height above the horizon, vertical, but not passing through the sun. A rough sketch was made at the time, and the circles of the equatorial were afterwards employed to determine the azimuth of the point where the pillar cut the horizon. This was 70° from the north towards the west; and as the sun's azimuth was 69° at the same time, the pillar passed 1° to the west of the sun. In the sketch the pillar is represented as passing its own breadth to the west of the sun, but as the sun was then just below the horizon the former measure is likely to be more correct.

Now with regard to the nature of the phenomenon, it certainly was not the usual display of the zodiacal light. The light is here seen to perfection; every fine night when there is no moonlight the zodiacal light may be seen following the ecliptic from the one horizon to the other with but little variation, except perhaps as to the *gegenschein* or stronger illumination near the point in the heavens diametrically opposite to the sun. And so clearly is it seen, that some years ago I carefully measured its breadth at different distances from the sun, and so formed the following table:—

Ang. dist. from Sun.	Breadth of Z.L.	Ang. dist. from Sun.	Breadth of Z.L.
°	°	°	°
30	41·4	110	20·3
40	38·7	120	17·8
50	36·1	130	15·3
60	33·4	140	13·0
70	30·7	150	10·8
80	28·1	160	8·9
90	25·5	170	7·6
100	22·9	180	7·0

From various considerations based upon the figure corresponding to these measures I consider the zodiacal light a terrestrial phenomenon—rays of light are swept back from the sun, chiefly from the tropical parts of the earth, and tend to accumulate at the point in the heavens diametrically opposite the sun.

If there be any truth in this theory, the sun pillar may be a strong and comparatively local development of the same light; this is the only explanation I can give; the explanation given by Mr. G. J. Symons, the well-known meteorologist, "that it is merely a portion of a halo passing through the sun" (vol. xxviii. p. 7), will not apply to the Jamaica observation at all; the sky was far too pure and transparent at the time, and there was not the least trace of *cirrus* cloud. MAXWELL HALL

Kempshot Observatory, Jamaica, June 7

Error in Hutton's Tables of Logarithms

AT the end of Hutton's "Mathematical Tables" (new edition, 1858, Longmans and Co., London) there is a very useful table containing the logarithms of certain constants frequently used in calculation. The tropical revolution of the earth in days is there given as 365·24226, and the logarithm of this most important constant is given as 2·5625910 instead of 2·5625810.

I would be glad to know from any of your readers whether there are any other important errors in this edition, especially among those tables of logarithms in frequent use.

Jamaica, June 4 MAXWELL HALL

Palæozoic Sclerotic Plates

IN the course of my researches among the coal shales of Northumberland I discovered two specimens of ossicular rings known as sclerotic plates. The external diameter of one ring is five-eighths of an inch, and the orbital orifice is one-quarter of an inch; this ring of sclerotic plates consists of nine bones arranged as are the eye bones of Ichthyosaurus, Plesiosaurus, and eagles, viz. in tolerably uniform segments. The second specimen is a quadrant of a ring, and consists of six plates of larger size than the other specimen. I shall be glad to learn if any of your readers have di covered similar sclerotic plates in the Palæozoic rocks of the British Isles, as specimens are not exhibited in the British Museum, Jermyn Street Museum, or Edinburgh Museum. T. P. BARKAS

Newcastle-on-Tyne, June 25

Graft-Hybridisation

ST. PAUL, in his Epistle to the Romans, says (ch. xi. v. 17), in illustration of the admission of the Gentiles to the religious privileges of the children of Israel, "If thou, being a wild olive, wert grafted in among them, and didst become partaker with them of the root of the fatness of the olive tree," &c. Olshausen, in his commentary on this epistle, says (English translation, p. 369),

"Whereas, according to the image in this place, the wild branches are ingrafted into the generous tree, reversing the usual process by which good branches are grafted into wild trees, we are informed by both ancient and modern writers that such a process is practicable in this very tree, the olive, and is often practised in the East. Compare Columella 'De Rebus Rusticis,' *v. g.*" Can this be confirmed? It seems scarcely credible. The question bears on the subject of graft-hybridisation, about which many curious facts are collected in Darwin's work on "Variation under Domestication." JOSEPH JOHN MURPHY

Old Forge, Dunmurry, Co. Antrim, June 29

Wild Duck and Railways

LAST autumn I visited Canada and made a journey to the extreme west point (then reached) of the Canada Pacific Railway, on which three or four thousand men were at the time employed laying down the rails on the prairie, at the very rapid rate of three or four miles a day, or more than twenty miles a week. There are many ponds and lakelets along the track, which abounded at that season with a variety of ducks—mallard, teal, widgeon, &c.—usually very shy, and not easily approached by the sportsman. Yet these ducks had in the short space of from two to five days become so accustomed to the noisy and (to most of the birds) novel engine moving along, that they remained sitting quietly in the water within easy shot when the train was passing. On my return journey I was sorry to find that this confidence on the part of the ducks was taken advantage of by the conductor and other wretched sportsmen (?) who shot at the poor birds from the platform of the cars whilst in motion, although when they did *kill*—I am glad to say there were more misses than hits—they could not stop to pick up the game. A sportsman, to get equally near to the ducks as they permitted the train to approach them, had to use the cover of the long grass and some artful dodging to attain his object. This quick intelligence on the part of the ducks seemed to me something remarkable, as the senses both of sight and hearing must have been, one would suppose, at first alarmingly affected by the great noisy, smoking monster rushing along their favourite and hitherto usually silent haunts. JOHN RAE

4, Addison Gardens, June 30

Large Hailstones

A SEVERE thunderstorm passed over Woodlesford, six miles south-east of Leeds, between 3.10 and 4 p.m. this afternoon, proceeding from south-west to north-east. Flashes of lightning during that time were almost continuous. At 3.15 heavy rain began to fall, becoming so thick at 3.25 as to render objects a short distance away almost indistinct; at 3.30 this changed to hail, the stones during the worst period being generally irregular parallelopipeds of ice, with two edges of about one inch each, and the third of one-quarter of an inch. These blocks consisted of hard, colourless, transparent ice, surrounding a central, irregularly-shaped mass of opaque white, small air-bubbles of roughly ellipsoidal shape being ranged round this. The white nucleus was not quite so hard as the exterior transparent coating. The force of collision on the railway line was sufficient to make the masses bound to a vertical height of two or three feet. At 3.45 the hail had moderated, when a few light loose clouds were observed quickly passing from north-east to south-west, and thus directly opposite to the direction of the storm, and at a much lower level. R. WEBB

June 30

Extinction of Flatfish

I HAVE been advised by Mr. Murray of the *Challenger* expedition to inquire, through your columns, whether the experience of any of your correspondents coincides with mine as to the gradual failure—in some places almost the extinction—of flatfish where whelk-gathering is prosecuted. MALCOLM MCNEILL

The New Club, Edinburgh, June 30

Garfish

IN March last I was being pulled off from the shore to H.M.S. *Himalaya* in the harbour at Aden, when a fish jumped out of the water over the boat, and in doing so struck the hat of another officer and knocked it into the water. When the hat was recovered we found in the *hard* felt a slit about four inches in length. Unfortunately the fish escaped, but the impression of those who saw it was that it was some kind of garfish, and that the damage done was inflicted by the beak. It appeared to me to be about ten inches long. It is obvious that had the fish struck my friend in the face or neck, or even in the chest, it might have resulted in a fatal injury. S. ARCHER

Sheerness, June 29

The "Spirogyra quinina"

CAN any of your readers inform me of any practical method of exterminating, in a lodge or reservoir, confervoid algæ, more especially the fine filamentous variety *Spirogyra quinina?*

Hanley, Staffordshire, June 19 FREDK. HAIGH

ACTION OF LIGHT ON INDIARUBBER

IN continuation of the experiments described in NATURE, vol. xxvii. p. 312, two pieces of caoutchouc tube, about 48 mm. long and 7 mm. wide, were introduced on January 23, 1883, into test tubes containing oxygen confined over mercury. One of these tubes was surrounded by a case of black paper, and both tubes were placed side by side in a north window. On June 27 the tubes were examined: in that exposed to light about 17 cc. of oxygen (about three-quarters of the gas the test tube at first contained) had been absorbed, and the indiarubber had become altered, so that on pressing the tube between the fingers superficial cracks were produced. In the other test tube no appreciable diminution of gas had taken place, and the caoutchouc was unchanged, thus fully confirming the results of the former experiments. We may therefore conclude that caoutchouc alters under the combined influence of light and oxygen, but that neither alone produces any effect.

Cooper's Hill, June 29 HERBERT MCLEOD

ON WHALES, PAST AND PRESENT, AND THEIR PROBABLE ORIGIN[1]

II.

THOUGH the early stages by which whalebone has been modified from more simple palate structures are entirely lost to our sight, probably for ever, the conditions in which it now exists in different species of whales, show very marked varieties of progress, from a simple comparatively rudimental and imperfect condition, to what is perhaps the most wonderful example of mechanical adaptation to purpose known in any organic structure. These variations are worth dwelling upon for a few minutes, as they illustrate in an excellent manner the gradual modifications that may take place in an organ, evidently in adaptation to particular requirements, the causation of which can be perfectly explained upon Darwin's principle of natural selection.

In the Rorquals or fin-whales (genus *Balænoptera*), found in almost all seas, and so well known off our own coasts, the largest blades in an animal of 70 feet in length do not exceed 2 feet in length, including their hairy terminations; they are in most species of a pale horn colour, and their structure is coarse and inelastic, separating into thick, stiff fibres, so that they are of no value for the ordinary purposes to which whalebone is applied in the arts. These animals feed on fish of considerable size, from herrings up to cod, and for foraging among shoals of these creatures the construction of their mouth and the structure of their baleen is evidently sufficient. This is the type of the earliest known extinct forms of whales, and it has continued to exist, with several slight modifications, to this day, because it has fulfilled one purpose in the economy of nature. Other purposes for which it was not

[1] Lecture delivered at the Royal Institution on the evening of Friday, May 25, 1883, by Prof. Flower, LL.D., F.R.S., P.Z.S., &c. Concluded from p. 202.

sufficient have been supplied by gradual changes taking place, some of the stages of which are seen in the intermediate conditions still exhibited in the Megaptera, and the Atlantic and Southern Right Whales. Before describing the extreme modifications in the direction of complexity, I may mention, to show the range at present presented in the development of baleen, that there has lately been discovered in the North Pacific a species called by the whalers the Californian Gray Whale (*Rachianectes glaucus*), which shows the opposite extreme of simplicity. The animal is from 30 to 40 feet in length; the baleen blades are only 182 on each side (according to Scammon) and far apart, very short (the longest being from 14 to 16 inches in length), light brown or nearly white in colour, and still more coarse in grain and inelastic than that of the Rorquals. The food of these whales is not yet known with certainty. They have been seen apparently seeking for it along soft bottoms of the sea, and fuci and mussels have been found in their stomachs.

In the Greenland Right Whale of the circumpolar seas, the Bow-head of the American whalers (*Balæna mysticetus*), all the peculiarities which distinguish the head and mouth of the whales from other mammals have attained their greatest development. The head is of enormous size, exceeding one-third of the whole length of the creature. The cavity of the mouth is actually larger than that of the body, thorax and abdomen together. The upper jaw is very narrow, but greatly arched from before backwards, to increase the height of the cavity and allow for the great length of the baleen, the enormous rami of the mandibles are widely separated posteriorly, and have a still further outward sweep before they meet at the symphysis in front, giving the floor of the mouth the shape of an immense spoon. The baleen blades attain the number of 350 or more on each side, and those in the middle of the series have a length of ten or even twelve feet. They are black in colour, fine and highly elastic in texture, and fray out at the inner edge and ends into long delicate, soft, almost silky, but very tough hairs.

How these immensely long blades depending vertically from the palate were packed into a mouth the height of which was scarcely more than half their length, was a mystery not solved until a few years ago. Capt. David Gray of Peterhead, at my request, first gave us a clear idea of the arrangement of the baleen in the Greenland whale, and showed that the purpose of its wonderful elasticity was not primarily at least the benefit of the corset and umbrella makers, but that it was essential for the correct performance of its functions. It may here be mentioned that the modification of the mouth structure of the Right Whale is entirely in relation to its food. It is by this apparatus that it is enabled to avail itself of the minute but highly nutritious crustaceans and pteropods which swarm in immense shoals in the seas it frequents. The large mouth enables it to take in at one time a sufficient quantity of water filled with these small organisms, and the length and delicate structure of the baleen provides an efficient strainer or hair sieve by which the water can be drained off. If the baleen were, as in the Rorquals, short and rigid, and only of the length of the aperture between the upper and lower jaws when the mouth was shut, when the jaws were separated a space would be left beneath it through which the water and the minute particles of food would escape together. But instead of this, the long, slender, brush-like ends of the whalebone blades, when the mouth is closed, fold back, the front ones passing below the hinder ones in a channel lying between the tongue and the bone of the lower jaw. When the mouth is opened their elasticity causes them to straighten out like a bow that is unbent, so that at whatever distance the jaws are separated, the strainer remains in perfect action, filling the whole of the interval. The mechanical perfection of the arrangement is completed by the great development of the lower lip, which rises stiffly above the jaw-bone, and prevents the long, slender, flexible ends of the baleen being carried outwards by the rush of water from the mouth, when its cavity is being diminished by the closure of the jaws and raising of the tongue. The interest and admiration excited by the contemplation of such a beautifully adjusted piece of mechanism is certainly heightened by the knowledge that it has been brought about by the gradual adaptation and perfection of structures common to the whole class of animals to which the whale belongs.

Few points of the structure of whales offer so great a departure from the ordinary mammalian type as the limbs. The fore-limbs are reduced to the condition of simple paddles or oars, variously shaped, but always flattened and more or less oval in outline. They are freely movable at the shoulder-joint, where the humerus or upper-arm bone articulates with the shoulder-blade in the usual manner, but beyond this point, except a slight flexibility and elasticity, there is no motion between the different segments. The bones are all there, corresponding in number and general relations with those of the human or any other mammalian arm, but they are flattened out, and their contiguous ends, instead of presenting hinge-like joints, come in contact by flat surfaces, united together by strong ligamentous bands, and all wrapped up in an undivided covering of skin, which allows externally of no sign of the separate and many-jointed fingers seen in the skeleton.

Up to the year 1865 it was generally thought that there was nothing to be found between this bony framework and the covering skin, with its inner layer of blubber, except dense fibrous tissue, with blood-vessels and nerves sufficient to maintain its vitality. Dissecting a large Rorqual, 67 feet in length, upon the beach of Pevensey Bay in that year, I was surprised to find lying upon the bones of the fore-arm well-developed muscles, the red fibres of which reached nearly to the lower end of these bones, ending in strong tendons, passing to, and radiating out on, the palmar surface of the hand. Circumstances then prevented me following out the details of their arrangement and distribution, but not long afterwards Prof. Struthers of Aberdeen had an opportunity of carefully dissecting the fore-limb of another whale of the same species, and he has recorded and figured his observations in the *Journal of Anatomy* for November, 1871. He found on the internal or palmar aspect of the limb three distinct muscles corresponding in attachments to the flexor carpi ulnaris, the flexor profundus digitorum, and the flexor longus pollicis of man, and on the opposite side but one, the extensor communis digitorum.[1] Large as these muscles actually are, yet, compared with the size of the animal, they cannot but be regarded as rudimentary and being attached to bones without regular joints and firmly held together by unyielding tissues, their functions must be reduced almost to nothing. But rudimentary as the muscles of the Fin-whales are, lower stages of degradation of the same structures are found in other members of the group. In some they are indeed present in form, but their muscular structure is gone and they are reduced in most of the toothed whales to mere fibrous bands, scarcely distinguishable from the surrounding tissue which connects the inner surface of the skin with the bone. It is impossible to contemplate these structures without having the conviction forced home that here are the remains of parts once of use to their possessor, now, owing to the complete change of purpose and mode of action of the limb, reduced to a condition of atrophy verging on complete disappearance.

The changes that have taken place in the hind-limbs are even more remarkable. In all known Cetacea (unless

[1] The muscles of the forearm of an allied species, *Balænoptera rostrata*, were described by Macalister in 1868, and Perrin in 1870.

Platanista be really an exception) a pair of slender bones are found suspended a short distance below the vertebral column, but not attached to it, about the part where the body and the tail join. In museum skeletons these bones are often not seen, as, unless special care has been taken in the preparation, they are apt to get lost. They are, however, of much importance and interest, as their relations to surrounding parts show that they are the rudimentary representatives of the pelvic or hip bones, which in other mammals play such an important part in connecting the hind-limbs with the rest of the skeleton. The pelvic arch is thus almost universally present, but of the limb proper there is, as far as is yet known, not a vestige in any of the large group of toothed whales, not even in the great Cachalot or Sperm Whale, although it should be mentioned that it has never been looked for in that animal with any sort of care. With regard to the Whalebone Whales, at least to some of the species, the case is different. In these animals there are found, attached to the outer and lower side of the pelvic bone, other elements, bony or only cartilaginous as the case may be, clearly representing rudiments of the first and in some cases the second segment of the limb, the thigh or femur, and the leg or tibia. In the small *Balænoptera rostrata* a few thin fragments of cartilage, embedded in fibrous tissue attached to the side of the pelvic bone, constitute the most rudimentary possible condition of a hind-limb, and could not be recognised as such but for their analogy with other allied cases. In the large Rorqual, *Balænoptera musculus*, 67 feet long, previously spoken of, I was fortunate enough in 1865 to find attached by fibrous tissue to the side of the pelvic bone (which was sixteen inches in length) a distinct femur, consisting of a nodule of cartilage of a slightly compressed, irregularly oval form, and not quite one inch and a half in length. Other specimens of the same animal dissected by Van Beneden and Prof. Struthers have shown the same; in one case, partial ossification had taken place. In the genus *Megaptera* a similar femur has been described by Eschricht; and the observations of Reinhardt have shown that the Greenland Right Whale (*Balæna mysticetus*) has not only a representative of the femur developed far more completely than in the Rorqual, being from six to eight inches in length and completely ossified, but also a second smaller and more irregularly formed bone, representing the tibia. Our knowledge of these parts in this species has recently been greatly extended by the researches of Dr. Struthers of Aberdeen, who has published in the *Journal of Anatomy* for 1881 a most careful and detailed account of the dissection of several specimens, showing the amount of variation to which these bones (as with most rudimentary structures) are liable in different individuals, and describing for the first time their distinct articulation one with the other by synovial joints and capsular ligaments, and also the most remarkable and unlooked-for presence of muscles passing from one bone to the other, representing the adductors and flexors of mammals with completely developed limbs, but so situated that it is almost impossible to conceive that they can be of any use; the whole limb, such as it is, being buried deep below the surface, where any movement, except of the most limited kind, must be impossible. Indeed, that the movement is very limited and of no particular importance to the animal was shown by the fact that in two out of eleven whales dissected the hip-joint was firmly anchylosed (or fixed by bony union) though without any trace of disease. In the words of Dr. Struthers, "Nothing can be imagined more useless to the animal than rudiments of hind-legs entirely buried beneath the skin of a whale, so that one is inclined to suspect that these structures must admit of some other interpretation. Yet, approaching the inquiry with the most sceptical determination, one cannot help being convinced, as the dissection goes on, that these rudiments really are femur and tibia. The functional point of view fails to account for their presence. Altogether they present for contemplation a most interesting instance of those significant parts, rudimentary structures."

We have here a case in which it is not difficult to answer the question before alluded to, often asked with regard to rudimentary parts, Are they disappearing or are they incipient organs? We can have no hesitation in saying that they are the former. All we know of the origin of limbs shows that they commence as outgrowths upon the surface of the body, and that the first-formed portions are the most distal segments. The limb, as proved by its permanent state in the lowest Vertebrates, and by its embryological condition in higher forms, is at first a mere projection or outward fold of the skin, which, in the course of development, as it becomes of use in moving or supporting the animal, acquires the internal framework which strengthens it and perfects its functions. It would be impossible, on any theory of causation yet known, to conceive of a limb gradually developed from within outwards. On the other hand, its disappearance would naturally take place in the opposite direction; projecting parts which had become useless, being in the way, would, like all the other prominences on the surface of the whales, hair, ears, &c., be removed, while the most internal, offering far less interference with successful carrying on the purposes of life, would be the last to disappear, lingering, as in the case of the Greenland Whale, long enough to reveal their wonderful history to the anatomist who has been fortunate enough to possess the skill and the insight to interpret it.

Time will not allow of more illustrations drawn from the structure of existing Cetacea; we turn next to what the researches of palæontology teach of the past history of the order. Unfortunately this does not at present amount to very much. As is the case with nearly all other orders of mammals, we know nothing of their condition, if they existed, in the mesozoic age. Even in the cretaceous seas, the deposits at the bottom of which are so well adapted to preserve the remains of the creatures which swam in them, not a fragment of any whale or whale-like animal has been found. The earliest Cetaceans of whose organisation we have any good evidence, are the Zeuglodons of the Eocene formations of North America. These were creatures whose structure, as far as we know it, was intermediate between that of the existing suborders of whales, having the elongated nasal bones and anterior position of the nostrils of the Mystacocetes, with the teeth of the Odontocetes, and with some characters more like those of the generalised mammalian type, than of any of the existing forms. In fact *Zeuglodon* is precisely what we might have expected *a priori* an ancestral form of whale to have been. The remarkable smallness of its cerebral cavity, compared with the jaws and the rest of the skull, so different from that of modern Cetaceans, is exactly paralleled in the primitive types of other groups of mammals. The teeth are markedly differentiated in different parts of the series. In the anterior part of both jaws they are simple, conical, or slightly compressed and sharp pointed. The first three of the upper jaw are distinctly implanted in the premaxillary bone, and so may be reckoned as incisors. The tooth which succeeds, or the canine, is also simple and conical, but it does not greatly exceed the others in size. This is followed by five teeth with two distinct roots and compressed pointed crowns, with denticulated cutting edges. It has been thought that there was evidence of a vertical succession of the molar teeth, as in diphyodont mammals, but the proof of this is not quite satisfactory. Unfortunately the structure of the limbs is most imperfectly known. A mutilated humerus has given rise to many conjectures; to some anatomists it appears to indicate freedom of motion at the elbow-joint, while to others its characters seem to be those of the ordinary Cetacea.

Of the structure of the pelvis and hind limb we are at present in ignorance.

From the middle Miocene period fossil Cetacea are abundant, and distinctly divided into the two groups now existing. The Mystacocetes, or Whalebone Whales, of the Miocene seas were, as far as we know now, only *Balænopterè*, some of which (as the genus *Cetotherium*) were, in the elongated flattened form of the nasal bones, the greater distance between the occipital and frontal bone at the top of the head, and the greater length of the cervical vertebræ, more generalised than any now existing. In the shape of the mandible also, Van Beneden, to whose researches we are chiefly indebted for a knowledge of these forms, discerns some approximation to the Odontocetes. Right Whales (*Balæna*) have not been found earlier than the Pliocene period, and it is interesting to note that instead of the individuals diminishing in bulk as we approach the times we live in, as with many other groups of animals, the contrary has been the case, no known extinct species of whales equalling in size those that are now to be met with in the ocean. The size of whales, as of all other things whose most striking attribute is magnitude, has been greatly exaggerated; but when reduced to the limits of sober fact, the Greenland Right Whale of 50 feet long, the Sperm Whale of 60, and the Great Northern Rorqual (*Balænoptera Sibbaldii*) of 80, exceed all other organic structures known, past or present. Instead of living in an age of degeneracy of physical growth, we are in an age of giants, but it may be at the end of that age. For countless ages impulses from within and the forces of circumstances from without have been gradually shaping the whales into their present wonderful form and gigantic size, but the very perfection of their structure and their magnitude combined, the rich supply of oil protecting their internal parts from cold, the beautiful apparatus of whalebone by which their nutrition is provided for, have been fatal gifts, which, under the sudden revolution produced on the surface of the globe by the development of the wants and arts of civilised man, cannot but lead in a few years to their extinction.

It does not need much foresight to divine the future history of whales, but let us return to the question with which we started, What was their probable origin?

In the first place, the evidence is absolutely conclusive that they were not originally aquatic in habit, but are derived from terrestrial mammals of fairly high organisation, belonging to the placental division of the class,—animals in which a hairy covering was developed, and with sense organs, especially that of smell, adapted for living on land; animals, moreover, with four completely-developed pairs of limbs on the type of the higher vertebrata, and not of that of fishes. Although their teeth are now of the simple homodont and diphyodont type, there is much evidence to show that this has taken place by the process of degradation from a more perfect type, even the fœtal teeth of Whalebone Whales showing signs of differentiation into molars and incisors, and many extinct forms, not only the Zeuglodons, but also true dolphins, as the Squalodons, having a distinct heterodont dentition, the loss of which, though technically called a "degradation," has been a change in conformity to the habits and needs of the individuals. So much may be considered very nearly if not quite within the range of demonstrated facts, but it is in determining the particular group of mammals from which the Cetacea arose that greater difficulties are met with.

One of the methods by which a land mammal may have been changed into an aquatic one is clearly shown in the stages which still survive among the Carnivora. The seals are obviously modifications of the land Carnivora, the Otaria, or Sea-Lions and Sea-Bears, being curiously intermediate. Many naturalists have been tempted to think that the whales represent a still further stage of the same kind of modification. So firmly has this idea taken root that in most popular works on zoology in which an attempt is made to trace the pedigree of existing mammals, the Cetacea are definitely placed as offshoots of the Pinnipedia, which in their turn are derived from the Carnivora. But there is to my mind a fatal objection to this view. The seal of course has much in common with the whale, inasmuch as it is a mammal adapted for an aquatic life, but it has been converted to its general fishlike form by the peculiar development of its hind-limbs into instruments of propulsion through the water; for though the thighs and legs are small, the feet are large and are the special organs of locomotion in the water, the tail being quite rudimentary. The two feet applied together form an organ very like the tail of a fish or whale, and functionlly representing it, but only functionally, for the time has I trust quite gone by when the Cetacea were defined as animals with the "hinder limbs united, forming a forked horizontal tail." In the whales, as we have seen, the hind-limbs are aborted and the tail developed into a powerful swimming organ. Now it is very difficult to suppose that, when the hind-limbs had once become so well adapted to a function so essential to the welfare of the animal as that of swimming, they could ever have become reduced and their action transferred to the tail;—the animal must have been in a too helpless condition to maintain its existence during the transference, if it took place, as we must suppose, gradually. It is far more reasonable to suppose that whales were derived from animals with large tails, which were used in swimming, eventually with such effect that the hind-limbs became no longer necessary, and so gradually disappeared. The powerful tail, with lateral cutaneous flanges, of an American species of Otter (*Pteronura sandbachii*) or the still more familiar tail of the beaver, may give some idea of this member in the primitive *Cetacea*. I think that this consideration disposes of the principal argument that the whales are related to the seals, as most of the other resemblances, such as those in the characters of their teeth, are evidently analogous resemblances related to similarity of habit.

As pointed out long ago by Hunter, there are numerous points in the structure of the visceral organs of the Cetacea far more resembling those of the Ungulata than the Carnivora. These are the complex stomach, simple liver, respiratory organs, and especially the reproductive organs and structures relating to the development of the young. Even the skull of Zeuglodon, which has been cited as presenting a great resemblance to that of a seal, has quite as much likeness to one of the primitive pig-like Ungulates, except in the purely-adaptive character of the form of the teeth.

Though there is, perhaps, generally more error than truth in popular ideas on natural history, I cannot help thinking that some insight has been shown in the common names attached to one of the most familiar of Cetaceans by those whose opportunities of knowing its nature have been greatest—"Sea-Hog," "Sea-Pig," or "Herring-Hog" of our fishermen, *Meerschwein* of the Germans, corrupted into the French "Marsouin," and also "Porc-poisson," shortened into "Porpoise."

A difficulty that might be suggested in the derivation of the Cetacea from the Ungulata, arising from the latter being at the present day mainly vegetable feeders, is not great, as the primitive Ungulates were probably omnivorous, as their least modified descendants, the pigs, are still; and the aquatic branch might easily have gradually become more and more piscivorous, as we know from the structure of their bones and teeth, the purely terrestrial members have become by degrees more exclusively graminivorous.

One other consideration may remove some of the difficulties that may arise in contemplating the transition of land mammals into whales. The Gangetic Dolphin (*Platanista*) and the somewhat related *Inia* of South

America, which retain several rather generalised mammalian characters, and are related to some of the earliest known European Miocene forms, are both to the present day exclusively fluviatile, being found in the rivers they inhabit almost up to their very sources, more than a thousand miles from the sea. May this not point to the freshwater origin of the whole group, and thus account for their otherwise inexplicable absence from the Cretaceous seas?

We may conclude by picturing to ourselves some primitive generalised, marsh-haunting animals with scanty covering of hair like the modern hippopotamus, but with broad, swimming tails and short limbs, omnivorous in their mode of feeding, probably combining water plants with mussels, worms, and freshwater crustaceans, gradually becoming more and more adapted to fill the void place ready for them on the aquatic side of the borderland on which they dwelt, and so by degrees being modified into dolphin-like creatures inhabiting lakes and rivers, and ultimately finding their way into the ocean. Here the disappearance of the huge Enaliosaurians, the *Ichthyosauri* and *Plesiosauri*, which formerly played the part the Cetacea do now, had left them ample scope. Favoured by various conditions of temperature and climate, wealth of food supply, almost complete immunity from deadly enemies, and illimitable expanses in which to roam, they have undergone the various modifications to which the Cetacean type has now arrived, and gradually attained that colossal magnitude which we have seen was not always an attribute of the animals of this group.

Please to recollect, however, that this is a mere speculation, which may or may not be confirmed by subsequent palæontological discovery. Such speculations are, I trust, not without their use and interest, especially when it is distinctly understood that they are offered only as speculations and not as demonstrated facts.

THE AMERICAN OBSERVATIONS OF THE ECLIPSE

NEWS of the American observations of the last eclipse has now arrived, and although details are yet wanting, enough information has been sent to show us that, as was to be expected, the American observers have left their mark upon the work. The telegram given below has been forwarded to me by the editors of *Science*, and is one transmitted by Prof. Holden to Prof. Young on the arrival of the former at San Francisco :—

"*San Francisco, Cal., June* 11

"American Eclipse Expedition arrived at St. Francisco June 11. Holden reports no Vulcan as bright as 5½ magnitude. Hasting's observations prove the corona to be largely a phenomenon of diffraction by the great change in lengh of 1474 line on east and west sides of sun. No black lines in corona spectrum but D. Full observations with grating spectroscopes, prismatic telescope, and integrating spectroscope, by Rockwell, Upton, and Brown. Contacts by Preston. English and French parties successful. (Signed) E. S. HOLDEN"

It will be seen from the above that the spectroscopic attack was a very strong one, and although the telegram gives only the results of the work of Prof. Hastings, these are of unusual interest. I propose, therefore, to devote attention to them in the present notice. It will, however, be well to anticipate my remarks by a prefatory notice of the eclipse work on which it throws light. For this purpose I can scarcely do better than give the following extract from an article which appeared in the *Times* on Monday last :—

"It was only really in the eclipse of 1869 that we began to know anything about the corona, and it was only in the eclipse of 1870 that we began to appreciate what a very difficult problem was presented to us by that phenomenon. The then Astronomer-Royal and Prof. Maedler, to cite some among the eminent authorities writing after the eclipse of 1860, had come to the conclusion that the corona was mainly a non-solar phenomenon. That *part* of it, however, was undoubtedly solar was admitted by all, for the reason that it was seen before and after totality. In the eclipse of 1870 the idea that part of it was really non-solar was enormously strengthened by a comparison of observations made by different astronomers. Its shape seemed to change as the moon swept over it, and this obviously, if it were true, implied some action of the moon's edge and reflection by something between the observer and the moon. In 1871, when the Government of India and the British Association took steps to have the corona photographed at the same time that it was carefully observed by the naked eye, the strange fact was first clearly indicated that the corona seen by the eye was a perfectly different thing to that recorded on the photographic plates. The explanation given at the time was that the coronal light was much more actinic than ordinary solar light of the same visible intensity, so that in the eye and on the photographic plate two different images were built up by different qualities of light proceeding from different sources. Hence the view was distinctly enunciated that the corona seen during eclipses was a dual phenomenon, partly solar, partly non-solar in its origin, the true solar corona being filamentous with variously-curved streamers, the visible corona being non-filamentous and consisting mainly of radial lines and rifts, extending to different distances from the edge of the moon"

This slight sketch may now be expanded by the following details. Thus, for instance, in March, 1870, Prof. Young, discussing the then current views of the corona, wrote :—"It is not impossible that the so-called corona may be complex, some portion of its radiance may perhaps originate in our own atmosphere, though I do not yet find myself able to agree with the conclusion of Dr. Gould and Mr. Lockyer in this respect, and am strongly disposed to believe that the whole phenomenon is purely solar."

With reference to the eclipse of 1870 I wrote :—"At the commencement and end of totality, when the moon unequally covered the sun, the photographs have recorded an excess of light on the corona on the side where the limbs occur nearest in contact. I am told that this effect in one of Lord Lindsay's photographs is very striking; it is certainly so in one of Mr. Brothers'. In the drawings we have a slightly different effect. At the commencement

of totality, when the western or right-hand limbs were in contact, we get (see figure) 1; at the end of totality the appearance recorded was like 2; the picture at the middle of totality compounding both these appearances, and being roughly represented by 3, in which the rectangular appearance comes out in its full strength."

Let us pass on to the eclipse of 1871. This was my description, written at the time, of what I saw :—"There, rigid in the heavens, was what struck everybody as a decoration, one that Emperors might fight for; a thousand times more brilliant even than the star of India,—where we then were,—a picture of surpassing loveliness, and giving one the idea of serenity among all the activity that was going on below, shining with a sheen as of silver essence, built up of rays almost symmetrically arranged round a bright ring above and below, with a marked absence of

them right and left, *the rays being composed of sharp radial lines*, separated by furrows of markedly less brilliancy."

After there had been time to examine the photographic records of the eclipse in connection with the above description, the enormous difference between the photograph and the eye picture was fully recognised, and in my lecture at the Royal Institution on the eclipse, after referring to the actinic corona, to the striking similarity in the details of the photographs taken at different times and in different places, I said: "The solar nature of most, if not all, of the corona recorded on the plates is established by the fact that the plates, taken in different places, and both at the beginning and end of totality, closely resemble each other, and much of the exterior detailed structure is a continuation of that observed in the inner portion independently determined by the spectroscope to belong to the sun."

Passing from the photographs to the drawings, I pointed out that in Mr. Holiday's sketch, for instance, we got an infinite number of dark radial lines extending down to the moon, with a greater extension than in the photographs, though in some places the shape of the actinic corona and some of its details were shown.

Thinking that this difference might be explained by different lights being superposed, so that of two superposed lights the naked eye used one, and the photographic plate the other, I asked the question whether the facts might not be reconciled, and really harmonised with what was actually seen in the telescope, even by supposing that the visual image, this glare let us call it, was sifted in the telescope by using greater or less magnification in the same way as it was separated out on the photographic plates and in our eyes by the different qualities of the light producing the visual and photographic images.

From this point of view, therefore, I regard Mr. Hasting's observation as one of very great interest, and I believe that it throws light upon a good many prior observations. I do not think, however, that any one will go with him when he proposes to abolish a true corona at the sun, for the reason that the observations to which I have drawn attention show that it is really a dual phenomenon as I pointed out in 1870, and although diffraction at the moon's edge may be the cause of one part, it cannot be the cause of the other. It is, perhaps, almost too early yet to speculate upon the changes in our views of the chemical nature of the external boundary of the sun's atmosphere which may be brought about by a complete discussion of the question which these observations again bring to the front. I long ago pointed out that the fact of getting in the spectroscope an indication of a line at so many minutes of arc from the limb of the dark moon, was by no means a proof of the existence of a vapour or gas at that height above the sun. Maclear's observation in 1870 was of course the test, for the reason that if such a *caveat* were not available we must assume the existence of coronal matter between us and the dark moon. But in any case it is not too early to bear this in mind, that if in our spectroscopes we have been dealing with a true glare, from whatever cause produced, there will be an almost complete inversion necessitated, and in this way: the brilliancy of any particular wave-length of the glare may either depend upon the area of the surface at the sun producing light of that wave-length, or upon its inherent intensity. Now if we assume that only the inherent intensity is to be considered, then obviously the region of greatest temperature will cause the brightest light. The brightest light will therefore be produced in the lowest level of the solar atmosphere, but because of the glare it will appear to extend to the greatest distance from the sun. It may therefore have been that the line 1474, instead of indicating, as it has been supposed to do, that a substance which gives a line at the part of the solar atmosphere most removed from the photosphere is really produced by that part of the atmosphere, was produced at that part of the atmosphere nearest the photosphere, and really at first sight—although this is by no means a matter on which one would wish to commit one's self hastily—it does seem as if this view would harmonise a great many facts which are very difficult of explanation in any other way.

I discovered the line 1474 in the chromosphere on June 6, 1869, and up to that time no bright line had been observed beyond those belonging to the spectra of hydrogen, sodium, and magnesium, with the exception of one line of barium, which was first seen in March, 1869. Now we know from the long-extended series of such observations for which we have to thank the industry of the Italian observers, that the line 1474 is now seen more persistently than any line which is not recorded in the spectra of hydrogen, magnesium, and sodium. The eclipse of last year taught us, if it taught us anything, that the lines which are thus persistent are the lines produced at the temperature of the hottest layers, and, if subsequent inquiry strengthens the view that the height to which the line 1474 appears to extend is really due to the depth at which the substance which produces it is restricted, the persistence of 1474 in ordinary chromospheric observations will be at once explained.

J. NORMAN LOCKYER

AGRICULTURE IN JAPAN[1]

DR. LIEBSCHER'S little work is the result, the author tells us, of his investigations during an eight months' sojourn in Japan in 1880. A cursory glance at the contents shows that it bears the physiognomy of a strictly scientific work. The work is divided into five parts:—(1) The condition of the climate and its influence upon the land-products; (2) the condition of soils and its influence upon the land-products; (3) the social condition before the year 1868 (before the reformation); (4) the reformation and reorganisation of the State since the year 1868; (5) foreign commerce. I shall notice shortly each chapter with some remarks. Beginning with the first chapter, Dr. Liebscher commences with the monsoon, within whose sphere Japan is situated. It has, as is well known, a certain determined direction during the whole year. The summer (south-west) monsoon comes from the south-west from April to September, while the winter (north-east) monsoon comes from the north-east during the rest of the year. To the first, according to Dr. Liebscher, Japan owes its tropical flora, such as *Chamærops excelsa*, *Thea viridis*, *Cycas revoluta*, &c., and to the same he attributes the chief land-products, such as cotton, sugar-cane, tobacco, Indian corn, and rice. Why the summer monsoon is so favourable to the growth of the land-products is because, says the author, it causes a warm temperature, and the abundant precipitation of rain (maximum 1794 mm. in a year). He ignores then altogether the geographical position of Japan, that on one side she lies partly in a subtropical and temperate zone, on the other she is surrounded on all sides by a large body of water. The north-east monsoon brings a dry and terribly cold winter, though somewhat modified by the "Kuro-Siwo" current and this monsoon is the sole factor that renders the climate unfavourable, causing the remarkable phenomenon of the "freezing of the soil." Dr. Liebscher says, the regular course of the monsoon assures the people who happen to inhabit those lands which lie within the sphere of that wind, of a never-failing good crop of rice. Thus we are accustomed to depend solely upon rice, and

[1] "Japan's landwirthschaftliche und allgemeinwirthschaftliche Verhältnisse nach eigenen Beobachtungen dargestellt." Von Dr. G. Liebscher. (Jena 1882.)

consequently we become vegetarians. We cannot entirely agree with him, but rather lay more stress upon the influence of the Buddhist religion, which once wielded sway over us. As to the unfavourableness of the climate due to the monsoon, he is unfortunate in selecting as an example the Hakone region. The volcano of Fuji San (3784 m.) is a high peak covered with everlasting snow, and at the foot of this lies the Hakone Pass (804 m.). Here Dr. Liebscher had seen on the western side (toward Fuji) around the Lake Hakone, a dreary sterile slope; while the opposite mountains, lying on the south, are covered with a luxuriant growth of forest. He ascribes the cause of the sterility of the northern to the cold winter monsoon, and the thickly wooded ranges to the summer monsoon. I explain this striking contrast quite in another way. Fuji San is an active volcano, and at the foot of this lies the region referred to. It is natural that no tree will flourish at or near recent volcanoes, which send out an enormous quantity of scoriæ. Moreover the Hakone Pass is situated at a high altitude (804 m.). We find thick forest at the top of the Brocken in the Harz mountains. Could we expect the same at the summit of Vesuvius? The climate of Japan is not so ineffective as Dr. Leibscher has depicted in his work; in reality it is far more conducive to fertility than that of Germany.

The second chapter deals with the soil and its influence upon the agriculture. "A large tract of plain not far from Tokio is left uncultivated," says the author; "while the mountain slopes are turned into useful land. Such an irrational course is not difficult to understand when I consider the other deeds done by the Government and people." This is not so serious as it seems; he did not understand the irrigation of soils, which is of particular importance in the rice-producing countries. He mentions in another page that the total area of the empire is 38,243,640 hectares, of which the cultivated land occupies 4,508,482 hectares, *i.e.* 11·8 per cent.; while the area of Prussia is 34,823,420, with 17,435,605 hectares, *i.e.* 50·7 per cent. of the cultivated land. The balance is evidently against Japan. I must here remark that Prussia is not mountainous. The only notable range in the heart of Prussia is the Harz; the Thuringian forest, the Riesen and Sudeten mountains lie at the southernmost boundaries of that country; all the rest forms what is called the "North German Plain," levelled down uniformly by the Scandinavian glaciers in the Diluvial period. On the contrary, Japan is very mountainous. Moreover, it must be taken into account that we have newly taken possession of the Riû-Kiû Islands. The island Hokkaidô, Chi-Sima (the Kurile Islands) were neglected till thirteen years ago. They are now substantially incorporated into Japan, and the present Government is energetically striving to convert these into utility. From these circumstances the author is not justified in jumping to the conclusion as to the present state of things. We are glad to find that the yield per hectare in Japan is 35·62, while in Germany it is only 6·11 (Dr. E. Naumann). As to the geology, the bearing of which is of great importance to the soil and subsoil, Dr. Liebscher closely follows Rein's "Japan," without contributing his own observations. The chief rock-groups are: (1) the crystalline massive rocks (granite, diorite, diabase, porphyries); (2) the palæozoic schists; (3) the more recent volcanic rocks (trachyte, rhyolite, andesites, dolerite, basalt); (4) the alluvium and diluvium. Among the first group are phosphates, salts of potash and soda in the form of felspar, and apatite; and the same minerals are richly contained in the third group. In Rein's palæozoic schists, recent trias and cretaceous formations are ascertained by geologists of the Geological Survey, and must be separated from the second group of Rein's geological category. The author lays great stress upon the sterility of soils, to the extensive development of the talc and chlorite schists and so-called "tuff soils"—a fine volcanic ejectamenta poured from the vent, and sediment under water. Indeed, I saw, myself, in the provinces of Musasi, Sanuki, and Rü, the phyllite system, in which the talc and chlorite schists form an essential member; still they sink into insignificance when compared with the other rock groups. Moreover, the so-called talc schist is in reality micaceous clay slate, and the pseudochlorite schist is chloritic epidote hornblende schist. These facts will somewhat modify the author's conclusion. As to the "tuff soil," he discusses and repudiates the uncertain analyses of Prof. E. Kinch and Herr von Korschelt. Neither of these gentlemen, I think, are correct, supposing that their analyses have been carefully prosecuted. They select as samples the "tuff soils" from the neighbourhood of Tokio. This city lies in the plain, surrounded by lofty volcanic chains—Fuji, Asama, Sirane, and many other ranges of volcanic nature, bounded on the south-east by sandstone mountains of the Awa province. Tuff and sandstones, *a priori*, could not produce fertile soils, and indeed "tuff soils" are the poorest in Japan. It is not found everywhere in that country, and appears exclusively confined to the neighbourhood of Tokio. I doubt very much the nature of the so-called "tuff soil." It may perhaps be an accumulation of diluvial sand and gravels. If samples for chemical analyses were obtained, the soils from the Mino province among others, we should be able to get a true insight into the Japanese soils. The author's conclusions, based upon these unfortunately ill-chosen samples, could, of course, not be correct, because the premises are already wrong. It is remarkable that Dr. Liebscher, as a professional agriculturist, after travelling through the greater part of Japan, should not be able to throw some new light on this point.

On the third chapter I have little to say, for the description relates to the bygone world prior to the year 1868. At present, our social condition assumes quite a new phase. Moreover the facts are compiled from the *Transactions of the Asiatic Society of Japan* and from the *Mittheilungen der deutschen Gesellschaft für Natur und Völkerkunde Ostasiens*. Most of the *Transactions* are translations from old obscure Japanese documents under the guise of new titles. One thing cannot however be passed unnoticed, that is the footnote on p. 72, which runs as follows:—"The Mikado may have, according to the Land Statute, 12 wives; the nobles, 8; the samurai, 2; the commons, 1." No such law ever existed in Japan. We are neither Mormons nor Mohammedans!

The fourth chapter deals with the political and social changes since the year 1868. It presents nothing new, except some odd remarks of a fanciful nature. The full accounts are already worked out by Le Gendre in "Progressive Japan," in Griffis's "Mikado's Empire," and lastly in Rein's "Japan." On p. 105 it is stated that the Japanese Government lays a heavy tax upon the farmer which may amount to half what he has won by patient labour; this oppressive measure would hinder future agricultural progress. In reality the legitimate tax is only 2½ per cent. of the net product.

The last (fifth) chapter treats of the historical development of foreign commerce and the balance of exports and imports. It is seen from the elaborately compiled tables that Japan is now in a favourable condition. In spite of the author depreciating and underrating what the Japanese have done, and the apparently incurably unfavourable physical conditions of the country, the author has, in the concluding chapter, a somewhat reassuring statement. He says that Japan will gradually produce more and more agricultural products if the heavy tax is taken off and serviceable roads are constructed throughout the interior. If this should be the case, the buying power of the country will be increased, and Germany will have to look for an opportunity to engross the export commerce. I must remark, lastly, that the author seems to me not fair-

minded in doing a great injustice to the Government of Japan, by which he was temporarily employed.

Munich B. KOTÔ

NOTES

AT the annual general meeting of the Society of Arts, which was held on the 27th ult., Sir William Siemens being in the chair, the following resolution relative to the death of Mr. Spottiswoode, who was a vice-president of the Society, was passed :—"That this meeting of the Society of Arts desires to express the deep regret with which it has received the news of the death of Mr. William Spottiswoode, one of its vice-presidents, and its sense of the loss which the Society has sustained by his decease. In him England loses one of her most remarkable men of science, science itself one of its greatest ornaments, and all who knew him a sincere and valued friend. Besides devoting his own time and thought to the advancement of knowledge, he was ever ready to lend to all engaged in like pursuits the assistance of his experience and his wise counsel. In thus placing on record their own appreciation of his services, the Society desires to express its feelings of sympathy with his widow and his family, and also with the Fellows of the Royal Society, of which he was the honoured and beloved President."

THE report of the Council for the past year, which was then read, makes it abundantly evident that the useful work of the Society is being carried on as successfully as heretofore. The *conversazione* of the Society previously fixed for the 11th inst. has been postponed to the 25th. On that day it will be held at the Fisheries Exhibition, South Kensington, when the Prince and Princess of Wales will be present.

INTELLIGENCE has been received from Vivi, on the Congo, of the sudden death of the well-known Swedish explorer, Capt. T. G. Een. Mr. Een, who was on his way to join Mr. Stanley on the Upper Congo, fell down dead from heart disease, just as the signal for his caravan to start was given.

THE Vienna Academy of Sciences offers two prizes of 1000 florins each (about 84*l.*) for the best treatises (1) on the capacity of various crystals for conducting electrical currents; and (2) on the chemical constitution of albumen matter.

THE well known Russian merchant Sibiriakoff is about to send another vessel to the Siberian rivers this summer. This is the steamer *Obe*, built of Bessemer steel at Motala in Sweden, and which will leave Gothenburg this week. The vessel, which is provisioned for sixteen months, is commanded by the Russian Capt. Weide, who has for many years sailed on the Yenisei and Lena. She will proceed to Tromsö, where she will meet his other steamer, the *Nordenskjöld*. A schooner with building materials will accompany the steamers as far as Novaya Zemlya, where it is intended to erect some storehouses at Yugor Scharr for the reception of cargoes when ice prevents the approach to Obi or Yenisei. At Novaya Zemlya a member of the expedition, Capt. Grönbeck, with two Samoyedes, will be left behind to study the ice and make meteorological observations during the winter. The *Obe* and *Nordenskjöld* will proceed to Port Dickson and the River Yenisei, in the mouth of which, in the Sastorovsky, the *Nordenskjöld* discharges her cargo, viz. merchandise, and loads a cargo of Siberian produce, with which she returns to Europe. The *Obe* proceeds up river with what cargo she can carry as far as Yeniseisk, and remains there for river navigation during next summer.

M. THOLLON is now working in the Observatory at Paris. We are informed that the Pic du Midi Observatory is making great progress towards completion, and that Admiral Mouchez, M. Thollon, and other astronomers will visit it towards the end of August.

THE monthly meeting of electricians has developed into a new institution, which is to be called Société des Electriciens. A committee has been established for determining the regulations to be proposed at a general meeting next October. M. Cochéry, Ministre des Postes et Telegraphes has been appointed honorary president of the society.

A REMARKABLE instance of the fidelity and sagacity of the dog happened on Friday last at Milford Haven, and is recorded in the daily papers. Two men named Davies and Taylor were out in a boat which was swamped. The former of these was the owner of a dog, and whilst the men were struggling in the water the animal caught hold of Taylor with the object of supporting him; finding, however, that it was not his master to whom he was rendering this assistance, he relinquished his grasp and went to the aid of Davies, his master, supporting him until he was rescued by a passing steamer, the other man being drowned.

ON June 13 at about 2 p.m. an earthquake was felt in the neighbourhood of Vossevangen in Norway. There was one continuous shock lasting several seconds, accompanied by a noise as that of a heavy train passing.

A NEW electric boat, exceeding in size all that have hitherto been designed, is now being fitted up at Millwall by the Electrical Power Storage Company, and is, we understand, nearly ready for her formal trial trip. The new craft is of iron, and measures forty-six feet in length. Her "engine" is a Siemens' dynamo of the D2 type, and works direct on the screw shaft without any gearing. The screw is of unusually narrow pitch, in order to enable the dynamo to run with a high velocity. She carries sixty-five accumulators of the Faure-Sellon-Volckmar pattern of the same size as those used in the smaller electric boat constructed last autumn by the same company. In the private trials made, a speed of eight miles per hour was maintained. This boat will be sent to Vienna, and will doubtless attract much notice at the forthcoming Electrical Exhibition in that city.

RIGNOLD'S panorama of the Arctic regions will be exhibited at the Royal Victoria Coffee Hall during the present month. This panorama, which was painted by the late Clarkson Stanfield, R.A., has the reputation of being the finest marine painting extant.

UNDER the title of "Hardy Perennials and Old-fashioned Flowers" Mr. L. Upcott Gill of 170, Strand, has issued the first number of what will be, if carried out on the lines here laid down, a rather bulky book, and moreover an expensive one, inasmuch as the number before us, which bears date April, is priced at 6*d.*, contains only forty-eight pages, and proceeds only to CAL. in an alphabetical arrangement of the names of the flowers which are recommended for cultivation. The aim of the work is a good one, namely, the bringing to notice many flowers for cultivation in our gardens that are now totally neglected or forgotten. Many old familiar friends are brought to mind in glancing through these forty-eight pages. The arrangement of the plants in alphabetical order of their scientific names is the best that could have been adopted. The wholesale use of capital letters for the specific names should be altered, and more care should be taken in the spelling, such mistakes occurring as *Achillea Ægyptica* for *egyptiaca*, *Calthus* for *Caltha*, &c. Some of the figures also are extremely poor.

SINCE the above was written we have received the June number of this little work, which brings it down to *Helleborus* or the Christmas Rose. In this latest number the same lavish use of capitals occurs for the initial letter of the specific name

and the average number of mistakes also occurs. Thus under the genus *Funkia* the common name given is *Planting* Lily, whereas it should be *Plantain* Lily, a name that has been quite recently accorded to these plants by a gardening contemporary.

THE annual Reports of Colonial Botanical Gardens are so frequently reaching us and the matter contained in them is of such value and importance that we regret we have not space at our disposal to give a more extended notice of some of these records of scientific work in our widely spread dependencies. Two of these reports lie before us, namely, that of Dr. Trimen on the Royal Botanic Gardens, Peradeniya, Ceylon, for the year 1882, which report is dated at Peradeniya on January 1 of the present year, and that of Mr. Charles Ford on the Hong Kong Gardens, or rather on his work as Superintendent of the Botanic and Afforestation Department, Hong Kong. A large portion of Dr. Trimen's report is given to the consideration of economic plants, the first mentioned being coffee. Under this head it is with no satisfaction we learn that "Leaf disease has in no degree diminished, and the continued failure of crop during the past year has added to the difficulties of all concerned in the planting enterprise of the colony." Dr. Trimen continues, "No combined effort whatever to prevent the disease on the lines indicated by its known nature has been even attempted, whilst the waste of money and time in local applications of 'cures' has continued. As at the same time high cultivation and liberal manuring have become generally impossible from pecuniary necessities, the existing state of things, however much to be lamented, cannot be considered surprising. A remarkably wet season, too, has aggravated the condition of the badly nourished trees, and the low prices ruling for coffee have intensified the loss by short crops. Thus the cultivation of coffee has been in many places found not to cover expenses, and the necessity of growing other products has been more than ever forced upon proprietors." From this we gather that the prospects of coffee cultivation in Ceylon are anything but promising, and with regard to Liberian coffee, upon which the hopes of planters were at one time founded, we find that it likewise has had to bear the severe attacks of leaf disease, and consequently rises and falls in the estimation of planters. In suitable soils and localities, however, it does well, and the old trees now between eight and nine years old, though badly diseased, show no diminution in their crop-bearing capabilities. No record however is kept of the exports of Liberian coffee from Ceylon distinct from the produce of the other kind. Dr. Trimen remarks that the *Hemileia* not unfrequently attacks the fruits of Liberian coffee. As might be supposed, the subject of cinchona cultivation occupies a large portion of the report, and next to it comes tea and cocoa. The past year, we are told, has witnessed a very striking rise in the export of the first-named beverage, the exports amounting to 623,292 lbs., an advance on the previous year of 345,702 lbs. Tea estates have been opened at all elevations, and many old coffee estates not suited for cinchona culture are now cropped with tea. Indiarubber, gutta percha, and many other industrial and medicinal plants come under Dr. Trimen's review of a year's work at Ceylon, proving once more, if proof were needed, the value of the Peradeniya Gardens amongst others in promoting the advance of applied botany; and the same may be said of Mr. Ford's report of the Hong Kong Garden, for we find there that a considerable amount of attention has been given to the growth of such plants as *Cinnamomum cassia*, the tree furnishing Cassia Lignea of the London market, the Chinese varnish tree (*Aleurites cordata*), and the mahogany tree (*Swietenia mahogani*).

A NEW form of dry pile has been described in *Wiedemann's Annalen* by J. Elster and H. Geitel. In the previous forms of dry pile, from the time of Zamboni downwards, the disks of foil and paper have been placed in glass tubes, with the result that the film of moisture collecting on the inner surface of the tube has always exerted a more or less destructive influence. In the new dry piles the disks are strung with a sewing-needle upon a single strong silk thread, which insures better insulation. Messrs. Elster and Geitel have made the very interesting observation that piles of this type can be charged from a Holtz machine. An ordinary Zamboni pile of 11,000 pairs of disks of tin and copper foil gave, after ten minutes' charging, sparks one millimetre long, and was able to illuminate a small Geissler tube for some time with a discharge continuous at first and afterwards intermittent. Following up this analogy dry piles were constructed on the plan of a Planté battery. Thin disks of lead foil alternating with disks of silk paper painted with a mixture of soluble glass and peroxide of lead were strung upon silk strings. A charged pile of 7000 such plates gave for ten minutes a spark one millimetre long; and after twenty four hours still showed electrification.

THE last report of the British Consul at Tientsin supplies us with information respecting the only colliery at present in complete working order in China. This is at Kaiping, not far from Peking. The coal is said to belong to the true carboniferous system, and the bed dips to the south some forty-five degrees, forming a large basin under the Gulf of Pehchihli. No fear is entertained that the measures will run short. So far as has been ascertained, the coal bearing stratum is about one thousand feet, containing thirteen seams. During the winter months two hundred tons per day of the inferior kinds of coal can be sold to natives in the vicinity, who use it for pottery, brick, and lime-kilns; indeed, one of the most important results achieved by the opening of the colliery has been the revival of several industries in the vicinity which were languishing or extinct, on account of the surface coal of the district being mostly worked out, and the price of other coal being too high to be used with profit. In connection with the colliery is a small railway, the only one in all China. Its length is but six and a half miles, and at the terminus the coal is placed in barges and carried down by canal. After a little opposition the locomotives were allowed to run freely. But ironworks, which it was also intended to start, could not get over the superstitious opposition raised on the score of the proximity of the Imperial tombs, and the consequent geomantic disturbances caused by sinking shafts, &c. The iron ore is said to exist in enormous quantities, but it is not easy to work owing to the amount of silica present.

WE have received Parts 4–6 of the *Transactions of the Yorkshire Naturalists' Union*, which do credit to that energetic body of local naturalists. They are entirely occupied by lists and notes concerning the fauna and flora of this, our largest, county, so arranged that each subject has a separate pagination, and most of the authors give evidence of considerable bibliographical research; some of the articles are of far more than local importance.

FROM several parts of Sweden the appearance of an unknown caterpillar, which consumes the crops, is reported. Its length is from one inch to one and a half, and its colour grey-brown with green stripes. In one place it put in an appearance immediately after a violent storm with rain. The Academy of Agriculture has despatched an entomologist to visit the places from which it is reported.

THE German Society of Analytical Chemists offers two prizes, of 25*l.* and 15*l.* respectively, for the best treatises on cocoa and cocoa manufactures, with reference to their commercial value and efficacy in nutrition.

ADMIRAL MOUCHEZ will not be reappointed at the expiration of his term of office. The Government is fully convinced that it is useless to resort to this formality, and that it would be better to continue his appointment by *toute réconduction*, as is customary in France under peculiar circumstances.

MISS FIELDE, an American missionary lady stationed at Swatow, has, it is stated, completed a voluminous dictionary of the Swatow dialect, which will be published shortly.

THE additions to the Zoological Society's Gardens during the past week include a Feline Dourocouli (*Nyctipithecus vociferans* ♀) from Columbia, presented by Mr. H. H. Thiele; an Indian Civet (*Viverricula indica* ♀) from India, presented by Capt. Wilson; two Squirrel-like Phalangers (*Belideus sciureus*) from Australia, presented by A. Pretyman; a Vulpine Phalanger (*Phalangista vulpina*) from Australia, presented by Mr. J. E. Dothie; an Australian Crow (*Corvus australis*) from Australia, presented by Mrs. A. H. Jamrach; a Nicobar Pigeon (*Calœnas nicobarica*) from the Philippine Islands, presented by Mr. Hugh Low; two Common Gulls (*Larus canus*), British, presented by Mr. C. W. Jervis Smith; a Spotted Mud Frog (*Pelodytes punctatus*) from the South of France, presented by Mr. H. P. Cambridge; a Cape Ant Bear (*Orycteropus capensis*), twelve Derbian Zonures (*Zonurus derbianus*) from South Africa, two Canadian Beavers (*Castor canadensis* ♂ ♀) from Canada, a Viperine Snake (*Tropidonotus viperinus*) from North Africa, a Tree Boa (*Corallus hortulanus*) from South America, purchased; a Hairy-footed Jerboa (*Dipus hirtepes*) from Arabia, a Simon's Dwarf Jerboa (*Dipodillus simoni*) from Algeria, received in exchange; a Japanese Deer (*Cervus sika* ♂), a Hybrid Syrian Wild Ass (between *Equus hemippus* ♂ and *Equus onager* ♀), an Impeyan Pheasant (*Lophophorus impeyanus*), four Amherst's Pheasants (*Thaumalea amherstiæ*), bred in the Gardens.

ON THE CAUSES OF GLACIER MOTION[1]

THE question of the causes which produce the movement of glaciers, which was at one time so eagerly discussed, would appear to have slumbered for the last ten years. This cannot be said to arise from the fact that a perfectly satisfactory theory has been developed, and recognised as such by all inquirers. The ambiguous allusion to the subject in Sir John Lubbock's presidential address to the British Association is an evidence that such certainty has not been attained. It is indeed generally supposed that the fact of the melting-point of ice being lowered by pressure is somehow at the root of the matter; but a full explanation of the origin of this pressure in the case of glaciers and of the mechanical features of the problem has yet to be given. I may therefore be pardoned if I draw attention to a different solution, proposed not by myself but by one of the greatest of English mechanicians. My apology for doing so is that I approach the question as an engineer, not as a physicist; and that it is in its essence, as will be shown immediately, a mechanical rather than a physical problem.

The following are leading facts of glacier-motion which must be accounted for by any valid theory on the subject:—

(1.) The phenomena of the movement of a glacier are simply those of a solid body in a state of flow.

(2.) The present glaciers of Switzerland and Norway, which are the only ones which have been critically examined, are mere shrunken fragments of the glaciers of the Great Ice Age. To take one instance, the present glacier of the Rhone is about 6 miles long and perhaps 500 feet deep; but the old glacier of the Rhone, which abutted against the Jura, was 120 miles long, and must have been 2000 to 3000 feet deep. The movement of such glaciers as this must also be accounted for in any satisfactory theory.

(3.) The glaciers of the present day are not confined to the temperate region; they are found in much larger numbers and of much greater size in the Arctic regions.

(4.) Both in the temperate and in the Arctic regions glaciers move in winter as well as in summer, and by night as well as by day.

That a glacier is in a state of flow was first proved by Forbes, and has since been confirmed by the measurements of Tyndall and others. Whilst the whole mass moves downwards, the top moves faster than the bottom and the sides than the middle; the upper layers must therefore be continually shearing over the lower, and the medial over the lateral. A glacier, being a body in a state of flow, must move under the influence of forces powerful enough to overcome its resistance, and so produce this condition.

The general phenomena of the motion of a glacier are exactly reproduced when a viscous body moves through a channel under the influence of its own weight. We have therefore first to inquire whether the shearing resistance of ice is sufficiently low to enable us to regard a glacier as a viscous mass.

The only experiments known to me on the shearing resistance of ice, are those of Moseley (*Phil. Mag.*, January, 1870). He found that, with pressures from 100 to 110 lbs. per square inch, cylinders of ice sheared slowly across the two planes in contact, sliding over each other without losing continuity. The distance sheared through was about five-eighths of an inch in half an hour. A load of 119 lbs. per square inch was sufficient to shear through a cylinder of $1\frac{1}{2}$ inches in diameter in two to three minutes. From these experiments it would appear that the lowest shearing stress which will cause ice to flow is about 100 lbs. per square inch; but sufficient time was not allowed in the experiments to make this a matter of certainty.

There is another way in which the shearing resistance of ice may be tested. In the case of a block of ice of vertical sides, gravity of course produces a shearing resistance along all planes passing through the base. Let h be the height of such a block in feet, and consider the shearing force due to gravity on any square foot of a plane making an angle θ with the vertical. This shearing force is given by—

$$\frac{wh \times h \tan\theta}{2} \times \cos\theta \Big/ h \sec\theta = \frac{wh}{2} \sin\theta \cos\theta.$$

This expression is a maximum when $\theta = 45°$, and its value is then—

$$\frac{wh}{4}.$$

What is the greatest height at which a vertical cliff of ice will stand? I am not able to state this precisely, but it is very considerable. Mr. Whymper mentions crevasses in South America 300 feet deep. Cliffs of fully that height have been seen standing out of water in the case of icebergs, and as so small a part of an iceberg projects above water, these cliffs probably extend below to a considerable depth. Taking, however, only 300 feet for the value of h, or for the maximum height of an ice cliff, this would give about 30 lbs. per square inch as the lowest shearing force upon a plane of ice which would cause it to assume the condition of flow.

Let us now suppose a glacier of thickness a, lying upon a slope whose inclination to the horizontal is β; then the force per square foot, tending to shear the ice at its junction with the slope, is clearly $aw \sin\beta$.

Supposing $\sin\beta$ to equal $\frac{1}{4}$, and that the shearing resistance is 30 lbs. per square inch, we get a = about 290. Hence we may say that a glacier lying on a slope of 1 in 4 will not move at all under its own weight unless it be at least 300 feet thick, and that, if it be more than this, the upper 300 feet will move as one solid mass, the part below alone representing the conditions of flow.

It is needless to say that there are hundreds of glaciers which are less than 300 feet thick, and which at no part of their course have a slope anything approaching 1 in 4.

We have now to show that the theories generally propounded for glacier action are all of them negatived by some of the foregoing considerations. These theories may be stated as follows:—

(1.) The glacier simply slides over its bed as a solid body. This is negatived by the fact that some parts move faster than others.

(2.) The glacier flows under the action of its own weight, exactly as a viscous body flows. This is the theory of Forbes. It is disproved by the facts given above, which show that even on a slope of 1 in 4 a glacier would not flow unless it was at least 300 feet thick.

(3.) The glacier moves by the crushing of its base. This has been disproved by Moseley's experiments, which showed that the crushing resistance of ice was considerably higher than the shearing resistance.

(4.) The glacier moves by the melting of its base. This is the theory of Hopkins. He placed a block of ice at 32° F. on a slab at a small angle, and found that it slowly descended as it melted. On this view the bottom of the glacier must always

[1] Paper by Walter R. Browne, M.Inst.C.E., read at the Royal Society, June 15, 1882.

be in a melting state. But glaciers are of all sizes and thicknesses, and they move in winter as well as summer. Bessels ("Die Amerikanische Nordpol Expedition," p. 398) measured the motion of an Arctic glacier (not apparently very thick), in the month of April, which is just when the winter cold would have sunk deepest, and found it considerable. Again in the *Zeitschrift des deutschen Geologischen Gesellschaft*, vol. xxxiii. p. 693, is an account of measurements of a Greenland glacier, both in winter and summer, which show that the motion in winter is only 20 per cent. less than in summer. It has been suggested to me that the interior heat of the earth may be sufficient to keep the bottom of the ice from freezing; but this cannot apply near the sides, where the ice is shallow, and the freezing of a very small strip on each side would be sufficient to keep the whole mass from descending. Moreover, this cause would apply to masses of snow as much as to ice. But it is known that masses of snow, though lying on steep slopes, do not descend in this way, even in summer, but melt away where they lie.

(5.) According to the theories of Tyndall, Croll, and others, the glacier moves not in the form of ice but of water. These theories are based on the known fact that the freezing point of ice is lowered by pressure. Hence it is supposed that certain parts of a glacier are continually being exposed to so much pressure that they melt. The water escapes downward, and the pressure being relieved it freezes again. The continuity of the glacier is further kept up by the process of regelation, according to which two pieces of ice, if placed in contact, form into one solid mass.

The advocates of this theory hardly seem to consider how very small the lowering of the freezing point is for any ordinary pressure. It is only ·0075° per atmosphere. In other words, it will require a pressure of 2000 lbs. per square inch to liquefy ice at 31° instead of 32°. This is equivalent to the weight of a column of ice about 5000 feet high. It is needless to ask whether such a pressure can exist within an ordinary glacier, while on the other hand glaciers undoubtedly move at temperatures far below freezing point—in the Arctic regions below zero.

It seems to be generally supposed that the pressure in the lower part of a glacier is due to the steeper upper portions: the glacier channel is spoken of as a mould, through which the ice is forced by pressure from behind. But in the upper glacier, slopes of ice or *nevé* are not uncommon at angles of 30° or even more. Such slopes usually do not even touch the more level parts of the glacier below them, but are separated from them by a wide, deep crevasse called a Bergschrund. Of this the well-known ice wall of the Strahleck is a conspicuous example. In other cases such slopes do not end in a glacier at all, but die away upon the mountain side. It is certain, therefore, that ice or *nevé* is able to maintain itself at a high angle upon its slope of rocks, and therefore cannot possibly exercise pressure upon the parts of the glacier far in advance of its foot. The fallacy of this idea may be further illustrated by referring, not to modern glaciers, but to those of the Great Ice Age. Can we suppose that the pressure of the snows about the sources of the Rhone was sufficient to drive that glacier down the valley to Martigny, round a sharp angle to the Lake of Geneva, through the bed of that lake, and on to the slopes of the Jura, a distance of more than 100 miles, in which the average slope was about 1 in 200; giving a propelling force per ton of ice of about 11 lbs. only?

All these theories have this in common, that they regard gravity as the sole and direct agent in the movement of glaciers, and the above considerations seem to prove that it is an agent far too weak for the work it has to do.[1]

The only other agent which has been suggested, or seems likely to be suggested, to account for the motion of glaciers, is heat. This suggestion, as is well known, is due to the late Canon Moseley, F.R.S., and was to some extent worked out by him in papers published in the *Phil. Mag.*, 1869 and 1870.

The mode of operation, on this theory, is well known. Ice is here considered merely as a solid body, obeying the ordinary laws of expansion and contraction under differences of temperature. This it is known to do, the coefficient of linear expansion, for 1° F., being ·00002856 (Moseley, *Phil. Mag.*, January, 1870), which is very high. When a mass of ice, such as a glacier, suffers a rise in temperature, either through conduction or radiation, it will expand; this expansion will take place mainly in the direction where movement is easiest, that is, down the valley. If from any cause the temperature falls, the glacier will again contract; but since the expansion is assisted by gravity whilst the contraction is opposed by it, the latter will be somewhat less in amount than the former, and when the ice has returned to its original temperature, its centre of gravity will have moved a certain small distance down the valley. By such alternate expansions and contractions the glacier moves gradually from the top to the bottom of its course.

That variations of temperature do take place in a glacier cannot be doubted, whatever be the condition in which it lies. This granted, the fact that it should move in the way described appears to me no more surprising than that the sheets of lead on which Canon Moseley made his well-known experiments did so move; and that the motion thus produced is of the character which answers to all the facts of the case, so far as they are at present known, can, I believe, be established.

The controversy occasioned by Canon Moseley's articles was unfortunately terminated by his illness and death, before the matter had been fully cleared up. The main objections urged to his theory were two. The first was that a glacier is not one continuous body (as assumed by Canon Moseley in his mathematical investigation), but is broken up into many parts by crevasses. But in the first place, the assumption above mentioned is merely one of convenience, and not in the least necessary to the theory. A detached piece of ice would move in the same way as a glacier, or as the sheet of lead did in Canon Moseley's experiments. Secondly, if a glacier is anywhere divided in its whole thickness by a crevasse, this is absolutely fatal to the gravitation theories, since there can be no pressure between the portions above and below this division. The only possible explanation of crevasses, on these theories, is that they are due to the glacier bending over a convex part of its bed. In that case the bottom half will be in compression, and only the top half in tension, so that the crevasse cannot possibly extend more than half way through the thickness.

The second objection was that the conductivity of ice is low; hence the effect of the heat would be confined to the layers near the surface, and could not account for the motion of the glacier as a whole. This objection does not seem to be confirmed by careful reflection upon the way in which such forces act. Let us suppose a glacier 100 feet deep, of which each successive foot expands and contracts alike throughout, but adheres with a definite shearing resistance to the layers above and below. Let there be a rise in temperature, which does not extend beyond the uppermost 10 feet. This layer will expand, and if it were free would expand to the full amount due to the increase in temperature. But its lower surface is not free. In expanding it will therefore drag the next layer after it, or in other words will cause it to expand also. The amount of expansion, however, will not be so great, because there will be a certain shearing extension at the plane of division between the two. The second layer will similarly cause an expansion in the third, and so on to the bottom. In consequence the energy which would all have been exerted on the top layer, had that been free, will be distributed over the whole of the layers; and the extension of the top layers will of course be much smaller than it otherwise would have been. Should the temperature then remain constant, the layers will retain their position, and adapt themselves to the new circumstances. If the temperature falls, the layers will contract, but from the now opposing effect of gravity they will not return to their original position. The top layer, which has extended furthest, will be the furthest below its original position; the second layer next and so on. If we suppose the layers to be indefinitely thin, we have the condition of things in an actual glacier. The ice in any vertical section will, on the whole, move down the slope, but the top will move faster than the middle, and the middle than the bottom, exactly as it is known to do. The same holds with regard to a horizontal section. At the sides the ice will be held back, not only by the friction, but also by the protuberances of the rock, which compel the ice to shear over them. Hence the velocity there will be retarded, and will be less than that in the middle, which is comparatively free.

A more important objection remains to be considered, which is this. On the present theory the motion at any point on the surface of a glacier will be not continuous, but oscillating alternately downwards and upwards, and the net distance by which it has descended, say, in a day, will be a mere fraction of the total distance through which it has moved in that period. If

[1] Another evidence against pressure from behind as a cause of motion is furnished by the very small size of many glaciers. Some of these, notably those of the class called "glaciers remanés," are only a few hundred yards long, and cannot be many feet deep.

so, this alternate motion ought to have been noticed in the various observations which have been made upon glaciers, and this does not appear to have been the case. But, in reply to this, it may be remarked that most of the observations have only given the net movement of points on the glacier during intervals of a day or more, and therefore would not show the oscillations. Again, such observations have always been at points near the end of a glacier. Now the variations in temperature of a glacier will be very different at different parts, and the motion of the end of the glacier will, to a great extent, show the average result of these different advances and retreats in different parts of the higher regions. This average result will, of course, be a steady progression down the valley, and the oscillatory movement at the end of the glacier may be so much masked by this as not to be readily observable. Lastly, it may be suggested as possible that a certain amount of expansion by heat may have the effect of giving a *set* to ice, so that it does not return to its original length when brought back to the same temperature. If this be so, the oscillations would be much less marked, and at the end of the glacier would probably be indistinguishable.

I may now draw attention to some phenomena of glacier action, which are explained by the heat theory, but which do not seem explicable on the gravitation theory.

(1.) It is well known that glaciers, when they emerge from a narrow gorge into a comparatively wide valley, spread out into a fan shape. The Rhone glacier is a well-known instance. A still better one is a small glacier in Norway, mentioned by Prof. Sexa, which spreads out to five or six times its previous width. Now the effect of gravity, acting on a mass as a whole, is to carry it in one single direction, that of the steepest slope. The only way in which gravity can produce such a spreading out is by the parts of the glacier shearing over each other in the manner of a viscous solid. But the phenomena of ice cliffs, as mentioned above, show that ice does not spread from this cause, so that the fact seems impossible to explain by gravitation alone. On the heat theory it is, of course, perfectly easy: the expansion and contraction will take place in all directions where there is freedom to move.

(2.) Connected with this phenomenon is that of the longitudinal crevasses seen near the edges of glaciers, and particularly where they spread out in the manner just described. Now on the gravitation theory, as remarked above, the only possible explanation of a crevasse is that the ice is bending over a convex surface, and that its upper part is thus placed in a state of tension, under which it breaks. Since, on the gravitation theory, every part of a glacier is exposed to a severe pressure from behind, this explanation does not fit very well even for transverse crevasses; but to longitudinal crevasses it is clearly inapplicable, since the bottom of a valley is seldom or never convex in the direction of its width. On the heat theory the explanation is simple. We may suppose the heat energy communicated per square foot of surface to be about the same, whether near the middle or edge of a glacier. This energy is expended in producing an expansion throughout the whole thickness of the glacier, as described above. Hence the smaller this thickness, the greater will be the amount of expansion, and the greater therefore the net motion which results. Hence the thinner parts of a glacier will always be tending to tear themselves off from the thicker, and thus longitudinal crevasses will frequently be found.

(3.) The striæ which are so marked a feature of glacier-worn rocks become more easily explained on this theory. I have seen such striæ, even in the hard hypersthene of Skye, which were a considerable fraction of an inch in depth. When we consider the enormous force necessary to plough out such a furrow in hard rock, it is almost impossible to believe that it was done by the simple passage over it, once for all, of a stone imbedded in the ice. If, however, the stone descended by a series of oscillations, so that it passed many times over the same spot, this difficulty is greatly lessened.

(4.) In conclusion I may point out that the advocates of the gravitation theory are bound to explain what becomes of the heat energy which is poured into a glacier. When the sun is shining this radiant energy is always very large, although the temperature of the air may be low. In such cases the glacier does not melt; it is perfectly clear that it must expand, as any other solid must expand under the action of heat. If so, it seems unreasonable not to hold that the gradual descent by alternate expansion and contraction must follow, as it is known to follow in the case of other materials.

On the subject of the motion of Arctic ice, Dr. Rae, F.R.S., has kindly permitted the publication of the following particulars:—

"When in Greenland, in the autumn of 1866, I was ice-bound at the head of one of the fiords, and slept a couple of nights at an Eskimo's house. A glacier about half a mile distant was then in full activity, the movement of which might, I believe, have been as visible to the eye as it certainly was audible to the ear.

"My own idea is that Arctic glaciers must have a downward motion more or less during the whole year, summer and winter. I believe the alternation of heat and cold—or, I should rather say, of temperature—would of itself cause motion, especially near the upper surface.

"We know that ice 2 or 3 feet or more thick contracts very considerably in a few hours by a sudden fall of 15 or 20 degrees of temperature. I have found cracks in Lake Winnipeg 3 or 4 feet wide, formed by this cause during a single night, almost stopping our sledge journey. This gap soon freezes up. Then the weather gets milder, the ice expands, and with the new additional formation is too large for the lake, and is forced up into ridges. This process goes on at every 'cold snap,'[1] alternating with milder weather. Now supposing a glacier for 10 or more feet of its depth contracts by cold, as lake ice is known to do, it will get a series of cracks probably in its longest axis, say from inland seaward; the first snowdrift will fill up these cracks or some of them, and this filling up will to some extent perform the same office as the freezing of the cracks in the lakes. The longitudinal extent of the glacier will be increased. A snowstorm always brings milder weather, which would expand the glacier, but as this expansion would naturally tend downhill, instead of up, the whole motion would be downwards. But even if the cracks I mention did not take place, the contraction by cold would pull the ice downhill, not up, whilst the expansion by increase of temperature would tend to *push* the glacier downhill, so that these opposite actions would produce similar effects in moving the glacier, or such part of it as could be acted upon by external temperature, downwards.

"I may also add that when a crack, however slight, is formed by contraction, the cold is admitted into the body of the glacier, and increases the contracting power or influence."

SCIENTIFIC SERIALS

Annalen der Physik und Chimie, xix., part 4.—Electrical experiments: electric pressure on solids, by G. Quincke. This paper forms a continuation to a series of experiments in electrostatics published by the author in previous numbers of the *Annalen*, under the title of "Electric Expansion." It is illustrated with twenty-six cuts, and will be followed by a communication on the resistance of insulating fluids to electric force.—On electric disturbance at contact of gases with bodies in combustion, with four illustrations, by Julius Elste and Hans Geitel. The authors arrive at the general conclusion that all flames may be regarded as streams of hot gas, which generate negative electricity in burning electrodes introduced from without, as well as in small bodies in combustion suspended in them.—On electric vibration, and more especially on the phenomena of polarisation produced by vibratory movements, with four illustrations, by A. Overbeck.—On the dependence of gases as heat conductors on the state of the temperature, with three illustrations, by A. Winkelmann.—On the fundamental equations of E. Ketteler's theory of optics, by W. Voigt. The author shows that, so far from flowing from the principles of the doctrine of elasticity, Ketteler's fundamental equations are diametrically opposed to them.

THE *Journal de Physique* (May, 1883) contains the following original papers:—On the difference in barometrical pressure at two points in the same vertical line, by J. Jamin.—On the action of heat upon boracite and upon sulphate of potash, by E. Mallard.—On the penetration of actinic rays into the eye of man and that of vertebrates, and on their vision of ultra-violet rays, by E. de Chardonnet.—On a new apparatus for verifying the laws governing the fall of bodies, by M. Paquet.—On an experimental demonstration of the unequal velocity of the transmission of sound in gases and solids, by F. Griveaux.

[1] "Cold snap," an American term meaning a rather sudden increase of cold.

Zeitschrift für wissenschaftliche Zoologie, Bd. xxxviii. Heft 2 (April 27, 1883), contains:—Contribution to a knowledge of the infusoria, by Dr. G. Entz (Plate 8).—On the primordial skull of some mammalia, by Fred. Decker (Plate 9).—On some Coelenterata of the South Sea, by Dr. R. v. Lendenfeld, of Melbourne, Part II.—On new Aplysinidiæ (Plates 10 to 13).—On the embryology of Hydra, by Dr. A. Korotneff (Plate 14).—On the larval development of *Phoxichilidium plumulariæ*, nov. sp., by Dr. R. v. Lendenfeld, with woodcuts.

Rendiconti of the *R. Istituto Lombardo di Scienze e Lettere*, May 10 and 17.—Preliminary inquiry into Zanardelli's proposed penal code (continued), by Prof. A. Buccellati.—On the commentaries of Gaius and the paraphrase of Theophilus, by Dr. C. Ferrini.—A few remarks on the first five sections of Ricardo's chapter on value, by Prof. E. Nazzani.—On the mortality of infants in the various provinces of Italy, by Prof. G. Sormani. The death-rate during the first month is shown to be much higher in winter than in summer, and in the northern than in the southern provinces. Thus: 50 per 1000 in Palermo, 190 in Padova, medium for the kingdom 91·9.—On the formation of the primitive line and primitive cleft in the gastrula of the Mexican axolotl, by Prof. G. Bellonci.—Alterations in the lower hollow vein aggravating hepatic cirrosis, by Prof. A. de Giovanni.—Observations on the comet of Brooks made in the Brera Observatory, Milan, by G. V. Schiaparelli.—On a deposit of fossiliferous Pliocene clay recently discovered near Taino, to the east of Angera, in Lombardy, by Prof. T. Taramelli.

SOCIETIES AND ACADEMIES

LONDON

Linnean Society, June 21.—Prof. P. M. Duncan, F.R.S., vice-president, in the chair.—The following gentlemen were balloted for and elected Fellows of the Society, viz. Messrs. E. J. Baillie, J. Borland, K. McKean, E. C. Malan, and H. A. A. Nicholls.—A specimen of *Polyporus sulfureus* was exhibited for the Rev. A. A. Harland, obtained from the stem of a yew tree in the Cliveden Woods, Bucks.—A series of fossil fruits, &c., from Australia were shown for Dr. Charles E. Barnard; among these were species of *Phymatocaryon*, *Eisothecaryon*, *Ochthodocaryon*, *Spondylostrobus*, *Plesiocapparis*, and others.—Mr. W. T. Thiselton Dyer exhibited several interesting vegetable economic products, and made remarks thereon. Of a species of wax extracted by Mr. D. Morris of Jamaica from *Myrica microcarpa*, it was stated that while the berries are used for obtaining wax in South Africa, the West Indian fruits had not hitherto been used for this purpose. A gray, camphor-like substance, the product of *Artemisia noxa*, he mentioned as a rare example among the Compositæ; and there was a probability that this camphor was used in the production of Indian ink by the Chinese, and gave the peculiar aromatic odour to the true China ink. A rosary was shown made of fruits of *Trapa verbanensis*, De Not. (locally called Frutti de' Lago), from the Lago di Varese, Italy; also specimens of wax and candles made from *Rhus vernicifera* of Japan; the latter preparation is quite a local industry, which unfortunately is now ceasing on account of the rivalry of the cheap American oils.—The following plants were exhibited, viz., *Arnoseris pusilla* and *Hypochæris glabra*, obtained by Mr. Thomas Howse in West Surrey, and specimens of the Cheddar Pink (*Dianthus cæsius*), which had been grown freely by Mr. C. F. White on his garden wall at Ealing.—A paper on the structure of the hard parts of the Fungidæ (part 2, Lophoserinæ), was read by Prof. Duncan, and another by Mr. R. A. Rolfe of Kew, on the Selagineæ described by Linnæus, Bergius, and Thunberg.—A communication was read from Mr. H. G. Doran, on the malleus of *Rhytina stelleri*, based on a specimen obtained in the voyage of the *Vega*, and exhibited in the Swedish Department of the International Fisheries Exhibition, under the charge of Prof. Smitt of Stockholm. The author concludes that this auditory ossicle in the extinct Northern Sea Cow (*Rhytina*) is larger than in the Manatee (*Manatus*), and therefore it is the largest and bulkiest malleus to be found in the whole section of the animal kingdom where such a bone exists. In the character of its body it resembles that of the Manatee rather than that of the Dugong (*Halicore*); while in the manubrium it differs in *Rhytina* from the other Sirenia, and is far more generalised.—The following paper was taken as read, Notes on some new economic products recently received at the Royal Gardens, Kew, by W. T. Thiselton Dyer. Therein he treats of the West African indigo, the Inhambane copal, and the Ogea gum as exhibited at a previous meeting.—On the testis of *Limulus*, formed a communication from Mr. W. B. S. Benham. He describes the structures in question, noting the apparent isolation of many of the spermatic sacs, and the probability that they are not diverticula of the spermatic duct, but secondarily acquire connection therewith, the two structures being independently developed. He remarks that in no crustacean do the ducts of the generative glands form a network, whereas in the King Crab, as in the Scorpion and other Arachnids, they do. There followed a paper on the Mollusca of H.M.S. *Challenger* (part xx.), by the Rev. R. Boog Watson. This contains a continued descriptive account of the family Bullidæ, dealing with the genera *Atys* and *Scaphander*, along with the group *Aplysiidæ*, genus *Dolabrifera*.

Zoological Society, June 5.—Osbert Salvin, F.R.S., vice-president, in the chair.—Mr. Sclater exhibited and made remarks on two birds obtained near Lima by Prof. W. Nation, C.M.Z.S., and on a collection of birds made in New Britain, New Ireland, and the Solomon Islands, that has been sent to him for examination by the Rev. George Brown, C.M.Z.S.—Mr. Sclater also called the attention of the meeting to a Condor from Peru, living in the Society's Gardens since 1877, which he was induced to believe was a specimen of the "*Condor pardo*," or *Sarcorhamphus æquatorialis*, Sharpe.—Mr. G. French Angas exhibited a collection of butterflies made during a recent visit to the island of Dominica, W.I.—A communication was read from Prof. Owen, C.B., entitled "Embryological Testimony to General Homology."—A communication was read from the Rev. O. P. Cambridge on some new genera and species of spiders. Eight spiders, representing as many new genera, were described: two of them belonged to the family Theraphoridæ, one to the Drassidæ, and the others to the Thomisidæ. Three of these species were from Ceylon, three from Caffraria, one from New Zealand, and one from California.—A communication was read from Mr. A. G. Butler containing an account of the Lepidoptera collected by Mr. H. O. Forbes in the islands of the Timor-Laut group. Examples of twenty-three species were obtained.—A communication was read from Mr. Herbert Druce containing descriptions of some new species of moths of the families Zygænidæ and Arctiidæ, mostly collected in Ecuador by Mr. C. Buckley. The number of new species described was fifty, belonging to twenty-four genera.—A paper was read by Messrs. Godman and Salvin, containing remarks on the variations of certain species of butterflies of the genus *Agrias*.—Mr. G. A. Boulenger read a report on a collection of reptiles and Batrachians from the Timor-Laut group of islands, formed by Mr. H. O. Forbes. Two new species were described—the one a lizard of the Australian genus *Lophognathus*, and the other a snake of the Indian genus *Simotes*, proposed to be named respectively *L. maculilabris* and *S. forbesii*. The snake was of special interest, as no species of the genus *Simotes* had hitherto been previously known to occur eastward of Java.

Chemical Society, June 21.—Dr. W. H. Perkin, president, in the chair.—The following gentlemen were elected Fellows:—G. S. Bowler, C. Beringer, T. H. Coleman, A. Esilman, H. E. Harrison, C. Hulke, H. Heap, B. Hobbs, C. T. Heycock, W. J. Livingston, B. P. Lascelles, H. R. Mill, M. F. Purcell, J. E. Richardson, F. G. Roberts, W. R. Reffel, A. Smith, E. H. B. Stephenson, A. W. Soward, A. H. Samuel, D. Wilson, and R. Williams.—The following papers were read:—On evaporation in vacuo, by H. McLeod. The author has contrived several forms of apparatus, and in the present paper describes two. One in which the water was evaporated in a glass dish with ground top, at a temperature not exceeding 50°, 50 c.c. evaporated in two hours; a Körtings water pump was used to obtain the vacuum. Instead of the dish a test tube or a combustion tube may be employed. In the second form of apparatus sulphuric acid was allowed to trickle down the tube into which the aqueous vapour passed, and thus the use of a condenser was avoided.—Note on a hydrocarbon and some substitution derivatives from camphor, by H. E. Armstrong.—On the preparation of the pentathionates, by G. S. Shaw. The author has reinvestigated this subject, because Prof. Spring states in *Liebig's Annalen* that he was unable to obtain pentathionates by using the method described by V. Lewes. The author completely confirms the results obtained by Lewes, and has obtained beautifully crystalline salts in which the ratio of potassium to sulphur was as 2 atoms to 5. A note is appended to the paper by Watson Smith.—On the decomposition of ammonium nitrate;

an investigation into the rate of chemical change, by V. H. Veley.—Note on the action of allylic iodide upon phenol in the presence of zinc or aluminium foil, by P. Frankland and T. Turner. Orthopropyl phenol was obtained.—On a new gas burner for heating combustion tubes, by W. Ramsay.—On a by-product of the manufacture of aurin, by A. Claparède and Watson Smith. When aurin is prepared from phenol, oxalic acid, and sulphuric acid, some quantity of white crystals appears on the lids of the aurin-pots. These were examined by the authors, and were found to consist of a phenyl ortho-oxalic ether.

Meteorological Society, June 20.—Mr. J. K. Laughton, M.A., F.R.A.S., president, in the chair.—The following papers were read:—On the structure of the ice-cloud disposed in threads, proposed to be called "cirro-filum," by the Rev. W. Clement Ley, M.A., F.M.S. Of the cirriform clouds one of the most important to the weather forecaster is that to which the author has given the name of "cirro-filum." Having from the time he was twelve years of age carefully studied this cloud whenever visible, and having for the last twenty-five years made it the subject of minute study, he is enabled to bring forward some results which may prove of value. The author then gives, first, a short account of the mode in which he was led to prosecute this study; secondly, a classification of the more recent and reliable observations; and lastly, an explanation of the principal phenomena observed.—Notes on a second series of experiments on the distribution of pressure upon flat surfaces perpendicularly exposed to the wind, by Richard H. Curtis, F.M.S. The results obtained in these experiments agree very closely with those of the former experiments.—On the reduction of wind records, by the Hon. Ralph Abercromby, F.M.S. The author discusses the significance and best method of deducing from anemographic records the total quantity, the quantity from different points of the compass, the relative frequency, the mean and annual velocity, the mean velocity from different quarters, the resultant, and the mean and diurnal direction of the wind.—The spectroscope as an aid to forecasting weather, by F. W. Cory, M.R.C.S., F.M.S.—Note on river temperatures as compared with air temperatures at Greenwich and Bremen, by Robert H. Scott, M.A., F.R.S. The author compares the results given in a recent paper by Sir G. B. Airy on a comparison between the records of the temperature of the Thames and those of air temperature taken at Greenwich with those published by Herr von Freeden for the temperature of the Weser as compared with that of the air at Elsfleth, close to Bremen, for the ten years 1858–67.

Physical Society, June 23.—Prof. Clifton in the chair.—New member, Mr. Stearn.—Prof. D. E. Hughes, F.R.S., exhibited a number of experiments illustrating his theory that a magnet is made up of magnetic molecules each of which is a small magnet. When a magnetic metal is in a neutral state he showed that there is a symmetrical arrangement of the molecules such as to make them satisfy their mutual attractions; not as on Ampère's theory a "higgledy-piggledy" arrangement. Prof. Guthrie stated that a piece of watch-spring magnetised retains its magnetism when impregnated with mercury. Prof. Everett, Mr. W. H. Coffin, and others remarked that Ampère's theory tried to account for the magnetism of the molecules. Professors Perry and Ayrton observed that when soft iron is between red and white hot, it ceases to be attracted by a magnet.—The new absolute sine galvanometer of Prof. Minchin was then exhibited to the meeting by Prof. G. Carey Foster. It is intended for the Cornell University, and measures less than the E.M.F. of a Daniell cell. The principle of the instrument was described at a former meeting of the Society. Prof. Ayrton, Lord Rayleigh, Mr. Coffin, and Prof. Clifton offered some remarks on the apparatus.—A note on the induction-balance effect and the densities of alloys of copper and antimony, by Mr. George Kamensky, A.R.S.M., was then explained by Prof. Chandler Roberts. These experiments were to determine whether the curve of the electrical resistance of the copper antimony alloys would be a straight horizontal line, U-shaped or of the L type. They were found to belong to the last type. It is seen from the curve exhibited that there is a rapid fall from copper to the alloy containing only 10 per cent. antimony, and this decrement is continued until the alloy $StCu_4$ is reached, when the curve turns rapidly and rises to $StCu_2$, then turns again, and passes to pure antimony. Prof. Roberts has shown that the alloy $SnCu_4$ occupies the lowest point of the curve, namely, the position that in the copper-antimony series is occupied by the alloy $StCu_4$. In the copper-tin series the second critical point is held by $SnCu_3$, and in the copper-antimony curve this point is held, not by Cu_3Sb, but Cu_2Sb, the formula for the violet alloy known to alchemists as the "regulus of Venus." The specific gravities were also plotted in curves, showing that the alloy Cu_2Sb does not stand out from the rest, while the alloy Cu_4Sb has a higher density than copper.

Edinburgh

Royal Society, June 18.—Prof. Maclagan, vice-president, in the chair.—The Astronomer-Royal for Scotland presented a paper which was read by Prof. Crum Brown, on bright clouds in a dark night sky. This phenomenon Prof. Smyth had twice witnessed, on April 8, 1882, and April 30, 1883. On both these occasions the meteorological conditions were peculiar, the air being for a few hours remarkably dry. The explanation given was that the glow on the clouds was due to reflection of the gas-lights of Edinburgh from the hollow water-drops in the cloud, which from their floating in a very dry atmosphere had become sufficiently thin-walled to throw back a strong reflection from the two surfaces.—Prof. Tait read a mathematical note by Mr. Anglin, in which a solution was given of the problem to express x^m in terms of powers of x lower than n, when x^n is given in terms of these lower powers, and m is greater than n.—Prof. Tait communicated the results of his recent measurements of the compressibility of water. The water was compressed in a tube silvered inside and dipping with its lower and open end in a trough of mercury. The whole was placed inside the hydraulic press, and exposed to pressures of 1, 2, 2½, and 3 tons weight per square inch, the compression of the water being measured by the height of ascent of the mercury, which was given at once by the lower limit of the silver film. For water, both fresh and salt, the compressibility was found to diminish with increase of pressure, diminishing at much the same rate in both cases, although to begin with the fresh water was more compressible than the sea-water in the ratio of about 72 : 67. The results obtained for the fresh water could be very accurately represented by the formula $c = \cdot0072\,(1 - \cdot043\,p)$, where c is the true compressibility per ton at pressure p tons weight per square inch. The mean temperature of the water was 12° C. At the same temperature alcohol of density ·83 showed a much greater compressibility (·01202 for one ton weight per square inch), which also diminished with increase of pressure—·01043 being the average compressibility for 3 tons weight.

Sydney

Linnean Society of New South Wales, April 25.—The following papers were read:—Notes on a collection of fishes from the Burdekin and Mary Rivers, Queensland, by William Macleay, F.L.S., &c. The new species described are *Serranus estuarius*, *Therapon fuliginosus* and *parviceps*, *Diagramma labiosum*, *Corvina argentea*, *Caranx compressus*, *Cybium semifasciatum*, *Platycephalus Mortoni*, *Electris planiceps*, *Atherinichthys maculatus*, *Mugil Ramsayi*, *Chatoëssus elongatus*, *Anguilla marginipinnis*, and *Tæniura Mortoni*.—By J. J. Fletcher, M.A., B.Sc., notes on a viviparous lizard. The author's attention had been drawn to the subject during last January, when he obtained at Burrawang several examples of female lizards in an advanced stage of pregnancy. The embryos were from two to three inches long, enveloped in a thin and transparent chorion quite devoid of the calcareous matter with which it is more or less impregnated in the oviparous species.—Notes on a method of obtaining water from *Eucalyptus* roots, as practised by the natives of the country between the Lachlan and Darling Rivers, by K. H. Bennett.—Prof. Stephens exhibited a photograph and a sketch forwarded by Mr. C. Jenkins, representing a fossil from the Devonian formation of the Murrumbidgee valley, near Yass. Mr. Jenkins is inclined to refer it to *Asterolepis* (which is closely connected with *Pterichthys*), but chiefly on account of the character of sculpture of the scales. On the same ground he doubts its relationship to *Cacosteus* or *Cephalaspis*. Prof. Stephens added that without the actual specimen before them with all its collected fragments, it would be premature to determine even the genus of this ancient fish, but pointed out that it appeared to have some points of resemblance to *Macropetalichthys* of the North American Devonians.—Mr. J. J. Fletcher exhibited a specimen of a giant earthworm, 25 inches long, from Burrawang, N.S.W. It probably belongs to Prof. M'Coy's genus *Megascolides*, and its existence in this colony is now recorded for the first time.

BERLIN

Physical Society, May 25.—Dr. Aron spoke on the glow-light coal, which, as is well known, is distinguished by its electrical conductibility and by its resistance to combustion when exposed to the atmosphere in an incandescent condition, and which thus resembles graphite, which possesses both these properties in a high degree. Experiments which were made in order to determine whether such good conducting and indestructible coal, as well as artificial graphite, could be made artificially, led to the result that organic substances, *e.g.* paper, cloth, wadding, when charred in vacuo at very high temperatures in graphite crucibles, acquire the property of resisting combustion and afterwards become good conductors. Wood-coal also, which, though it is with difficulty combustible, is a bad conductor, was converted into a good conductor by strong incandescence. When the incandescence and the subsequent cooling down were conducted in a stream of hydrogen, this had no effect upon the resistance to combustion. Soot, which was made incandescent under similar conditions, also acquired the properties of graphite in a high degree, so that for many purposes (*e.g.* in galvano-plastic work) soot that has been made strongly incandescent can be made to replace graphite. The property of leaving an impression which graphite possesses, and which makes it so well adapted to the manufacture of lead-pencils, was not acquired by the different kinds of carbon in the process of incandescence; very probably this property depends upon the crystalline composition of the graphite.

VIENNA

Imperial Academy of Sciences, March 8.—E. Mach, experiments and notes on the system of lightning-conductors of Mr. Melsens.—C. von Ettingshausen, contributions to the knowledge of the Tertiary flora of Java.—L. Pfaundler, on the mantlering machine of Kravogl, and its relation to the machine of Pacinotti-Gramme.—F. Hochstetter, sixth report of the Prehistoric Commission: on the mounds recently found at Watsch and St. Margarethen (Carniola).—F. Steindachner, on Japanese fishes.—G. Goldschmidt and R. Wegscheider, on the derivatives of pyrene.—R. Wegscheider, on some derivatives of opianic acid.—E. von Bruecke, on alcophyr, and on the true and the so-called biuret reaction.

April 5.—E. Mach, preliminary communication on new experiments made with the influence-machine.—F. Lukas, on the knowledge of the absolute strength of vegetable tissues.—W. Simerka, on the power of conviction (a mathematical study).—T. V. Tanovsky, on nitro and amido derivatives of azobenzene.—A. Nalepa, contributions to the anatomy of Stylommatophora.—A Lieben and L. Haitinger, preliminary communication on chelidonic acid.—E. Lippmann, on azylines.—B. Schwarz, on an eclipse of the sun mentioned by Archilochos. T. M. Pernter, psychrometrical studies.

PARIS

Academy of Sciences, June 25.—New methods of determining the right ascensions and absolute declinations of the stars (continued), by M. Loewy.—Experimental studies in relation to the photometric observation of the eclipses of the satellites of Jupiter, by MM. A. Cornu and A. Obrecht.—A study of the deformations produced by sharp-edged tools in drilling, by M. Tresca.—On the employment of partial photographs in studying human and animal locomotion, by M. Marey. The object of this process is to avoid the great confusion caused by the superposition of numerous reflections in the case of slow locomotion. It is illustrated by a cut showing the attitude of the left leg of a man walking at a moderate pace and reflected at the rate of about sixty per second. The partial photographs obtained by this method enable the observer to analyse all kinds of motion, such as walking, running, leaping, and even action confined to one place.—On the action of mixtures of air with vapour of chloroform, and on a new process of anæsthesia, by Paul Bert. The experiments were made on dogs, which were treated with doses of chloroform diluted in varying proportions with air. From the effects observed it is hoped that many important problems may be solved connected with the action of this anæsthetic. But although all risk may thus be avoided in its application, the disadvantages inherent in chloroform itself cannot be overcome, and protoxide of azote still maintains its preeminence above all the anæsthetics.—On the reciprocal of homogeneity; similitude of mathematical formulas, by A. Ledieu.—Methods of separating gallium from ruthenium, osmium, arsenic, and selenium, by M. Lecoq de Boisbaudran.—On a case of long-standing hysteria, all the symptoms of which disappeared under the influence of aluminium, by M. Burcq.—On a method of computing secular perturbations in the elements of the orbits of planets, asteroids, comets, &c., by O. Callandreau.—A new generalisation of a formula of Lagrange, already generalised by Cauchy, by Em. Barbier.—On the relations of induction to electrodynamic action, and on a general law of induction, by M. Quet.—Automatic impression of telephotic despatches, that is, of despatches transmitted by light, memoir by M. Martin de Brettes.—On a method of determining by constant registration the slight movements of the crust of the earth. This method of recording microseismic movements was first suggested by MM. Bertelli and de Rossi, and forms the subject of a paper published in the *Engineer* for December 17, 1875.—On the sulphate of thorium, by Eug. Demarçay.—On a base derived from crotonic aldehyde, by Alph. Combes.—Researches on mesitylene, by MM. Robinet and Colson. A new glycol is described, and it is shown that the dichloride and the dibromide of mesitylene obtained by the action of chlorine and bromine on mesitylene gas are identical with the dichlorhydric and dibromhydric ethers of this gas.—Observations on the fermentation of breadstuffs, by M. Moussette.—On the concomitance of the anatomic and organographic characters of plants, by M. J. Vesque.—Borings at Rilhac, in the Brassac basin, east of Arvant, by M. Daubrée. These borings were most successful, revealing at a depth of eighty-six metres productive carboniferous strata underlying horizontal beds of clay and more or less argillaceous sandstones.—Borings at Toussieu, department of Isère, by M. Grand'Eury.—After piercing various alluvial, limestone, clay, and sandstone formations, coal was reached at a depth of 364 metres. These borings were begun after those of Chaponay had revealed carboniferous beds at the depth of 212 metres immediately below the marine molasse. The chief object of both is to determine the extension of the coal measures of the Loire basin under the tertiary plain in the north of Lower Dauphiny.—Scientific results of Col. Prejevalsky's journeys, and especially of his third expedition towards Tibet and the sources of the Yellow River, by M. Venukoff. Amongst the more important results were the animal and vegetable collections, comprising 408 specimens of 90 species of mammalia, 3425 of 400 species of birds, 976 of 50 species of reptiles, 423 of 53 species of fishes, 6000 of insects, and 12,000 of 1500 species of plants.

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THURSDAY, JULY 12, 1883

HYDRAULIC MANUAL

Hydraulic Manual. By L. D'A. Jackson. 4th Edition. Pp. xiv. + 307 Text + 184 Tables. (London : Crosby Lockwood and Co., 1883.)

THIS well-known text-book having reached its fourth edition, it is unnecessary to review it as a new work. The changes from the third edition are very great; the chief is the omission of the whole of the "Hydraulic and Meteorological Statistics" (about 224 pp. of tables); these relate chiefly to India, so that their omission is an advantage to the "Manual" as a general text-book, as it has enabled the text to be increased from 221 to 307 pp., and the general working tables from 104 to 184 pp., without increasing the bulk of the volume; the chief increase of the text is the introduction of an account of the great Roorkee hydraulic experiments.

Much stress is rightly laid on the small value of the old hydraulic knowledge; thus (p. 3) it is said, "Taken generally the mass of hydraulic science . . . prior to about 1856 may be considered superannuated. . . ." The most useful feature of this work is indeed its freedom from what is "superannuated," and its thorough adoption of recent experiment; the text is in fact in great part a short account of the great modern experiments. In detailing field operations the author has indeed preferred to give a "brief account of the modes adopted by various hydraulicians" as being "a far better guide to the engineer about to undertake the execution of gauging operations than any arbitrary advice or set of rules could possibly be." These concise accounts are on the whole well condensed; but the recapitulation—in some cases verbatim—of the several experimenters' own conclusions has the disadvantage that in several cases contradictory conclusions appear on different pages; this is inseparable from the progressive state of our knowledge of the motion of water when stated in this way; a little more discussion of the contradictory views would have been useful.

Kutter's general formula for mean velocity was early adopted by the author; its use as the formula to be preferred to all others for the case of canals (whenever velocity-observation has to be dispensed with) is now insisted on, much evidence in favour of it having been brought out by the recent large Roorkee experiments, with the very fair reservation however that Kutter's rugosity-coefficient (n) should at present be determined by actual experiment for each new channel, the data for its *a priori* determination (from the mere nature of the channel) not being as yet good enough. On the other hand it is rightly said that "to determine with accuracy the discharge of any ordinary or large river independent of velocity-observation is at present impossible."

A few minor details are worth notice. The units of measure, &c., adopted are an extremely simple and useful decimal system; they include the foot, the "foot-weight" of 1000 fluid ounces, *i.e.* the weight of a cubic foot of water at its greatest density, and a "league" of two London miles of 5000 feet each; this league is particularly suited to measurement of hydraulic slopes, a fall of 1, 2, &c., feet per league being at once seen to give a slope of 1, 2, &c., in 10,000. Two new very expressive names are introduced for two velocities, which recur very frequently in discussions on flow of water, viz. "verticalic velocity" and "transversalic velocity" for velocities past any vertical line or any (horizontal) transverse line in a channel section; these short terms will be a great relief from the wearisome periphrases hitherto in use, and merit general adoption.

A few suggestions towards improvement of the work may now be made. (1) In a purely professional work such expressions as "international recrimination," and "bureaucratic and heated with vanity" (p. 37) are surely out of place. (2) About one page of text and three of tables are devoted to the variation of gravity in different latitudes and at different heights; now the variation is so small that for the rough calculations of practical hydraulics this is an unnecessary refinement. (3) Among the "general notation" (p. 11) occurs the rather awkward phrase "g = velocity acquired by gravity in one second." (4) In finding the (trapezoidal) "section of maximum discharge" from the expression for discharge $Q = A\,V$ where $V = 100\,c\,\sqrt{R\,S}$ and $R = A \div P$, the argument used is that "under the condition of maximum discharge, A will be a maximum, so also will R; and when these are temporarily constant, P will be a minimum;" this argument might be considerably improved, somewhat as follows:—"Since $Q = 100\,c\,A\,\sqrt{R}.\,\sqrt{S}$, therefore Q is greatest (provided S be kept constant) when c, A, and R are all maxima together; now c is known (from experiment) to increase with R, and $R = A \div P$; hence Q will be greatest when A is a max. and P a min. at same time (provided of course that S is constant)": this argument is more general than that in the text; the effect of the S-variation is unknown. (5) About certain formulæ for "mean verticalic velocity," quoted from the Roorkee work, it is said (p. 209)—"The defect in these methods is evident; it consists in making the parabolic curvature dependent on one point or on two points, whereas three points are the least necessary." This last statement is a mistake; three points are necessary (for finding a mean ordinate) only if they be taken at random, but *two points are sufficient when suitably chosen*, as in the "two-velocity formulæ" quoted on pp. 87, 208 from the Roorkee work; these formulæ are in fact accurate for the parabolic form, and the proof of this (from the Roorkee work) is actually given at p. 87. The "one-velocity formulæ" are of course only approximate. It may be mentioned here that the writer has lately[1] discovered another (and far better) "two-velocity formula," also accurate for the parabola, viz. $U = \frac{1}{2}\,(v_{\cdot 211\,H} + v_{\cdot 789\,H})$, showing that the "mean verticalic velocity" is the arithmetic mean of the velocities at ·211 and ·789 (or say $\frac{2}{10}$ and $\frac{8}{10}$) of the depth: this new formula has several great practical advantages over any other yet published; among others, the two velocities can be measured at one operation with a single instrument (a compound "double-float" with two equal subfloats at the depths named), which is itself moreover susceptible of being made a more accurate instrument than any other of its class (double-float).

ALLAN CUNNINGHAM

[1] See *Proc. Inst. Civil Engineers*, vol. lxxi. pp. 18, 19, where the formula and instrument are both discussed.

ORIGINES CELTICÆ

Origines Celticæ (a Fragment), and other Contributions to the History of Britain. By Edwin Guest. Two Vols. (London: Macmillan and Co., 1883.)

A MAN'S foes are indeed those of his own household. More than one literary or scientific reputation has been injured by the injudicious zeal of a writer's friends to publish after his death the fragments and papers he has left behind. It is natural to imagine that the work and suggestions of a scholar must all be equally valuable, and that by omitting to print any portion of it the world may be a loser. But it must be remembered on the other side that a good deal which a scientific worker commits to manuscript is never intended to see the light, and that in any case it is unfair to him to publish fragmentary remains which he has never had the chance of revising and correcting.

Dr. Guest's name is deservedly one of power among all those who have interested themselves in the earlier history of our country. His papers on the Invasion of Britain by Julius Cæsar, on the Campaign of Aulus Plautius, on the Four Roman Ways, and on the Saxon Conquests in Britain, are all models of sound scholarship and careful method. Dr. Freeman acknowledges him as a master, and declares that "whenever they meet on the same ground, he ranks above Palgrave and Kemble." Friends and public alike, therefore, might have expected to find in the fragments of his unfinished work, "Origines Celticæ," a fresh monument to his historical sagacity and another contribution of importance to the ethnology of our islands.

But friends and public alike must be grievously disappointed by what is actually placed before them. It would have been far better to spare the paper and ink that has been expended upon it, and, what is of more consequence, the fair fame of the author himself. The "Origines Celticæ," which occupy the whole of the first volume and the opening pages of the second volume of Dr. Guest's posthumous works are a barren waste of unscientific theorising and uncritical collection of facts. The work carries us back to an age when the application of the scientific method to history was unknown, when ethnology and comparative philology were as yet undreamt of, and when the most amazing generalisations were built on the chance coincidence of proper names. In our search for the fathers of the Kelts we are transported to the Caucasus, to Egypt, and even to Ur of the Chaldees, and no shadow of doubt is allowed to cross the mind that Kimmerians and Kimbrians and Kymry are all one and the same people. The fact that there were Iberians in Georgia and Iberians in Spain is considered quite sufficient to prove that the early population of the Spanish Peninsula came from the sources of the Euphrates.

Dr. Guest's philology is as wild as his ethnology. He has heard of "Grimm's Laws"; but as their existence is inconvenient to his own etymological mode of procedure he denounces both the "laws" and their observers, though without understanding what they really mean. When Indo-European philology is treated in this way it is not surprising that the Rutennu of the Egyptian inscriptions are connected with the Assyrians of Resen, that initial *k* and *h* are said to interchange in Phœnician, or that an Egyptian settlement in Kolkhis is declared to admit of "no reasonable doubt."

Dr. Guest's turn of mind, in fact, was literary rather than scientific. Wherever the question was a purely literary one, he displayed erudition, patience, and common sense; where, on the contrary, it was ethnological or philological, he showed himself as helpless as a Jewish rabbi. The old well-threshed statements of Greek and Latin writers are heaped together, and tricked out here and there with references to the discoveries of Egyptian and Assyrian research. How little he knew of the latter, however, may be judged from the frequent mistakes he makes when appealing to them, as when, for instance, he insists on calling Sumer Sommari, or tells us that Assur-bani-pal lived in the ninth century B.C.

Had the "Origines Celticæ" appeared a hundred years ago they would have been hailed as a profoundly learned and interesting book. There is no place for them in an age when the departments of knowledge with which they deal have been occupied by the method and spirit of inductive science. To know what Dr. Guest really was and of what he was really capable we must turn to the papers reprinted in the second volume of his remains, though even here we shall from time to time be reminded of the literary spirit which accepts what is not disproved rather than of the scientific spirit which doubts everything and holds fast only to that which is proved.

A. H. SAYCE

OUR BOOK SHELF

Handbook of Vertebrate Dissection. Part II. "How to Dissect a Bird." By H. Newell Martin, D.Sc., M.D., M.A., and William A. Moale, M.D. (New York: Macmillan and Co., 1883.)

SOME months ago we noticed in these columns (vol. xxvii. p. 335) the first of a series of Handbooks of Vertebrate Dissection, by Drs. Martin and Moale—"How to Dissect a Chelonian." The second, "How to Dissect a Bird," has now appeared, and, as the type selected is the pigeon, this volume will doubtless be appreciated by a large number of students.

The general arrangement of the book is much the same as that of its predecessor, directions being given how to proceed step by step, so that the student, with its aid, ought to be able to gain a good knowledge of the anatomical characters of a bird. The skeleton, in particular, is described in great detail, and there are four good figures and a diagram of the skull, as well as a figure of the hind limb. It is, however, to be regretted that there are no illustrations of the soft parts, for figures of the skeleton—at any rate of allied forms—can be got in almost any text-book on Comparative Anatomy, while satisfactory drawings of the viscera, &c., are not so easily obtainable.

The directions are on the whole excellent, with one or two slight exceptions. The description of the air-sacs, for instance, is very indefinite, and gives no idea of their true relations. If the authors had glanced through Prof. Huxley's recent paper on the subject in the *Proceedings of the Zoological Society*, and compared the air-sacs of the pigeon with the description there given, there is no doubt that the position of these structures and their relations to the lungs would have been stated more clearly.

We must also call attention to the following points, which are not very accurate:—

Only one pancreatic duct is described instead of three.

The inferior mesenteric artery, instead of the median sacral, is stated to be the termination of the aorta.

The descriptions of the thymus and thyroid glands appear to have been transposed.

The three divisions of the cloaca are not described, and the rudimentary right oviduct is not mentioned, though the "*Fallopian tubes*" are said to open into the cloaca.

It is a mistake to introduce questionable homologies into a book of this kind, especially when they are unsupported by fact. Thus the statement in § 118 that the "thin sheet of muscle which is closely adapted to the concave ventral surface of the lungs . . . represents the diaphragm of mammals," is certainly misleading. In the first place, the position and relations of these muscles are entirely different from those of the mammalian diaphragm, and, moreover, they receive their nerve-supply from the intercostals, the phrenic being absent. The fact that the phrenic arises so far forwards appears to indicate an entirely different origin for these two structures.

With these slight exceptions, however, the descriptions and directions leave little to be desired for clearness and accuracy. It is certain that accurate detailed directions are far more valuable for elementary teaching than more general ones; the student, once having mastered them, finds little difficulty in grasping the wider bearings of the subject. Such works as the present, therefore, which entail a careful examination of every point mentioned, not only save both student and demonstrator much trouble, but insure more accuracy in work. A series of pamphlets such as the authors intend to publish, treating of all the more important vertebrate types usually dissected in an ordinary course on comparative anatomy, will certainly prove most valuable.

An Easy Introduction to Chemistry. Edited by the Rev. Arthur Rigg, M.A., and Walter T. Goolden, M.A. New Edition Revised, pp. 148. (London: Rivingtons, 1883.)

THIS book is based on a "First Book of Chemistry," by Dr. Worthington Hooker, and is intended, we are told in the preface, "to convey information in respect to changes which are likely to attract the attention of young persons who observe and inquire."

It is questionable whether "young persons" do well in attempting to study chemistry; the chemical laboratory is not a place in every way suited to the requirements of youth, but without steady work in a laboratory no real progress in chemistry can be looked for. Should, however, any youth desire information regarding material changes which he observes around him, he will find a considerable amount of information in this little book; but should he be desirous to study chemistry, he will not we are afraid derive much assistance from this "Easy Introduction." Many experiments are described and numerous well-executed illustrations are given, but several of these experiments could not be performed by a beginner without the aid of a teacher or of much more detailed description than is given in the text. To read statements of the results of experiments is not the way by which young persons can acquire interest in or a knowledge of chemistry.

Although excellent in many ways, yet we cannot think this book will prove an efficient introduction to chemistry; a perusal of it may, however, serve to stimulate young persons to seek for an introduction to the science, some of the materials for the construction of which are put before them in this work.

Practical Electric Lighting. By A. Bromley Holmes, Assoc. Inst. C.E. Sixty-two Illustrations. (London: E. and F. N. Spon, 1883.)

IT is with pleasure that we shall watch the success of Mr. Holmes's little book on "Practical Electric Lighting." Mr. Holmes has clearly and simply put before the unelectrical public as much and no more of theoretical electricity as is necessary for his purpose, together with a good general summary of the chief machines and appliances in present use.

Besides this, much useful information is given in the last two chapters, first, on the present economic state of electric lighting, and second, on the best means of applying the power to electric machinery. If there be one point in the book not so strong as the rest it is that the descriptions of the dynamos and lamps would have been better if they had entered a little more into detail.

C. C. S.

LETTERS TO THE EDITOR

[*The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, or to correspond with the writers of, rejected manuscripts. No notice is taken of anonymous communications.*

[*The Editor urgently requests correspondents to keep their letters as short as possible. The pressure on his space is so great that it is impossible otherwise to insure the appearance even of communications containing interesting and novel facts.*]

Geology of the Congo

I HAVE received from one of the Baptist missionaries in the front of the Congo mission a basket of specimens of rocks and a letter giving some particulars of the geological structure of the localities. The letter may be interesting as the first news of this kind from the centre of Africa, on its western side, and I therefore place it at your service. S. R. PATTISON

5, Lyndhurst Road, Hampstead, N.W., July 7

Liverpool Station, B.M.S., Stanley Pool, Congo River, S.W. Central Africa, March 15, 1883

S. R. PATTISON, Esq.

DEAR SIR,—Before leaving England in 1879 you made us a kind offer to render us any help in geological and mineralogical matters that lay in your power, and that kindness has been recalled to mind every time I have examined a piece of rock. I had seen such geological variety in the few parts of England that I had visited, that in my ignorance I was expecting to find a much greater variety out here and at least some fossil treasures. But in this, as you may guess, I have been disappointed.

In sending home some curios the other day, I inclosed a few native ingots of lead and copper, which I thought might interest you. They are "mined" in a district of the Bizunseke tribe called Noama, some twenty-five miles west-north-west of the Ntombo Mataka Falls of the river. I have not visited the place, but I believe de Brazza (concerning whom there have been some paragraphs in the newspapers lately) passed through this "mining district."

Although I believe that no metal from that part is ever sold to white traders, it is an important item in native trade with the far interior. Some are used to make bullets, others are recast to make anklets, &c. If the district is rich, or there is much silver in the lead, the French will perhaps work there.

The case of curios was sent away before I had intended. I had hoped to have added other things, and a piece of sandstone from the cataracts here.

Mr. Stanley indirectly hinted that Stanley Pool might be the crater of a volcano (extinct of course) which in old time had rent a rift in the hills, forming an exit to the pent-up waters of a vast interior sea. I am not sure how much of this was made public by him. It was, however, his opinion on our return from our first visit to the Pool. He speaks also of lava reefs, granite, gneiss, trap, &c.

Dr. Pechuël Lösche, late of the German Expedition, which spent some time (about five or six years ago) on the coast about the Kioilo and Chiloango Rivers, was for a short time in charge of the Belgian expedition here during Mr Stanley's absence. He assures me that there is no trace of igneous action above Isangila at least. There may be traces of such action at the Yelala Falls, which form the first bar to navigation from the sea. Between there and Isangila Falls quartz, slate, micaceous, and granitic (apparently) rocks are the rule.

Above Isangila limestone is abundant for about ten miles, above that slaty rocks are prevalent. Limestone crops out again about the country of the Basundi. This gives place to a red shale at the western boundary of the Babwende, and at the Ntombo Mataka Falls a red sandstone appears under the shale.

This sandstone is soft and is broken up and rounded into huge boulders, which are covered with a smooth, chocolate-coloured, ferruginous glaze, deposited by the river, and hardened by the sun. These boulders thus glazed might well have been regarded by Mr. Stanley as trap and lava, &c., while the large grain of the stone, together with the appearance of the blocks in some places might suggest its being granite. This sandstone with the exception of a little which is quartzitic, is the only rock I have seen between Manyanga and Stanley Pool, and is certainly the rock at the great Ntamo cataracts here.

On the hills and cliffs about the Pool there are some white shining patches, which I hear are sand, but I believe there is no calcareous rock in the neighbourhood. The pool itself is a strange break in the lines of sandstone hills, which, although now much eroded by water, are the remains, doubtless, of what was once a plateau, at the level of about 1500–1800 feet above the sea.

On the road to San Salvador from our old Musuka station we find boulders of ironstone and small nodules of the same, mixed with clay, on the top of quartz, micaceous, and granitic rocks. Limestone crops up in several places, but the principal formation visible is the ironstone clay. In all this country I have not met with a trace of a fossil of any kind.

When at Landana, about two miles south of the mouth of the Chiloango River, some months ago, I saw some stones from the cliffs which appeared to be almost identical with a Portland stone (?) which I have seen used in fortifications in the south of England. There were many fossils, but I could neither spare time to examine the cliffs nor carry many specimens, being on an express journey by hammock up the coast. This was the only occasion that I have met with any fossils in Africa, and that in a part of the coast now well known through the work of the German Expedition. The quartz, micaceous, slate, shale, and sandstone rocks of this part of the continent are a poor field for palæontologic research.

I am very curious as to the geological formation of the Congo Valley between this point and the Stanley Falls, but at present have learned nothing. I should expect, however, to find the sandstone the only visible rock.

I wish that I could speak with better acquaintance with the names of the rocks, but often I feel sorely puzzled. On our first journey to Stanley Pool we mistook some strangely shaped hills near to Manyanga for granite, but have since ascertained them to be singular relics of the sandstone.

I need not enter into details of our work, which are so fully and constantly reported in the *Missionary Herald*. Regretting that the information I can supply is so meagre,

Believe me, dear Sir, yours very truly,

W. Holman Bentley

Intelligence in Animals

1. I observe that Dr. Romanes, in his very interesting work on "Animal Intelligence," has been good enough to notice an account given by me in Nature, vol. xi. p. 29, of an instance of a scorpion committing suicide under special excitement. It may be well to remention the fact that in this case the rays of the sun, focused on the back of the scorpion by means of a common lens, were the exciting cause of the self-inflicted fatal sting; and to set the matter at rest it may be remarked that two witnesses who saw the experiment can corroborate my statements. On reconsidering the whole affair, however, it occurred to me that in wounding its own back the scorpion may have merely been trying to get rid of an imaginary enemy. The concentrated rays of the sun no doubt caused pain, and the sting was probably directed towards the seat of this in an automatic manner, as a defensive act. This seems to me a more feasible explanation than to regard the action as due to an instinct detrimental to the individual and to the species.

2. While writing on the subject of "animal intelligence," it has occurred to me that the following remarkable example is worthy of being put on record:—Some years ago, while living in Western Mysore I occupied a house surrounded by several acres of fine pasture land. The superior grass in this preserve was a great temptation to the village cattle, and whenever the gates were open, trespass was common. My servants did their best to drive off the intruders, but one day they came to me rather troubled, stating that a *Brahminy bull* which they had beaten had fallen down dead. It may be remarked that these bulls are sacred and privileged animals, being allowed to roam at large and eat whatever they may fancy in the open shops of the bazaar-men.

On hearing that the trespasser was dead, I immediately went to view the body, and there sure enough it was lying exactly as if life were extinct. Being rather vexed about the occurrence, in case of getting into trouble with the natives, I did not stay to make any minute examination, but at once returned to the house with the view of reporting the affair to the district authorities. I had only been gone a short time, when a man, with joy in his face, came running to tell me that the bull was on his legs again and quietly grazing! Suffice it to say that the brute had acquired the trick of feigning death, which practically rendered its expulsion impossible, when it found itself in a desirable situation which it did not wish to quit. The ruse was practised frequently, with the object of enjoying my excellent grass, and although for a time amusing, it at length became tiresome, and resolving to get rid of him the sooner, I one day, when he had fallen down, sent to the kitchen for a supply of hot cinders, which we placed on his rump. At first he did not seem to mind this much, but as the application waxed hot, he gradually raised his head, took a steady look at the site of the cinders, and finally getting on his legs, went off at a racing pace, and cleared the fence like a deer. This was the last occasion on which we were favoured with a visit from our friend.

G. Bidie

Ootacamund, June 5

The Mealy Odorous Spot in Lepidoptera

The mealy spot on the base of the front margin of diurnal Lepidoptera, which emits an odour supposed to serve for sexual purposes, is present only in the male. It is therefore most interesting to observe that this spot is not always present in different individuals of the same species. Among the numerous varieties of *Papilio priamus* proved by rearing to belong to that species, the spot in question is present only in *P. priamus*, and is wanting in the male of all the varieties which have come under my observation. *Callidryas eubule* has the spot present only in specimens from Florida; it is wanting in all specimens from other localities of the United States, including a large number from Texas. In *Colias electra* and *edusa*, Keferstein (*Wien. Zool. Bot. Gesell.* 1882, p. 451) states that after an examination of a series of males he has found the mealy spot only exceptionally present, and the same is supposed by him to be the case in other species of *Colias*.

It would be interesting to know how this exceptional presence of so prominent a characteristic is to be explained.

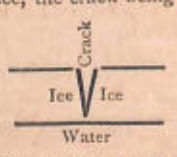
Cambridge, Mass., June 21

H. A. Hagen

Causes of Glacier Motion

Unfortunately not having been present when Mr. W. R. Browne read his paper on glacier motion at the Royal Society on June 15, 1882, it only came under my notice when published in Nature, vol. xxviii. p. 235. It is doubtless of little importance, but there is one sentence which does not seem to read exactly as I wrote it, namely, "It (a glacier) will get a series of cracks *in its longer axis*," should be "*across* (or transverse to) its longer axis," which I think makes the meaning more clear.

I may perhaps mention that when ice on lakes becomes from four to seven feet thick the effect of a sudden decrease of temperature does not, for obvious reasons, always cause a complete solution of continuity of the ice all the way through from its upper to its under surface, the crack being wedge-shaped, thus—



so that the water sometimes does not flow into the crack; the equable and higher temperature of the water counteracting at a certain point of the ice's thickness the penetration and consequent contracting influence of the colder air.

When the ice has acquired the great thickness above mentioned, the cracks by contraction are never so wide as when the ice is from one to three feet thick, but as far as I can remember they were more numerous, and when the water did not flow into them, were drifted full of snow by the first breeze of wind.

John Rae

4, Addison Gardens, July 7

Sand

NOT having had the pleasure of perusing Mr. Waller's paper on sand, I gather from Mr. Gardner's notice of it that it is an attempt to distinguish by the aid of the microscope whether sand has been formed by the action of wind or of surf. Having a number of years ago become possessed with the idea that the form of the materials which make up the soils and subsoils found in any country might lead to a knowledge of the sources from which they had been derived, I had many soils and subsoils from Europe and Australasia looked at, but without being able to detect sufficient difference of shape or form as to lead to any definite result. Having been long familiar with the soils formed out of the boulder clay and drift of the south-east of Scotland, I had hoped to have seen a very marked difference in the form of the particles of sand existing in them from those of the interior of Victoria, New South Wales, and Queensland, large portions of the surface coverings of which countries are believed to have been deposited when covered with the sea. This difference exists certainly—that the soils of the boulder clays and drifts contain a far greater portion of fine and rough gravel, and rounder in shape than do those from Australia. Yet, so far as I could observe, the form of the sand was similar. It seems to me that both Messrs. Waller and Gardner are on the wrong track when searching solely for the typical forms of sand in the seashore or from torrents. The amount of sand found on the seashores of the world is large, no doubt, so is that from the rivers. What is that to the quantities contained in the surface coverings of the land? It is from this source the rivers obtain the supply they carry to sea or the shores, and make up the waste by friction. It has long seemed to me probable the sands, fine gravels, and silt formed by the passing of ice over the surface of the rocks would have a distinct form from the surface covering produced by other forces. The gravel or shingle of the rivers has a flatter shape than that of the seabeach when derived from the same rock. If such difference can be discovered in the silts, sands, and gravels derived from glacial action, it may be possible to assign limits to the extent to which ice has effected the present covering of the surface from the broken up strata over which it has passed. Silt, sand, and shingle must all, however, be taken into account, and that from the deposits themselves, not from what has been subjected to littoral, fluviatile, or wind action.

Bonnington JAMES MELVIN

Garfish—Wild Fowl

WITH reference to Mr. Archer's note in NATURE last week (p. 226), may I remark that the beak of the garfish of southern waters (*Hemiramphus*, A.) is of rather too fragile a nature to be capable of making a slit of four inches in length in a hard felt hat? May not the fish in question have been more likely a young and small *Xiphias*—or, as is equally probable, a juvenile *Pristis* or sawfish—emulating with the thoughtless exuberance of youth the habits of *Exocetus*?

Any Australian can confirm the correctness of Dr. Rae's observations in the same page of NATURE *re* wild ducks and railways. Looking down upon the reedy waterholes on the south bank of the Yarra, from Princes Bridge in Melbourne, abundance of native waterfowl can any day be seen swimming about in conscious security and much less on the alert than they are in any swamp in the loneliest part of the bush. The constant roar of a great passing traffic, as well as the unceasing turmoil and unearthly noises of a large railway station within stone's throw of their haunts, is now quite unnoticed by these usually most watchful and wary of all birds.

But for the fear of trespassing on your space, I could give many more illustrations of the truth of Dr. Rae's remarks and of the quick and unerring instinct which so soon teaches both furred and feathered animals to dread less the roaring and shrieking ogre that is so swiftly tearing his way into their most secluded haunts in the uttermost parts of the earth than the silent, solitary biped who with gun in hand creeps stealthily upon them.

Edinburgh, July 9 ROBERT S. GOODSIR

Glowworms

WHILE watching, last evening, some glowworms in a mossy stone wall, my attention was attracted to a firefly flying to and fro in the field beyond and approaching the wall where I stood. Arriving within two or three feet of the glowworm I was watching, he made several sharp zigzag flights, drawing nearer the light of the glowworm, and then, making a dash like that of a hawk at an object it has been watching, pitched directly on the glowworm, covering it in the fraction of a second. I had been noting the curious habit of this, which thus appeared to be the female insect, of standing with its abdomen erected in the air and quite motionless, except for a sort of pulsation, but on the contact of the male, the body fell to a normal position, and it was evident that coitus was taking place. I watched them ten minutes until I was completely satisfied that this was the case, when I swept them both into a card box which I send with this for examination by a competent entomologist of the insects, which have not the slightest likeness to each other, the female resembling in general form the glowworm of England, but having an intenser light, and the light-emitting organs, beside the abdominal, which is the most luminous as well as the largest, being two glands (apparently) situated where the joints of wings might be expected if the insect were winged. The light is of an exquisite green, and so brilliant as to pale little at the proximity of a wax taper burning at six inches' distance.

This morning, on opening the box, I found the female apparently dead and collapsed; but the male, on the light returning to them, attempted to renew his embraces.

I remember a discussion at Cambridge (U.S.A.) some years ago, in which Agassiz conjectured that the light of the glowworm served as an amorous guide, but I had only a few weeks before noticed quite a different use for it. In one of the primitive forests of New York State, where twilight is normal from the density of the shade, I was attracted by the loud buzzing of a fly under a recumbent tree trunk. On looking for the cause of it I found a large, luminiferous insect resembling in general construction the common glowworm, but with powerful mandibles, which had built itself a little pit resembling that of an ant-lion, at the bottom of which it was lying, its light distinctly visible. The fly was in the clutch of the mandibles, helpless, though as large as a bluebottle, nor could I easily extricate him. There could be no more mistaking in his case that the light was a decoy than in this of the Pistoiese insect being a sexual invitation.

Cutigliano, Pistoiese Apennines, June 25 W. J. STILLMAN

[The name of the glowworm is *Lamprorhiza splendidula*, a common South European species.—ED.]

Mimicry

I HEARD what I fancy was rather a curious instance of mimicry last Wednesday evening (June 28) about 10 o'clock. I was walking with a friend across a field adjoining a meadow, in which was a landrail (*Rallus Crex*); we both noticed that the animal's cry, or crake as it is called here, was pitched in a higher and somewhat softer key than is usually the case, and my friend remarked that perhaps it was a young bird, but we were considerably surprised to hear him imitate the cry of the lapwing (*Tringa vanellus*). At first this cry was uttered only once alternately with several crakes, but we listened for about ten minutes, at which time, I suppose, he fancied that his note was perfected (which, however, it was not, being much less sharp than the pee-wit of the lapwing), and so he essayed it several times in succession. But he ultimately relapsed into his craking again.

Filston Hall, Shoreham, Kent, July 4 A. HALE

Indian Numeration

IN your review (p. 195) of "Field and Garden Crops of the North-Western Provinces and Oudh" you speak of the peculiar system of numeration used by the author, as in the instance 6,79,06,496, expressing sixty-seven millions, &c. Perhaps I may be allowed to point out that this marking is quite in accordance with the native Indian method of numeration, in which there is no word equivalent to "million." In India the series runs thus:—Thousands, tens of thousands, lakhs, tens of lakhs, krors (or crore). A lakh is a hundred thousand, a kror is ten millions.

It may be doubted whether it is advisable to adopt this system in an English book, for even native readers of it would easily enough follow our own; still it is not uncommon to see lakhs and krors made use of in English official papers.

Of three questions asked by the reviewer, the above remarks give an answer to one; as to the others I may say that a "seer" is two pounds avoirdupois, and a "maund" is forty seers.

Eton College, July 4 FREDERIC DREW

FUNERAL OF MR. SPOTTISWOODE

THE funeral of the late President of the Royal Society on Thursday last was impressive and solemn, and was a fitting end to the life that had passed away.

We take from the *Times* the following account of the general arrangements of the funeral :—

A large number of those who were present assembled in the Jerusalem Chamber, which the Dean had kindly placed at the disposal of the family. Those who by courtesy were styled pall-bearers met here—Dr. Evans, Vice-President and Treasurer of the Royal Society, the Marquis of Salisbury (Chancellor of the University of Oxford), Earl Granville (Chancellor of the University of London), Mr. Childers, Sir W. Siemens, the Duke of Northumberland, Sir Frederick Leighton, P.R.A., the Master of the Stationers' Company, Lord Aberdare, Sir John Lubbock, Mr. E. J. Stone, Sir Bartle Frere, Prof. Flower, Sir W. Armstrong, and, representing departments in the firms with which the name of Spottiswoode is connected, Mr. Shinn, Mr. Millwood, Mr. Carey, Mr. White, Mr. Howe, Mr. Wilson, Mr. Hamilton, and Mr. Straker. Others, who went first to the Jerusalem Chamber, were the Archbishop of York, the Bishop of Lincoln, Mr. Mundella, M.P., Mr. Shaw-Lefevre, M.P., the Dean of Christ Church, the Master of Balliol (Prof. Jowett), the Archdeacon of Maidstone, Sir Frederick Bramwell, Sir Richard Cross, M.P., Mr. Warren De La Rue, Sir Frederick Evans, Sir Joseph Fayrer, Sir James Caird, Lord Claud Hamilton, the Hon. George Brodrick (Warden of Merton), Mr. W. H. Smith, M.P., Mr. W. E. Forster, M.P., Sir Charles Dilke, General Sir H. Rawlinson, Sir James Paget, Mr. Irving, Prof. Huxley, Sir Joseph Hooker, Mr. Lecky, Sir Richard Temple, and Mr. J. Norman Lockyer. Some again, among whom were Lord O'Hagan, Sir Walter Stirling, Sir Henry Barkly, Sir James Cockle, the Dean of Wells, Mr. Philip Magnus, Director of the City and Guilds of London Institute, Mr. Trueman Wood, Secretary, and Mr. Wheatley, Assistant Secretary of the Society of Arts, Mr. Symons, F.R.S., of the Meteorological Society, and Sir John Kennaway, M.P., at once took their places in the choir or south transept, the seats in the north transept being reserved for *employés* of Messrs. Eyre and Spottiswoode and Messrs. Spottiswoode and Co.

Besides those who have already been named, the list of mourners invited to attend in the Jerusalem Chamber included the following gentlemen, of whom nearly all were present :—

Mr. Andrew Cockerell (representing his Royal Highness the Prince of Wales), the Lord Mayor, Mr. Gladstone, the American Minister, Count D'Aunay, Count Munster, the Lord Chancellor, the Earl of Northbrook, the Duke of Argyll, the Duke of Buccleuch, the Earl of Derby, the Earl of Ducie, the Earl of Dufferin, Earl Sydney, Sir Stafford Northcote, M.P., Lord Sherbrooke, Earl Spencer, Sir Frederick Abel, C.B., Capt. Abney, R.E., Prof. Acland, M.D., Prof. J. Adams, LL.D., Prof. W. Adams, M.A., Sir George Airy, K.C.B., Prof. Allman, M.D., Prof. C. Babington, M.A., Mr. John Ball, M.A., Mr. P. W. Barlow, F.G.S., the Earl of Rosse, Lord Chelmsford, Lord Eustace Cecil, Lord Lawrence, Lord Reay, the Marquis of Hartington, M.P., Lord Rayleigh, Lord Colin Campbell, Lord Carlingford, the Earl of Kimberley, Earl Amherst, Lord Houghton, the Bishop of London, the Dean of St. Paul's, the Bishop of Truro, the Dean of Salisbury, Mr. W. J. Farrar, Mr. W. H. Barlow, Mr. J. F. Bateman, F.G.S., Prof. Beale, M.D., Mr. I. L. Bell, F.C.S., Sir J. R. Bennett, M.D., Mr. George Bentham, F.L.S., Mr. Beresford-Hope, M.P., Sir Henry Bessemer, Mr. H. W. Blake, M.A., General Boileau, F.R.A.S., the Rev. T. G. Bonney, M.A., Mr. W. Bowman, LL.D., Mr. T. L. Brunton, M.D., Mr. G. B. Buckton, F.G.S., Sir C. J. Bunbury, Lord Cardwell, F.G.S., Dr. W. B. Carpenter, C.B., Mr. W. Carruthers, V.P.L.S., Prof. Cayley, V.P.R.A.S., Mr. Chamberlain, General Clark, R.A., Prof. R. B. Clifton, M.A., the Earl of Crawford and Balcarres, Prof. W. Crookes, F.C.S., Mr. T. B. Curling, F.R.C.S., Prof. G. H. Darwin, M.A., Prof. W. B. Dawkins, M.A., Prof. H. Debas, Ph.D., Prof. J. Dewar, M.A., Prof. Duncan, M.B., Mr. Edwin Dukin, F.R.A.S., Mr. W. T. Dyer, M.A., Sir W. Elliott, K.C.S.I., Mr. A. J. Ellis, B.A., Mr. Arthur Farre, M.D., Mr. Fawcett, M.P., Mr. James Fergusson, D.C.L., Prof. G. C. Foster, B.A., Dr. M. Foster, Prof. E. Frankland, D.C.L., Capt. Douglas Galton, C.B., Mr. Francis Galton, M.A., Dr. J. H. Gladstone, Mr. J. Glaisher, F.R.A.S., Mr. R. Godwin Austen, F.G.S., the Right Hon. J. G. Goschen, M.P., Lieut.-Col. J. Grant, C.B., the Right Hon. Sir W. H. Gregory, K.C.M.G., Sir W. Grove, Sir W. Gull, Mr. Albert Gunther, M.A., Prof. F. Guthrie, F.G.S., Mr. W. A. Guy, M.B., Sir W. V. Harcourt, M.P., Mr. A. G. Harcourt, V.P.C.S., Sir John Hawkshaw, Mr. Thomas Hawksley, M.I.C.E., Mr. R. B. Haywood, M.A., Mr. P. G. Hewett, F.R.C.S., Mr. James Heywood, F.G.S., Dr. T. A. Hirst, Prof. A. W. Hoffman, Ph.D., Mr. J. Hopkinson, M.A., Dr. W. Huggins, Mr. J. W. Hulke, F.R.C.S., Prof. Humphrey, M.D., Dr. J. H. Jackson, Dr. J. G. Jeffreys, Sir W. Jenner, K.C.B., Dr. J. C. Joule, Sir John and Lady Kennaway, Admiral Sir Astley Cooper Key, K.C.B., Prof. Ray Lankester, M.A., General Sir J. H. Lefroy, C.B., Mr. Joseph Lister, F.R.C.S., Admiral Sir F. L. M'Clintock, Sir H. Sumner Maine, LL.D., Prof. Marshall, V.P.R.C.S., Prof. N. S. Maskelyne, M.A., Mr. C. W. Merrifield, Mr. Alfred Newton, M.A., Prof. Odling, Mr. Daniel Oliver, F.L.S., Prof. Owen, C.B., Dr. John Percy, Mr. W. H. Perkin, C.S., Major-Gen. Pitt-Rivers, Sir Lyon Playfair, M.P., Dr. W. Pole, Mr. W. H. Preece, C.E., Prof. J. Prestwich, M.A., the Rev. Bartholomew Price, the Rev. Charles Pritchard, M.A., Dr. Quain, Sir A. C. Ramsay, LL.D., Prof. Osborne Reynolds, Admiral Sir G. H. Richards, C.B., Mr. G. J. Romanes, M.A., Prof. H. Roscoe, B.A., Mr. Osbert Salvin, M.A., Prof. Sanderson, Mr. P. L. Sclater, M.A., Mr. R. H. Scott, M.A., Mr. John Simon, C.B., Mr. W. W. Smyth, M.A., General W. J. Smythe, Mr. H. C. Sorby, LL.D., Mr. H. T. Stainton, F.L.S., Prof. Balfour Stewart, M.A., Prof. G. G. Stokes, M.A., General R. Strachey, R.E., Prof. J. J. Sylvester, M.A., Dr. Allen Thomson, Sir W. Thomson, LL.D., Mr. J. Todhunter, M.A., Prof. Tyndall, Dr. A. W. Williamson, Mr. W. H. Pollock, Mr. E. Bunbury, the Rev. B. Compton, Mr. Horace Davey, Q.C., M.P., the Head Master of Rugby, the Provost of Eton, the Head Master of Eton, the Hon. Ralph Dutton, the Hon. Robert Butler, Mr. Osborne Morgan, M.P., the Bishop of Exeter, Sir Louis Pelly, Sir Henry Thompson, Sir James Lacaita, Mr. J. Boehm, Mr. A. Milman, Mr. W. Hasseltine, Mr. F. Pollock, Mr. Pascoe Grenfell, Mr. T. Woolner, Mr. Lawrence T. Cave, Mr. T. H. Gordon, the Rev. W. H. Milman, Mr. T. Chepery, Mr. W. F. Burton, Mr. Douglas Freshfield, General Hutt, Dr. W. Grey, Dr. Priestly, Prof. Bryce, M.P., Mr. W. C. Cartwright, Sir Julian Goldsmid, Sir Louis Malet, Sir Rutherford Alcock, Sir Arthur Hobhouse, Sir Charles Mills, M.P., General Sir M. M'Murdo, General Sir Patrick Grant, Sir Charles Trevelyan, Sir James Stephen, Sir Charles Bowen, Lord G. Hamilton, M.P., the Recorder of London, Alderman Sir S. H. Waterlow, M.P., the Wardens of the Stationers' Company, Col. Donnelly, Prof. Ruskin, Cardinal Manning, a deputation from the Chemical Society, Mr. J. G. Dodson, M.P., Dr. Cumberbatch, Dr. Gibbons, Mr. Robert Browning, Mr. E. Chinnery, Mr. J. A. Froude, Sir R. Lingen, Mr. Herbert Spencer, the Dean of Llandaff, Sir Harry Verney, M.P., Lord Wolseley, Mr. Cyril Graham, Mr. Charles Eastlake, Mr. George Frere, F.R.S., Mr. Talfourd Ely, Sir Thomas Pears, Prof. Leone Levi, Prof. Max Müller, Mr. Frederick Verney, Mr. H. C. Hughes, and Major Gordon.

The body was borne from the house in Grosvenor Place to the Abbey on an open funeral car drawn by four horses. In the carriages immediately following the funeral car were Mrs. Spottiswoode, Mr. Hugh Spottiswoode, Mr. G. A. Spottiswoode, Mr. Cyril Spottiswoode, Mr. Rate, Mrs. George Spottiswoode, Miss Spottiswoode, Miss Augusta Spottiswoode, Mr. Arthur Brandreth, Mrs. Brandreth (sister of Mr. Spottiswoode), Mr. and Mrs. G. Noble Taylor, Mr. T. P. Beckwith, Miss Ellen Arbuthnot, Miss Mabel Spottiswoode, Mr. Adrian Spottiswoode, Mr. Norton Longman, Miss Longman, Miss Elizabeth Spottiswoode, Mr. Eyre, Mr. and Mrs. R. M. Bray, Mr. Frederick Arbuthnot, Miss Margaret and Master John Arbuthnot, Mrs. Beckwith, Mr. Sydney Beckwith, Mrs.

Jervoise, and Mr. Rate, jun. The servants came next in two carriages, and after the empty family carriage, the carriage of his Royal Highness the Prince of Wales, and then those of friends of the family.

At the entrance to the cloisters a company of the 2nd London Rifle Volunteer Regiment, formed of *employés* of the Spottiswoode establishments, stood with arms reversed as the procession passed through to the Abbey. At the West Cloister door, choristers, scholars, and clergy, the Rev. Flood Jones, precentor, the Rev. John Troutbeck, Minor Canon, Canon Rowsell, Canon Barry, Archdeacon Farrar, and the Dean, met the body. Immediately behind the chief mourners, and in front of those from the Jerusalem Chamber came, by special invitation of the family, Earl Stanhope, the Earl of Dalhousie, Sir F. W. Pollock, and Mr. J. F. Moulton; then Mr. Andrew Cockerell, representing the Prince of Wales, and among those from the Jerusalem Chamber, Mr. George Busk, Vice-President of the Royal Institution. The coffin, still covered with its lovely floral tributes, was placed under the lantern, while the 90th Psalm was sung to Purcell's Burial Chant, and the lesson was read by Canon Duckworth. As the notes of the anthem died away the body was borne to its last resting-place, near the grave of Archbishop Spottiswood. So great was the congregation of mourners, that not half the number could find standing room in the narrow aisle in which the grave is made. The Dean said the "Committal" and the prayers, and after the singing of Bishop Wordsworth's well-known hymn, "Hark, the sound of holy voices, chanting at the crystal sea," the Dean pronounced the blessing, and the mourners, casting into the grave the wreaths and bunches of flowers which many of them had carried, slowly dispersed. Dr. Bridge played the "Dead March" in "Saul" at the conclusion of the funeral service. The inscription on the plate of the coffin, which for sole decoration bore a Latin cross of brass, was—

WILLIAM SPOTTISWOODE,
Born January 11, 1825,
Died June 27, 1883.

A sermon *in memoriam* was preached in the Abbey by the Dean on Sunday afternoon.

THE ECLIPSE PARTY

LETTERS have been received from the English and American members of the above, giving some details which we think may prove of interest to our readers.

Leaving England on February 17 in the s.s. *Medway* the English observers made a calm passage to Colon. Here they met the American party, consisting of Prof. Holden, Dr. Hastings, Mr. Rockwell, Mr. Preston, Lieut. Brown, and Mr. Upton, to which it will be remembered they were to be attached. The united party then proceeded to Panama, and took ship in the *Bolivia* for Callao, where they arrived on March 20. Early the following morning the instruments and baggage were removed to the U.S.S. *Hartford*, in which the voyage from thence was to be made, and the party left Callao about five o'clock on the evening of March 22, sighting Caroline Island, the spot selected for the observations, on April 20. Although named Caroline Island it is not a single island, but a low-lying chain of coral islets which enclose a central lagoon. The ring of islets is about seven and a half miles in length, and one and a half in breadth. The island like most of its kind is of value on account of its stores of guano, and its cocoanut produce, being leased to Messrs. Houlder Brothers of 146, Leadenhall Street, whose agent at intervals visits this, and other Pacific coral islands leased to the firm. On the arrival of the *Hartford* a boat under the charge of Lieut. Qualtrough put off to make a tour of inspection, returning with the intelligence that there were two large empty frame houses, several smaller ones, and seven inhabitants—four men, one woman, and two children—who had come thither from Tahiti two months previously. A site having been selected by Prof. Holden for the erection of the observatory, the work of disembarkation commenced. This was a matter of great difficulty, the nature of the coast preventing even the small ship's boats approaching within several hundred yards of the shore. The boats had first to run in through a narrow opening in the reef, the boxes had then to be carried through fifty yards or so of water, varying in depth from two to three feet, next over about fifty yards of sharp irregular coral rock that cut the men's shoes to pieces, and finally to be carried up a soft sandy beach for upwards of a quarter of a mile. However, the landing was effected without accident, and the observers took possession of their various quarters.

The English observers report that the house in which they were located was a very comfortable one, containing a kitchen, dining-room, bed-room, bath-room, and store-room, and a large laboratory. Mr. Rockwell, one of the American observers, was fortunate enough to obtain the luxury of a bed. Mr. Upton, another of the party, had to be content with a table, whilst the rest swung their hammocks and cots in the verandah, an arrangement which, while possessing perhaps advantages of its own when the weather was fine, was not altogether the best when the nights were wet. Still the observers were not uncomfortable; and if they did not "fare sumptuously every day," yet, with abundance of fish and cocoanuts, they did not live altogether badly.

The weather, with the exception of one severe rain-storm, was pleasant during the sojourn of the observers, although nearly every day slight showers were brought to the island by flying clouds.

On the evening of the 22nd, just as the *Hartford* was casting off for Tahiti, *L'Éclaireur* came in with the French expedition, consisting of MM. Janssen, Trouvelot, Palisa, and Tacchini on board.

The preparations for the eclipse proceeded briskly, and by April 28 the siderostat, equatorial, and photoheliograph were erected and adjusted in position. The spectroscopes were next taken in hand, and the rating of the clocks proceeded with. This took some time; but matters had so far advanced by May 1 that from that date, with the exception of May 4, when the weather was wet, two rehearsals of the observations were made daily, one at 7, the other at 11.30 a.m. Messrs. Preston and Brown of the U.S. Coast and Geodetic Survey during this period made pendulum observations.

By the evening of May 3 the photographers were nearly ready to take trial plates, and these they hoped to obtain the following day. The hitherto fine weather, however changed, and before noon the next day five inches of rain had fallen, and the photographic dark room which had been erected was destroyed, all the dye being washed out of the ruby curtains and window. This damage being repaired, an attempt was made to obtain trial plates the next day, but the length of time occupied in rehearsing the observations, and the still unsettled state of the weather, prevented this being done. The early morning of the eclipse found the weather in the same unsettled state; about nine o'clock, however, the clouds began to disperse themselves, and by ten o'clock the sky was moderately clear. After the first contact the lenses were dusted, the slits of the spectroscopes cleaned, and the adjustments finally inspected.

With regard to the work of observation itself, this was done in accordance with the programme laid down before the observers left England, although the time-table of exposures was slightly departed from to meet the circumstances of the case, as, for instance, a greater length of totality than was expected, the duration being five minutes twenty-five seconds. During the eclipse the direction and velocity of the wind remained constant,

whilst the meteorological observations of Mr. Upton showed a slight rise in barometric pressure, a rise in humidity, and a fall of temperature, the latter reaching even the nightly values, whilst radiation thermometers showed that the heat received by the earth was almost *nil*.

The observations with the photoheliographs which the English observers took out being taken in hand by Lieut. Qualtrough of the American navy.

Perhaps some details as to the work itself may be of interest.

First with regard to the work of Mr. Woods. A red-end collodion plate was washed and placed by him in one of the prismatic camera slides five minutes before totality. Four minutes later he started the clockwork of the integrating spectroscopic slide. Forty seconds before totality exposures were made in the Rowland grating cameras, and at totality the prismatic camera and slit spectroscope were each opened.

In the spectroscopes which were under the care of Mr. Lawrence the exposures commenced ten minutes before totality, his work continuing until ten minutes after totality.

The photoheliographs as we have said were looked after by Lieut. Qualtrough, the plates which he exposed in these instruments being given to Mr. Woods after the eclipse. During the intervals in the exposures of the plates the observers found time to note the corona. In its general character it seems to have much resembled that seen last year in Egypt, but its light was of a more natural tone, the landscape lacking the weird colouring so marked a feature in the Egyptian eclipse.

Mr. Lawrence examining the corona with the finder was able to detect much delicate detail, especially in those portions of it near the preceding limb of the moon. He also examined it with a small pocket spectroscope with lens. Taking out the prisms during mid totality he could see the green ring, and very faintly towards the end C and D_3. After totality he still saw the 1474 ring, as well as the red and yellow ones; these latter, however, being as before very faint. Replacing the prisms he could see then only the 1474 line, that examined by Prof. Hastings. The F line, for which he had specially searched, was not seen by him at all. Mr. Lawrence agrees in thinking that the coronal light was of a more natural tint than it was in the eclipse last year. Mr. Dixon of the American party made a careful sketch of the corona, showing five well defined streamers. Soon after totality the photoheliograph clock was stopped, and an endeavour made to obtain the run of the sun's crescent on the two cameras for the purpose of orientation, but, owing to the prevalence of clouds, the attempt was only successful with one, the smaller instrument, with which two exposures were obtained on one plate.

So much for the observations themselves. As to the results we learn that the photographs taken with the small photoheliograph are very good, that which had two minutes exposure showing as much as those which M. Janssen exposed during the whole of totality. The large photoheliograph has not given such good results, all the plates taken showing signs of slight shifts. Still it is believed that, by combining the photographs on each of the nine plates, the whole structure of the corona from the limb to its outmost limits will be obtained.

With the first order grating H and K were obtained as bright lines just before, and immediately after, totality, but with the second order grating no result seems to have been obtained; at least the observers could see nothing when they examined the plate on the island. The photographs taken with the dense prism spectroscope, like those obtained with the first order grating, show bright lines at the commencement and end of totality, particularly at the end, the photograph taken then showing H, K, *h*, *f*, and F very distinctly.

The integrating spectroscope also did useful work. Although no result was obtained during totality with this instrument, the flash of bright lines before and again after totality were successfully photographed by it. The more prominent lines in these photographs are those which belong to hydrogen and the lines H, K, and 1474.

The slit spectroscope was also successful, giving a good photograph from the ultra violet to the green. This spectrum, whilst being in the main a continuous one, is not the same on the two sides of the disk, nor are the lines so numerous as those obtained last year in Egypt. H and K are very strong in the present photograph, but in this respect also the spectrum differs from that obtained in Egypt, these lines then extending across the interval, which is not so in the present photograph. The hydrogen line near G, however, extends over nearly a solar diameter; and *h*, F, 1474, *h*, and other lines have also been obtained.

With regard to the gelatine red-end plates of the prismatic camera, although they gave good photographs, yet the almost entire absence of prominences will diminish their value. In the eclipse of last year, when many prominences were visible, these plates were used with good results. The Rowland grating, too, seems to have given no useful result, but this is probably due, like the small measure of success with the prismatic camera, to the comparative absence of prominences.

In developing the red-end plate immediately after totality Mr. Woods was unfortunate enough, owing to his having to manipulate it almost entirely in the dark, to get it torn, and nothing now remains but the gelatine edging.

The work now being complete, the things began to be repacked for the homeward journey. The *Hartford* returned to Caroline on the 8th, the work of reembarkation commenced, and on the 9th the expedition left.

The observers were almost sorry to leave the island, as their sojourn there had been a most pleasant one. Like most of its kind it is well wooded, the graceful outlines of the cocoanut palms being characteristic features in the pretty scenery which the island affords.

By day the smaller hermit crab swarmed the sandy beach, feeding on what decayed animal matter it could find, whilst at night the large red hermit crabs covered the same beach in their hundreds, they preferring dead vegetable matter. The lagoon too, around which the little islets arrange themselves, was a never-failing source of interest and amusement, and in boating there, and in the deeper water off the reef, or in hunting the shore in search of the brilliant-coloured shells and coral with which the island abounds, the observers found much amusement.

In deep water bivalve shells more than two feet across were observed, whilst the reefs at low water were covered with smaller representatives of the same or a similar species, which threw jets of water into the air. Several octopi were caught by the various members of the expedition, and many beautiful sea-urchins picked up by them in their daily walks. Thus did they spend their spare hours, and it was therefore with some regret that they saw the outlines of the island disappear on their horizon. The *Hartford* was bound for Honolulu in the Sandwich Islands. The voyage was however broken at Hilo, Hawaii, in order that the members of the expedition might visit the celebrated volcano of Kilauea. Honolulu was reached on May 30. Here Messrs. Preston and Brown, who were to continue their pendulum observations remained, the rest of the expedition proceeding in the *Zealandia* for San Francisco. The English observers left at Honolulu copies of the photographs they obtained, to be forwarded to England by the next mail. They left San Francisco on June 15, and may therefore be expected to arrive in England about the end of the present month.

THE ARCHÆOLOGY OF SOUTHERN CALIFORNIA [1]

A VALUABLE contribution to American anthropology has recently appeared, published under the auspices of the U.S. Government, forming the seventh volume of the "Reports of the U.S. Geographical Surveys West of the One Hundredth Meridian." It deals mainly with the remains of the Indians of Southern California, their implements, weapons, vessels, and ornaments.

The observers and collectors were those engaged upon the work of the survey, some of them detailed for work of a different character, but fortunately able to render valuable assistance in explorations for archæological finds.

The letterpress embodies the work of F. W. Putnam, the distinguished curator of the Peabody Museum, whose editorial revision and direction has moulded the whole, that of A. A. Abbott, the veteran explorer of the antiquities of New Jersey, H. C. Yarrow, S. S. Haldeman, A. S. Gatschet, H. W. Henshaw, and Lucien Carr, whose report upon the measurements of the crania from California is most suggestive and important. Besides their own contributions to the principal subject, these gentlemen have freely used the short descriptions of the personal visits of the officers of the army and others to the Pueblo villages of New Mexico and Arizona.

The present inhabitants of Central and Southern California are regarded as a degenerate race deteriorated from an ancestral people of superior parts, and they afford to-day a marked contrast with the more advanced and intelligent races of Northern California. This inferiority has been recognised by all observers, and was comprehended by the Jesuit missionaries, whose unfortunate system, however much its zealous propagation recommended their vigour and sincerity, only helped the natural tendency and hastened the course of a degradation already under way.

As early as 1534 the Spanish explorers invaded this region, and met in many instances a warlike and determined resistance. The priest and missal followed the sword and helmet, and completed the destruction of the people by processes more insidious than those of the warrior, but scarcely less fatal. Missions were established, the natives proselytised, not always by moral suasion, and brought under the control of the missions; they existed in a state of appanage, and became listless and degraded.

The natives of the immediate southern border of California show an improvement over those of Central California, approximating to the superior type in Northern California, a contrast which has so impressed the minds of students as to have started the assumption that the Central Californians belong to a different race, and are to be referred to Malay and Chinese origins. It is however with the description of the implements, utensils, ornaments, &c., of the southern Indians as exhumed from burial mounds, and the story told by such mortuary relics of the habits of their ancestors, that this volume is filled.

Attention had been directed by the Smithsonian Institution to the area upon the coast of California opposite the group of Santa Barbara Islands, and to these islands themselves, as a promising field for archæological search. The indications followed rewarded the Survey with many important objects, enough to permit a conception of the life of their makers.

These latter were in the stone age depending upon stone and bone implements as tools of war, chase, and industry. They seem to have been almost entirely without a knowledge of pottery, but this need may have been scarcely felt from their skill in the manufacture of stone vessels formed from steatite masses, and of all sizes, and adapted to the commonest domestic uses.

This series of objects affords a striking example of their patience and ingenuity. They are described under the designation of "Cooking pots and food vessels." They are in the main oblate spheroidal vessels of soapstone thickened over the base and sides exposed to the heat, and thinning towards the rim of the circular opening upon the top. The smaller specimens are frequently much finished in their smoothness, and vary enough in size and shape to suggest that they were the property of individuals, and prepared and kept for the personal use of their owners. These small vessels often show mending where fractured, a row of holes being perforated upon the two opposite sides of a crack, and the edges drawn together by sinews which are sunk in grooves, over which has been plastered asphaltum. Asphaltum figures in various ways, and was constantly resorted to as a convenient cement; it was employed to fasten their stone-bolts and arrow-heads to their shafts, to attach mouth-pieces to their pipes, the line to their fish-hooks, &c., it formed a surface over their objects upon which ornaments could be imbedded in rude decoration, and figures on their shell beads in spiral lines of black.

Besides the *ollas*, various dish-like utensils are figured with one or more holes for suspension after use, or for removal from the fire, being probably used as baking pans. Stone mortars of basalt and sandstone, small colour mixers, dishes of shell (*Haliotis*), and cups formed of fish vertebræ complete the list of serviceable vessels.

The smoking-pipes, which are carefully studied and described by Dr. Abbott, are long, straight, conical, and sub-cylindrical tubes of steatite, displaying no great variety of form and but inconspicuous attempts at ornamentation. The straight tube corresponding to the bowl of the common pipe is in line with the opening at the insertion of the mouthpiece, and it would seem that tubes of bone or reed inserted for stems must have been curved to permit of their use in any normal position.

The chipped flints are of striking beauty, and will be recognised by all who have examined specimens of ornamental spears and daggers from this region. They are shown of natural size upon two plates of considerable beauty, and vary from 4 inches to 8 or 10 inches in length, lenticular in section, and present ripple-like and corrugated surfaces of very delicate sculpture. The chapters upon perforated stones, miscellaneous objects made of stone, and textile fabrics are especially interesting.

The claim of any great age for these relics seems precluded by their association with glass beads, bronze cups and platters, iron swords, nails, knives, and pistol barrels, all pointing unmistakably to contact with the Spaniards. Yet there can be but little doubt that they perfectly represent the arts of life prevailing among the ancestors of their owners and makers for ages before the appearance of the white man, and that many are themselves heirlooms descended from a great antiquity.

The concluding chapter of Part I. is a suggestive summary of the results of cranial measurements, and the writer, Lucien Carr, indicates the past presence of two races whose intermingling remains are now found upon the Santa Barbara Islands, one—the dolichocephals or long heads—presenting a picture of subjugation and decadence; the other—the brachycephals or short heads—spread over the mainland, occupying the northern islands, and pressing upon the precarious remnant of their predecessors on the southern islands.

Part II. is a diversified compilation of a number of personal narratives of visits to the Pueblo villages, some chapters upon the implements and pottery of their occupants, which seem of a degraded type compared with the productions of their probable ancestors, and a short

[1] "Report upon the U.S. Geographical Surveys West of the One Hundredth Meridian in charge of First Lieutenant Geo. M. Wheeler." Vol. vii. "Archæology." (Washington, 1879.)

review of cranial measurements. The material seems insufficient and fragmentary, and affords imperfect means for judging in a satisfactory way of the exact status and organisation of these people. A final contribution to the linguistics of the subject, by A. S. Gatschet, closes the volume, with a compendious statement of the relations of the tribes of the western coast with a list of forty vocabularies of western languages.

Finally, this handsome volume, in typography, paper, and illustrations, is of irreproachable beauty, and it treats of a field in archæological study of deep interest and wide import. L. P. GRATACAP

THE SIZE OF ATOMS[1]

II.

IN making brass, if we mix zinc and copper together we find no very manifest signs of chemical affinity at all; there is not a great deal of heat developed: the mixture does not become warm, *it does not explode*. Hence we can infer certainly that contact-electricity action ceases, or does not go on increasing according to the same law, when the metals are subdivided to something like 1/100,000,000 of a centimetre. Now this is an exceedingly important argument. I have more decided data as to the actual magnitude of atoms or molecules to bring before you presently, but I have nothing more decided in *giving for certain a limit to supposable smallness*. We cannot reduce zinc and copper beyond a certain thickness without putting them into a condition in which they lose their properties as wholes, and in which, if put together, we should *not* find the same attraction as we should calculate upon from the thicker plates. I think it is impossible consistently with the knowledge we have of chemical affinities and of the effect of melting zinc and copper together, to admit that a piece of copper or zinc could be divided to a thinness of much less, if at all less, than 1/100,000,000 of a centimetre without separating the atoms or dividing the molecules, or doing away with the composition which constitutes as a whole the solid metal. In short, the structure as it were of bricks, or molecules, or atoms, of which copper and zinc are built up; cannot be much, if at all, less than 1/100,000,000 of a centimetre in diameter, and may be considerably greater.

I will now read you a statement from an article which was published thirteen years ago in NATURE.[2]

"Now let a second plate of zinc be brought by a similar "process to the other side of the plate of copper; a second "plate of copper to the remote side of this second plate of "zinc, and so on till a pile is formed consisting of 50,001 "plates of zinc and 50,000 plates of copper, separated by "100,000 spaces, each plate and each space 1/100,000 of "a centimetre thick. The whole work done by electric "attraction in the formation of this pile is two centimetre-"grammes.

"The whole mass of metal is eight grammes. Hence "the amount of work is a quarter of a centimetre-gramme "per gramme of metal. Now 4030 centimetre-grammes of "work, according to Joule's dynamical equivalent of heat, "is the amount required to warm a gramme of zinc or "copper by one degree Centigrade. Hence the work done "by the electric attraction could warm the substance by "only 1/16,120 of a degree. But now let the thickness of "each piece of metal and of each intervening space be "1/100,000,000 of a centimetre instead of 1/100,000. "The work would be increased a millionfold unless "1/100,000,000 of a centimetre approaches the small-"ness of a molecule. The heat equivalent would therefore "be enough to raise the temperature of the material by "62°. This is barely, if at all, inadmissible, according to "our present knowledge, or, rather, want of knowledge, "regarding the heat of combination of zinc and copper. "But suppose the metal plates and intervening spaces to "be made yet four times thinner, that is to say, the thick-"ness of each to be 1/400,000,000 of a centimetre. The "work and its heat equivalent will be increased sixteen-"fold. It would therefore be 990 times as much as that "required to warm the mass by 1° C., which is very much "more than can possibly be produced by zinc and copper "in entering into molecular combination. Were there in "reality anything like so much heat of combination as this, "a mixture of zinc and copper powders would, if melted in "any one spot, run together, generating more than heat "enough to melt each throughout; just as a large quantity "of gunpowder if ignited in any one spot burns throughout "without fresh application of heat. Hence plates of zinc "and copper of 1/300,000,000 of a centimetre thick, "placed close together alternately, form a near approxima-"tion to a chemical combination, if indeed such thin plates "could be made without splitting atoms."

Similar conclusions result from that curious and most interesting phenomenon, the soap-bubble. Philosophers old and young who occupy themselves with soap-bubbles, have one of the most interesting subjects of physical science to admire. Blow a soap-bubble and look at it,—you may study all your life perhaps and still learn lessons in physical science from it. You will now see on the screen the image of a soap-film in a ring of metal. The light is reflected from the film filling that ring, and focused on the screen. It will show, as you see, colours analogous to those of Newton's rings. As you see the image it is upside down. The liquid streams down (up in the image) and thins away from the highest point of the film. First we see that brilliant green colour. It will become thinner and thinner there, and will pass through beautiful gradations of colour till you see, as now, a deep red, then much lighter, till it becomes a dusky, yellowish white, then green, and blue, and deep violet, and lastly black, but after you see the black spot it very soon bursts. The film itself seems to begin to lose its tension, when it gets considerably less than a quarter of the wave-length of yellow light, which is the thickness for the dusky white, preceding the final black. When you are washing your hands, you may make and deliberately observe a film like this, in a ring formed by the forefingers and thumbs of two hands, and watch the colours. Whenever you begin to see a black spot or several black spots, the film soon after breaks. The film retains its strength until we come to the black spot, where the thickness is clearly much less than 1/60,000 of a centimetre, which is the thickness of the dusky white.

Newton, in the following passage in his "Optics" (pp. 187 and 191 of edition 1721, Second Book, Part I.), tells more of this important phenomenon of the black spot, than is known to many of the best of modern observers.

"Obs. 17.—If a bubble be blown with water, first made "tenacious by dissolving a little soap in it, it is a common "observation that after a while it will appear tinged with a "variety of colours. To defend these bubbles from being "agitated by the external air (whereby their colours are "irregularly moved one among another so that no accurate "observation can be made of them), as soon as I had "blown any of them I covered it with a clear glass, and by "that means its colours emerged in a very regular order, "like so many concentric rings encompassing the top of "the bubble. And as the bubble grew thinner by the con-"tinual subsiding of the water, these rings dilated slowly "and overspread the whole bubble, descending in order to "the bottom of it, where they vanished successively. In "the meanwhile, after all the colours were emerged at the "top, there grew in the centre of the rings a small round "black spot like that in the first observation, which con-"tinually dilated itself, till it became sometimes more than

[1] A lecture delivered by Sir William Thomson at the Royal Institution, on Friday, February 2. Revised by the Author. Continued from p. 205.

[2] See article "On the Size of Atoms," published in NATURE, vol. i. p. 551; printed in Thomson and Tait's "Natural Philosophy," second edition, 1883, vol. i. part 2, Appendix F.

"one-half or three-quarters of an inch in breadth before the "bubble broke. At first I thought there had been no light "reflected from the water in that place, but observing it "more curiously I saw within it several smaller round "spots, which appeared much blacker and darker than the "rest, whereby I knew that there was some reflection at the "other places which were not so dark as those spots. And "by farther trial I found that I could see the images of "some things (as of a candle or the sun) very faintly re-"flected, not only from the great black spot, but also from "the little darker spots which were within it.

"Obs. 18.—If the water was not very tenacious, the "black spots would break forth in the white without any "sensible intervention of the blue. And sometimes they "would break forth within the precedent yellow, or red, "or perhaps within the blue of the second order, before "the intermediate colours had time to display themselves."

Now I have a reason, an irrefragable reason, for saying that the film cannot keep up its tensile strength to 1/100,000,000 of a centimetre, and that is, that the work which would be required to stretch the film a little more than that, would be enough to drive it into vapour.

The theory of capillary attraction shows, that when a bubble—a soap-bubble for instance—is blown larger and larger, work is done by the stretching of a film which resists extension, as if it were an elastic membrane with a constant contractile force. This contractile force is to be reckoned as a certain number of units of force per unit of breadth. Observation of the ascent of water in capillary tubes, shows that the contractile force of a thin film of water, is about sixteen milligrammes weight per millimetre of breadth. Hence the work done in stretching a water film to any degree of thinness, reckoned in millimetre-milligrammes, is equal to sixteen times the number of square millimetres by which the area is augmented, provided the film is not made so thin that there is any sensible diminution of its contractile force. In an article "On the Thermal Effect of Drawing out a Film of Liquid," published in the *Proceedings* of the Royal Society for April, 1858, I have proved from the second law of thermodynamics that about half as much more energy, in the shape of heat, must be given to the film, to prevent it from sinking in temperature while it is being drawn out. Hence the intrinsic energy of a mass of water in the shape of a film kept at constant temperature, increases by twenty-four milligramme-millimetres for every square millimetre added to its area.

Suppose then a film to be given with a thickness of a millimetre, and suppose its area to be augmented ten thousand and one fold: the work done per square millimetre of the original film, that is to say, per milligramme of the mass, would be 240,000 millimetre-milligrammes. The heat equivalent of this is more than half a degree Centigrade (0·57°) of elevation of temperature of the substance. The thickness to which the film is reduced on this supposition, is very approximately 1/10,000 of a millimetre. The commonest observation on the soap-bubble, shows that there is no sensible diminution of contractile force, by reduction of the thickness to 1/10,000 of a millimetre; inasmuch as the thickness which gives the first maximum brightness, round the black spot seen where the bubble is thinnest, is only about 1/8,000 of a millimetre.

The very moderate amount of work shown in the preceding estimates, is quite consistent with this deduction. But suppose now the film to be farther stretched, until its thickness is reduced to 1/10,000,000 of a millimetre (1/100,000,000 of a centimetre). The work spent in doing this is two thousand times more than that which we have just calculated. The heat equivalent is 280 times the quantity required to raise the temperature of the liquid by one degree Centigrade. This is far more than we can admit as a possible amount of work done in the extension of a liquid film. It is more than half the amount of work, which if spent on the liquid, would convert it into vapour at ordinary atmospheric pressure. The conclusion is unavoidable, that a water-film falls off greatly in its contractile force, before it is reduced to a thickness of 1/10,000,000 of a millimetre. It is scarcely possible, upon any conceivable molecular theory, that there can be any considerable falling off in the contractile force, as long as there are several molecules in the thickness. It is therefore probable that there are not several molecules in a thickness of 1/10,000,000 of a millimetre of water.

Now when we are considering the subdivision of matter, look at those beautiful colours which you see in this little casket, left, I believe, by Prof. Brand to the Royal Institution. It contains polished steel bars, coloured by having been raised to different degrees of heat, as in the process of annealing hard-tempered steel. These colours, produced by heat on other polished metals besides steel, are due to thin films of transparent oxide, and their tints, as those of the soap-bubble and of the thin space of air in "Newton's rings," depend on the thickness of the film, which, in the case of oxidisable metals, forms by combination with the oxygen of the air, under the influence of heat—a true surface-burning.

You are all familiar with the brilliant and beautifully distributed fringes of heat-colours on polished steel grates and fire-irons, escaping that unhappy rule of domestic æsthetics, which too often keeps those articles glittering and cold and useless, instead of letting them show the exquisite play of warm colouring, naturally and inevitably brought out, when they are used in the work which is their reason for existence. The thickness of the film of oxide which gives the first perceptible colour, a very pale orange or buff tint, due to the enfeeblement or extinction of violet light and enfeeblement of blue, and less enfeeblement of the other colours in order, by interference of the reflections from the two surfaces of the film, is about 1/100,000 of a centimetre, being something less than a quarter wave-length of violet light in the oxide.

The exceedingly searching and detective efficacy of electricity comes to our aid here, and by the force as it were spread through such a film, proves to us the existence of the film when it is considerably thinner than that 1/100,000 of a centimetre, when in fact it is so very thin as to produce absolutely no perceptible effect on the reflected light, that is to say, so thin as to be absolutely invisible. If in the apparatus for measuring contact electricity, of which the drawing is before you (NATURE, vol. xxiii. p. 567), two plates of freshly polished copper be placed in the Volta condenser, a very perfect zero of effect is obtained. If, then, one of the plates be taken out, heated slightly by laying it on a piece of hot iron, and then allowed to cool again and replaced in the Volta condenser, it is found that negative electricity becomes condensed on the surface thus treated, and positive electricity on the bright copper surface facing it, when the two are in metallic connection. If the same process be repeated with somewhat higher temperatures, or somewhat longer times of exposure to it, the electrical difference is augmented. These effects are very sensible before any perceptible tint appears on the copper surface as modified by heat. The effect goes on increasing with higher and higher temperatures of the heating influence, until oxide-tints begin to appear, commencing with buff, and going on through a ruddier colour to a dark-blue slate colour, when no farther heating seems to augment the effect. The greatest contact-electricity effect which I thus obtained between a bright freshly polished copper surface and an opposing face of copper, rendered almost black by oxidation, was such as to require for the neutralising potential in my mode of experimenting[1] about one-half of the potential of a Daniell's cell.

[1] First described in a letter to Joule, published in the *Proceedings* of the Literary and Philosophical Society of Manchester of Jan. 21, 1862, where also I first pointed out the demonstration of a limit to the size of molecules from measurements of contact electricity. The mode of measurement is more fully described in the article of NATURE (vol. xxiii. p. 567), referred to above.

Some not hitherto published experiments with polished silver plates, which I made fifteen years ago, showed me very startlingly, an electric influence from a quite infinitesimal whiff of iodine vapour. The effect on the contact-electricity quality of the surface, seems to go on continuously from the first lodgment, to all other tests quite imperceptible, of a few atoms or molecules of the attacking substance (oxygen, or iodine, or sulphur, or chlorine, for example), and to go on increasing until some such thickness as 1/30,000 or 1/40,000 of a centimetre is reached by the film of oxide or iodide, or whatever it may be that is formed.

The subject is one that deserves much more of careful experimental work and measurement than has hitherto been devoted to it. I allude to it at present to point out to you how it is that by this electric action, we are enabled as it were to sound the depth, of the ocean of molecules attracted to the metallic surface, by the vapour or gas entering into combination with it.

When we come to thicknesses of considerably less than a wave-length, we find solid metals becoming transparent. Through the kindness of Prof. Dewar, I am able to show you some exceedingly thin films, of measured thicknesses of platinum, gold, and silver, placed on glass plates. The platinum is of $1\cdot9 \times 10$ thickness, and is quite opaque;

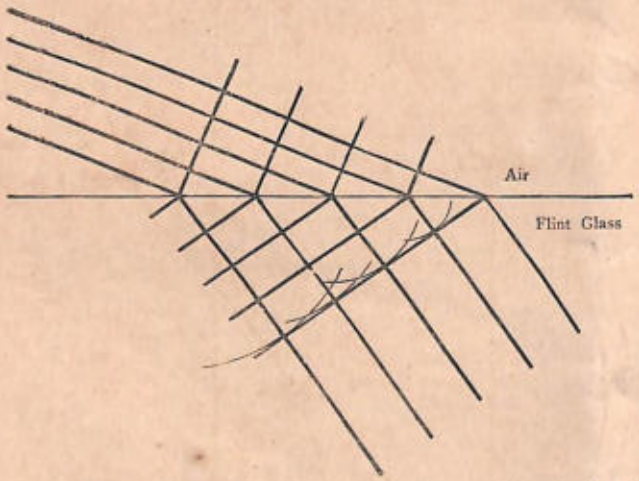


Fig. 3.—Diagram of Huyghen's construction for wave front of refracted light. Drawn for light passing from air to flint glass.

but here is a gold film of about the same thickness, which is transparent to the electric light, as you see, and transmits the beautiful green colour, which you see on the screen. The thickness of this gold (1·9, or nearly 2) is just half the wave-length of violet light in air. This transparent gold, transmitting green light to the screen as you see, at the same time reflects yellow light to the ceiling. Now I will show you the silver. It is thinner, being only $1\cdot5 \times 10^{-5}$ of a centimetre thick, or 3/8 of the air-wave-length of violet light. It is quite opaque to the electric light, so far as our eyes allow us to judge, and reflects all the light up to the ceiling. It is not wonderful that it should be opaque; we might wonder if it were otherwise; but there is an invisible ultra-violet light of a small range of wave-lengths, including a zinc-line of air wave-length $3\cdot4 \times 10^{-5}$, which this silver film transmits. For that particular light the silver film of $1\cdot5 \times 10^{-5}$ thickness is transparent. The image which you now see on the screen, is a magic lantern representation of the self-photographed spectrum, of light that actually came through that silver. You see the zinc-line very clear across it near its middle. Here then we have gold and silver transparent. The silver is opaque for all except that very definite light of wave-lengths from about 3·07 to 3·32.

The different refrangibility of different colours, is a result of observation, of vital importance in the question of the size of atoms. You now see on the screen before you a prismatic spectrum; a well-known phenomenon produced by the differences of the refractions of the different colours, in traversing the prism. The explanation of it in the undulatory theory of light, has taxed the powers of mathematicians to the utmost. Look first, however, to what is easy, and made clear by that diagram (Fig. 3) before you; and you will easily understand that refraction depends on difference of velocity of propagation of light, in the two transparent mediums concerned. The

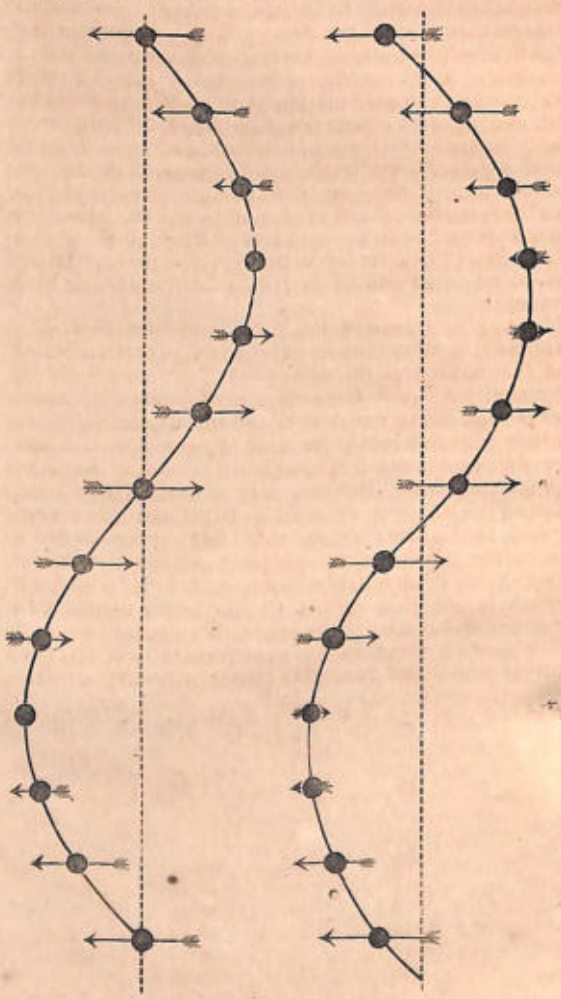


Fig. 4. Fig. 5.
Twelve particles in Wave-Length.

angles in the diagram are approximately correct, for refraction at an interface between air or vacuum and flint glass; and you see that in this case, the velocity of propagation is less in the denser medium. The more refractive medium (not always the denser) of the two, has the less velocity for light transmitted through it. The "refractive index" of any transparent medium, is the ratio of the velocity of propagation in the ether, to the velocity of propagation in the transparent substance.

Now, that the velocity of the propagation of light should be different in different mediums, and should in most cases be smaller in the denser than in the less dense medium, is quite what we should, according to dynamical principles, expect from any conceivable constitution of the

luminiferous ether and of palpable transparent substance. But that the velocity of propagation in any one transparent substance, should be different for light of different colours, that is to say, of different periods of vibration, is not what we should expect; and could not possibly be the fact if the medium is homogeneous, without any limit as to the smallness of the parts of which the qualities are compared. The fact that the velocity of propagation *does* depend on the period, gives what I believe to be irrefragable proof, that the substance of palpable transparent matter, such as water, or glass, or the bisulphuret of carbon of this prism whose spectrum is before you, is not infinitely homogeneous; but that on the contrary, if contiguous portions of any such medium, any medium in fact which can give the prismatic colours, be examined at intervals not incomparably small in comparison with the wave-lengths, utterly heterogeneous quality will be discovered; such heterogeneousness as that which we understand in palpable matter, as the difference between solid and fluid; or between substances differing enormously in density; or such heterogeneousness as differences of velocity and direction of motion, in different positions of a vortex ring in an homogeneous liquid; or such differences of material occupying the space examined, as we find in a great mass of brick building when we pass from brick to brick through mortar (or through *void*, as we too often find in Scotch-built domestic brick chimneys).

Cauchy was I believe the first of mathematicians or naturalists, to allow himself to be driven to the conclusion, that the refractive dispersion of light can only be accounted for, by a finite degree of molecular coarse-grainedness, in the structure of the transparent refracting matter; and as, however we view the question, and however much we may feel compelled to differ, from the details of molecular structure and molecular inter-action assumed by Cauchy, we remain more and more surely fortified in his conclusion, that finite grainedness of transparent palpable matter, is the cause of the difference of the velocity of different colours of light propagated through it, we must regard Cauchy as the discoverer of the dynamical theory of the prismatic colours.

But now we come to the grand difficulty of Cauchy's theory;[1] look at this little table (Table II.), and you will see

TABLE II.—*Velocity (V) according to Number (N) of Particles in Wave Length*

N	$V\left(=100\,\frac{\sin(\pi/N)}{\pi/N}\right)$
2	63·64
4	90·03
8	97·45
12	98·86
16	99·36
20	99·59
∞	100·00

in the heading, the formula which gives the velocity, in terms of the number of particles to the wave-length, supposing the medium to consist of equal particles arranged in cubic order, and each particle to attract its six nearest neighbours, with a force varying directly as the excess of the distance between them, above a certain constant line (the length of which is to be chosen, according to the degree of compressibility possessed by the elastic solid, which we desire to represent by a crowd of mutually interacting molecules). If you suppose particles of real matter arranged in the cubic order, and six steel wire spiral springs or elastic indiarubber bands, to be hooked on to each particle and stretched between it and its six nearest neighbours, the postulated force may be produced in a model with all needful accuracy; and if we could but successfully wish the theatre of the Royal Institution, conveyed to the centre of the earth, and kept there for five minutes, I should have great pleasure in showing you a model of an elastic solid thus constituted, and showing you waves propagated through it, as are waves of light in the luminiferous ether. Gravity is the inconvenient accident of our actual position, which prevents my showing it to you here just now. But instead, you have these two wave-models (see Fig. 2 above), each of which shows you the displacements and motions of a

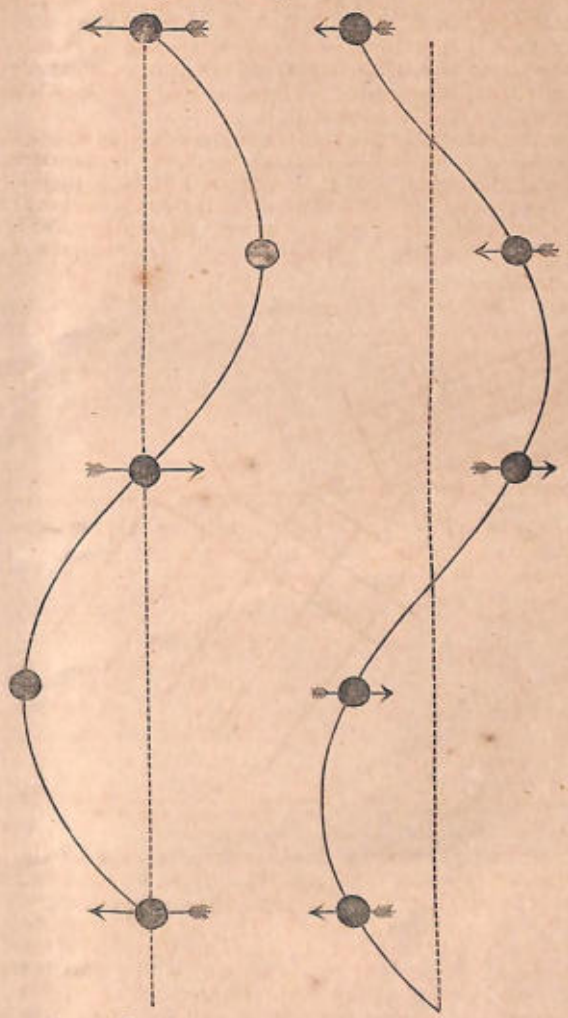


FIG. 6. FIG. 7.
Four particles in Wave-Length.

line of particles, in the propagation of a wave through our imaginary three-dimensional solid; the line of molecules chosen being those which, in equilibrium, are in one direct straight line of the cubic arrangement, and the supposed wave having its wave front perpendicular to this line, and the direction of its vibration, the direction of one of the other two direct lines of the cubic arrangement.

You have also before you this series of diagrams (Figs. 4 to 9) of waves in a molecularly-constituted elastic solid. These two diagrams (Figs. 4 and 5) illustrate a wave in which there are twelve molecules in the wave-length; this one (Fig. 4) showing (by the length and position of the arrows) the magnitude and direction of velocity of each molecule, at the instant when one of the

[1] For an account of the dynamical theory of the "Dispersion of Light," see "View of the Undulatory Theory as Applied to the Dispersion of Light," by the Rev. Baden Powell, M.A., &c. (London: 1841)

molecules is on the crest of the wave, or has reached its maximum displacement; that one (Fig. 5) showing the magnitude and direction of the velocities, after the wave has advanced such a distance, as (in this case equal to one-twenty-fourth of the wave-length) to bring the crest of the wave to midway between two molecules. This pair of diagrams (Figs. 6 and 7) shows the same for waves having four molecules in the wave-length, and this pair (Figs. 8 and 9) for a wave having two molecules in the wave-length.

The more nearly this critical case is approached, that is to say the shorter the wave-length, down to the limit of twice the distance from molecule to molecule, the less becomes the difference between the two configurations of

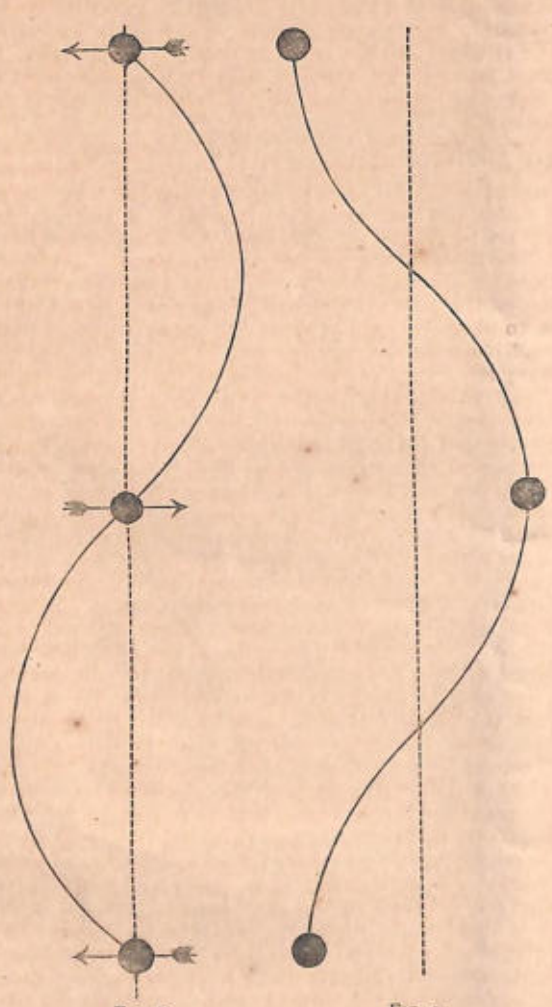


FIG. 8. FIG. 9.

Two particles in Wave-Length.

motion, constituted by waves travelling in opposite directions. In the extreme or critical case, the difference is annulled, and the motion is not a wave-motion, but a case of what is often called "standing vibration." Before I conclude this evening, I hope to explain in detail the kind of motion which we find instead of wave-motion (become mathematically imaginary), when the vibrational period of the exciter is anything less than the critical value; because this case is of extreme importance and interest in physical optics, according to Stokes' hitherto unpublished explanation of phosphorescence.

This supposition of each molecule acting with direct force only on its nearest neighbour, is not exactly the postulate on which Cauchy works. He supposes each molecule to act on all around it, according to some law of rapid decrease as the distance increases; but this must make the influence of coarse-grainedness on the velocity of propagation smaller than it is on the simple assumption, realised in the models and diagrams before you, which therefore represents the extreme limit of the efficacy of Cauchy's unmodified theory to explain dispersion.

Now, by looking at the little table (Table II.) of calculated results, you will see that with as few as 20 molecules in the wave-length, the velocity of propagation is 99½ per cent. of what it would be with an infinite number of molecules; hence the extreme difference of propagational velocity, accountable for by Cauchy's unmodified theory in its idealised extreme of mutual action limited to nearest neighbours, amounts to 1/200. Now look at this table (Table III.) of refractive indices, and you see that the difference of velocity of red light (A), and of violet light (H), amounts in carbon disulphide to 1/17; in dense flint glass to nearly 1/30; in hard crown glass to 1/73; and in water and alcohol to rather more than 1/100. Hence, none of these substances can have so many as 20 molecules in the wave-length, if dispersion is to be accounted for by Cauchy's unmodified theory, and by looking back to the little table of calculated results (Table II.), you will

TABLE III.—*Table of Refractive Indices.*

Line of Spectrum.	Material.				
	Hard Crown Glass.	Extra dense Flint Glass.	Water at 15° C.	Carbon Disulphide at 11° C.	Alcohol at 15° C.
A	1·5118	1·6391	1·3284	1·6142	1·3600
B	1·5136	1·6429	1·3300	1·6207	1·3612
C	1·5146	1·6449	1·3307	1·6240	1·3621
D	1·5171	1·6504	1·3324	1·6333	1·3638
E	1·5203	1·6576	1·3347	1·6465	1·3661
b	1·5210	1·6591	—	—	—
F	1·5231	1·6442	1·3366	1·6584	1·3683
G	1·5283	1·6770	1·3402	1·6836	1·3720
h	1·5310	1·6836	—	—	—
H	1·5328	1·6886	1·3431	1·7090	1·3751

The numbers in the first two columns were determined by Dr. Hopkinson, those in the last three by Messrs. Gladstone and Dale. The index of refraction of air for light near the line E is 1·000294.

see that there could not be more than twelve molecules in the wave-length of violet light in water or alcohol; sixteen in hard crown glass; eight in flint glass; and in carbon disulphide actually not more than four molecules in the wave-length, if we are to depend upon Cauchy's unmodified theory for the explanation of dispersion. So large coarse-grainedness of ordinary transparent bodies, solid or fluid, is quite untenable. Before I conclude I intend to show you, from the kinetic theory of gases, a *superior limit* to the size of molecules, according to which, in glass or in water, there is probably something like 600 molecules to the wave-length; and almost certainly *not fewer* than two, or three, or four hundred. But even without any such definite estimate of a superior limit to the size of molecules, there are many reasons against the admission that it is probable or possible, there can be only four, or five, or six to the wave-length. The very drawing by Nobert of 4,000 lines on a breadth of a millimetre, or at the rate of 40,000 to the centimetre, or about two to the ether wave-length of blue (F) light,[1] seems quite to negative the idea of any such possibility of only five or six molecules to the wave-length, even if we were not to declare against it from theory and observation of the reflection of light from polished surfaces.

(To be continued.)

[1] Loschmidt, "quoting from the Zollvereins department of the London International Exhibition of 1862, page 83, and from Harting 'On the Microscope,' page 881," *Sitzungsberichte der Wiener Akademie Math. Phys.* 1865, vol. lii.

STELLAR PHOTOGRAPHY AT HARVARD

AT the meeting of the Astronomical Society which was held on June 8 last, Prof. Pickering of Harvard College Observatory, so well known for his stellar observations, and who is a Foreign Associate of the Society, attended and gave an interesting account of the work which has been done during the past few years at his observatory.

Some few years ago Prof. Pickering took up the work of determining the intensity of the light of the principal stars by eye observation, without taking the question of colour into consideration, work which has been already dwelt upon in this journal. For this purpose he used a photometer, completing his observations, which number some 90,000, about a year ago, and a large part of his results are already in print. The published results of the more important investigators of star magnitudes, from the time of Almagest and Lúfi, have also been reduced. Sir W. Herschel's observations, which appeared almost a century ago in the *Philosophical Transactions*, have likewise been taken in hand at Harvard Observatory and completely discussed. Sir John Herschel's works, the "Uranometria Nova," the "Durchmusterung," as well as many other works in the same field, have also been made use of in preparing the Harvard Catalogue, which therefore shows those cases in which the photometric observations carried out by Prof. Pickering differ from the results obtained by other observers, when their observations are reduced to the same system. These eye observations of stars having been completed, Prof. Pickering, in conjunction with his brother, Mr. W. H. Pickering, has taken up stellar photography from the same point of view. By this means a comparison is obtained between the brightness of the star as seen by the eye, and its brightness as determined by its greater or less action upon the photographic plate; and by a comparison of photographs taken on different nights any variation in brightness may be detected; whilst the exact positions of stars may of course be more accurately and permanently recorded than by eye observations. Mr. A. A. Common recently, by taking photographs of the nebula in Orion on different nights and comparing them, has thus been able to detect a probable variation in one of the stars in the nebula, and in 1858 Professor George P. Bond, by measuring the diameters of stars in photographs was able to determine the relative brightness of the two stars which form the double ζ Ursæ Majoris.

But the work at Harvard University was to do more than this. The stars which Prof. Bond examined were close together. Prof. Pickering wished to compare stars far removed from each other. For this purpose the ordinary method of stellar photography, by which photographs are taken at the foci of large telescopes, would not suffice. These photographs only comprise a small region of but one or two degrees in diameter. A different method was therefore employed in the Harvard observations. A wholly different form to the ordinary equatorial telescope was used. It is not unusual to construct photographic cameras to take pictures of buildings which subtend an angle of 60° or even 90°. But when applied to the stars, however, the images at the edges are very poor, and only very small apertures can be used. It has, however, been found that some of the best lenses for pictures can be obtained covering a circle of 20° diameter without serious distortion, and at the same time large apertures can be used, thus reducing the time of exposure. In order to still further this work, Mr. W. H. Pickering investigated the sensitiveness of various photographic plates, and obtained some so sensitive that stars of the fifth and sixth magnitude have been photographed without using clockwork, they forming dots or making lines, as their images pass across the photographic plate, the length of these lines depending of course upon the time during which the plate is exposed. If the plate be exposed during ten seconds a distinct dot is obtained, whilst an exposure of thirty seconds causes a short line to be formed. The plates used at Harvard Observatory are six by eight inches. They are divided into six equal parts, each part being in turn exposed. By this means six regions of the heavens, each about 15° square, may be photographed on one plate; and by a variation in the dot and line system employed, sometimes taking the dot and sometimes the line first, three pictures may be taken on a single division of one of the plates without giving rise to any confusion. Instead of simply six, therefore, eighteen photographs are taken on one of these plates, so that on a single plate a portion of the heavens of more than three hours' right ascension, and extending from 30° S. to 60° N., may be included. Since each portion of the plate covers a region of about 15°, the camera mounting has a series of notches or stops, by which it may be instantly moved through that amount either of right ascension or declination.

When photographing the following is the exact method employed. The first exposure takes the region between 30° and 15° south declination, and between one hour and a half and half an hour west of the meridian. First the plate is exposed for ten seconds, and each star records itself by a dot. The plate is then covered for ten seconds; next it is exposed for a period of thirty seconds, and each star makes a line on the plate. By means of the clamping arrangement to which we have referred the plate is then moved through one hour in right ascension. This takes up the remaining few seconds of the minute, so that the taking of the next photograph begins with the first second of another minute. The camera is then on the meridian. The same part of the plate is again exposed, and in order to distinguish this series of stars from those first photographed, this time the plate is exposed first during thirty seconds, and then during ten, so that the result is a line followed by a dot. This gives the second series. But the same portion of the plate may be again used. The remaining ten seconds of the second minute, like those of the first, are spent in moving the camera through another hour of right ascension. Then a fresh exposure is made for thirty seconds, a line simply being obtained without a dot, and this completes the series. The first class of images is in dots and lines, the second in lines and dots, the third is recognised by the presence of lines alone. The thirty seconds which remain of the third minute are employed in exposing a second portion of the plate, and changing the position of the camera, which now takes in the region from 15° S. to the equator. The same process is then gone through again, three exposures as before being made in three different positions of right ascension. By continuing this process, taking three photographs on each of the six portions into which the plate is divided, the whole region included between the declinations of $-30°$ and $+60°$, and between three hours of right ascension, 1½ hours on each side of the meridian, being one eighth of the whole heavens, excluding the circumpolar stars, will be photographed on one plate, the whole operation occupying but eighteen minutes. With regard to those stars in the vicinity of the Pole, some other method will have to be adopted. Thus much for one branch of the work—and an important branch—carried on at Harvard Observatory.

Another portion of their work consists in the preparation of a photographic map of the entire heavens. The method just described, in which clockwork is dispensed with, only enables those stars whose magnitude is not less than five or six to be photographed, and stars of a less magnitude than this must of course be included in a map of the heavens. The camera in this work, therefore, is driven by clockwork. By this means stars of the eighth magnitude record their images on the photographic plate, and as many as 200 are visible in the paper print within a

circle of 5° in diameter. A photograph taken in this way of a portion of the constellation of Orion, besides showing the three stars of the Belt and the Sword-Handle, gives an interesting picture of the nebula.

With reference to the question of the colours of stars it is interesting to note the faintness of α Orionis in the photographs. To the eye its brilliancy is almost as great as that of β, whilst in the photograph it is not more prominent than λ. The reason is to be found in the colour of α. It is a red star, and consequently makes but little impression on the photographic plate.

Again, in the constellation Cetus the three stars which are brightest to the eye are α, γ, and δ. A, which is the brightest of the three, has close to it a very faint companion, scarcely visible to the naked eye, its magnitude being given as 6·3, whilst that of α is 2·7. This is the appearance of this part of that constellation as seen by the eye. A photograph of this region was taken at Harvard with the result that the small star is seen in the photograph nearly as bright as α, it being only three-tenths of a magnitude less. The colour of these stars again explains this, α being of a reddish tint, whilst the small star is of a deep blue colour, and being so the rays which flow from it have a greater influence on the photographic plate. A comparison of the number of stars seen in the photograph of Orion with the number in the photometric catalogue, further illustrates this effect of colour. In that part of this constellation included between 5° north and 5° south declination, and 75° to 90° of right ascension, sixteen stars were common to photograph and catalogue; a like number, being either too small in magnitude or too red in colour, although catalogued, remain unrecorded on the photographic plate; whilst five others seen in the photograph are not given in the catalogue. A reduction has been made of the results given by the plates of different makers, with the view of ascertaining the value of the deviation. In two of such plates the average deviation was 0·21 of a magnitude, and in two measurements of the same plate it was found to be 0·07 of a magnitude.

It is obvious from this account of the work at Harvard that star photography is entering into a new phase, and one which will entirely replace the present system of eye observations, for the reason that, whilst the eye is so variable, photographic plates may now be obtained, doing their work with almost definite wave-lengths of light. The constant record of the plate, must in time therefore be preferred to observation by the variable eye. At the same time as photography advances, if it be considered necessary to obtain photographic star maps to record the observations of the average eye, there will be no difficulty in this being done.

NOTES

In accordance with the provisions of the Statutes, the Council of the Royal Society met last Thursday to elect one from among themselves to fill the office of president until the annual election on November 30. The choice, as had been anticipated, fell upon Prof. Huxley. We believe that this *ad interim* election has given the greatest satisfaction to all the Fellows of the Society.

We have received from the Johns Hopkins University, Baltimore, the circular giving the programme for the next academic year and a report on the work of the year that is past. Not only are a great number of subjects included in the programme of this University, but provision is made that the work in each section shall be thoroughly done, and we think the Trustees are to be entirely congratulated upon the progress that is being made. Among the scientific subjects we find physics, chemistry, geology, mineralogy, and biology in all its branches. With the other subjects which the programme sets forth we have here of course little to do, but we must add that we are glad to note under the heading "Philosophy" that the study of psychology is well provided for. Not only are there courses of lectures, but a limited number of the students are provided with seats in the physiological laboratory, where they may prosecute original research. It is so in all the scientific subjects. The work of the advanced student is arranged with a view of initiating him into the methods of original investigation, which, when he has finished his course of instruction, he is encouraged to carry on. Thus in the physical laboratory, which is under the direction of Prof. Rowland and Dr. Hastings, during the past year original investigations have been carried on in many parts of the subject; for instance, to name one or two, the concave grating has been used in an attempt to photograph the spectrum, and with it an endeavour has also been made to ascertain the wave-lengths of the lines. The unit of electrical resistance has also been investigated during the past year, and during the coming session an attempt will be made to establish an international unit for such resistance. We notice too, as a feature of the advanced course in physics conducted by Prof. Rowland, that besides the lectures and laboratory work there are weekly meetings for the discussion of the current literature of the subject. The courses in chemistry, which are under the sole control of Prof. Remsen, are likewise excellent. Besides the ordinary courses in general and analytical chemistry, the programme states that arrangements will soon be made by which the study of applied chemistry—for example, metallurgy, the chemistry of iron and steel, of dye stuffs, of soils and fertilisers—may be taken up by the students. Original research has been a prominent feature in this laboratory also, the results appearing in the *American Chemical Journal*. With regard to mineralogy and geology we notice that they are included in the courses on chemistry. The courses on biology are most excellent, general biology, embryology, osteology, and plant analysis being included in the first year's work. In the second year the student takes up mammalian anatomy, animal physiology and histology, and animal morphology. Then when the student desires to take up the study of marine animals, the University provides him with a laboratory by the sea itself. This laboratory was open last year from May 1 until September 29, and during that time the development of Thallassema was investigated, studies were made with regard to the origin of the oyster-shell, the parthenogenesis of the Echini, the development of Tubularia, and other subjects, which want of space alone prevents our mentioning. The results of these investigations are published in "Studies from the Biological Laboratory"; abstracts of two of these researches have also been printed in the *Proceedings of the Royal Society*, and Dr. E. B. Wilson's paper on the Development of Renilla will appear in the *Philosophical Transactions*. We might add much more to what we have said concerning the excellent character of the work done at this University, as we do not doubt that the other courses are as well provided for as the more purely scientific subjects to which alone we have referred. The Johns Hopkins University, in fact, although but a new institution, has been founded on a broad basis, giving to the student those opportunities for original work which it is so difficult to obtain elsewhere. We should much like to see such an account of original research done and to be done issuing each year from the laboratories of Oxford and Cambridge.

The Berlin Academy of Sciences has elected Prof. Simon Newcomb (Washington) and Prof. B. Apthorp Gould (director of Cordova Observatory) as corresponding members.

In our review of the life of Sir Edward Sabine, which appeared in our issue of last week (p. 219), we stated that he accompanied the expedition which under the command of Capt. James Ross was sent to make a magnetical survey of the Antarctic regions. This was an error, as although all the observations

were investigated and discussed by him he was not with the expedition, but had the observations forwarded to him at regular intervals.

THE whale which was found by a fisherman in Selsea Bay some six weeks since, and presented to the Brighton Aquarium, is a valuable addition to that establishment. Although undoubtedly belonging to the whale family, competent authorities have pronounced it to be a bottle-nosed dolphin, a creature rarely to be seen alive in an aquarium. It has been placed in a tank which holds 100,000 gallons of water, and is 110 feet in length, so that the animal, which is ten feet long, has some amount of freedom. It seems to be doing quite well, for not only has it not lost in bulk since its capture, but has even gained, weighing now more than eight hundredweight. It is very tame, taking its food from the attendant. At present it subsists upon mackerel, that being the food most easily obtained just now. Of these it takes five meals each day, and manages to eat some 400 of them during a week. The mackerel season is, however, almost over, and some other diet must be found for the animal, perhaps herrings. When first placed in the tank it retreated to one end. After a week's sojourn there, it sought the other end of the tank. Here it remains, swimming in circles. When swimming it keeps close to the surface of the water, moving through it with a graceful undulating movement, coming now and again to the surface, and taking in a fresh supply of air about every third or fourth time it thus rises. The animal is certainly an interesting acquisition to the Aquarium.

THE balloon of the Paris Observatory has been in working order for some weeks. Its capacity being only sixty cubic metres, it was found difficult to use it except in calm weather. The motions of the registering apparatus are an obstacle to correct readings. The experiments, conducted by Admiral Mouchez, are stated to be only preliminary to further aërostatical experiments. The subject is quite new, scientific ballooning being only in its infancy, and it is only by gradual investigation that the extent of the services it can render to science can be ascertained.

A CORRESPONDENT of the *North China Herald* describes a journey from Hankow on the Yangtsze to Chunching in Szechuen, a distance of 720 geographical miles. After passing Ichang, the highest port on the great river opened to foreign trade, the first of the celebrated gorges is entered, and the mountainous country which extends up to and beyond Chunching begins. Through these ranges, which mostly run in a north and south direction, the Yangtsze, here called the Ch'uan Ho, or river of Szechuen, forces its way. Leaving the wild, little-inhabited country of the gorges behind, the traveller, on reaching Wan-hsien, 160 geographical miles above Ichang, emerges into a country of picturesque sandstone hills, at this season covered from base to summit with poppy gardens, with not a vacant spot except where perpendicular cliffs prevent all access. He emerges, too, among a people remarkable for their polished manners and especial politeness to Europeans. While Hupeh province was suffering from floods, the traveller found Eastern Szechuen, from Kweichow to Wan-hsien, praying for rain. The drought here had extended over six months, the south gates of the cities were closed (as facing the *yang* or fire-element), and all slaughtering of animals was forbidden. From Wan-hsien to Chunching, a distance of 200 miles, the aspect of the river remained the same—a succession of winding reaches, nearly all, owing to the peculiar sandstone formation, running at right angles to each other, and united by the customary rapid. Cliffs were frequent, and the sites of the towns and cities, built on steep projecting knolls, their walls and battlements crowning the precipices, are admirable. At length, two months from Shanghai, the traveller reached Chunching, the commercial metropolis of Szechuen, in which, by the Chefoo Convention, the English Government is authorised to maintain a Resident, who watches the commercial prospects and movements of the great provinces of Szechuen and Yunnan.

THE Paris *Figaro* recently published a special supplement on Tonkin, and if the writer is to be credited, that country is one of the richest in the world. Its gold mines, he says, can rival those of California and Australia. The natives use that metal for exchange; the females of the Muongs of the Black River, on their way to and from market, gamble with thousands of francs worth of it, without caring whether they win or lose. The mines of Talan, near Yuen-kiang, on the Red River, were visited by the Commission of the Meikong, who found gold there in bars as well as dust. Still higher, near the source of the Red River, the precious metal is obtained in large quantities. Silver also is not rare, and copper is found everywhere, all the domestic utensils of the people being made of this metal. The tin mines are not worked for want of capital, although those worked near Mong-tsze, in Yunnan, near the Red River, are the most valuable known to exist. Zinc, lead, iron, and bismuth are also known. The coal mines, however, are the most important of all. Tonkin produces also musk, tortoise-shell, mother-of-pearl, wax, silk, peacocks' feathers, as well as those of the blue pheasant, and other birds of brilliant plumage. "In short," concludes the *Figaro*, "it is a rich country, and worth the trouble of occupying it."

ANOTHER trial has been made in Paris of the electric tramcar in which Faure-Sellon-Volckmar accumulators were employed. The experiment was preceded by a lecture given by M. Philippart, tending to show the great economic superiority of electricity over the employment of horses. On this occasion the route chosen was not, as formerly, from the Place des Nations to La Muette and Trocadéro, but from Trocadéro to the Louvre and thence to the Place des Nations by the Bastille, an alteration made to show the capacity of the electric tramcar for ascending slopes on the common roads.

DR. OBACH has lately perfected his tangent galvanometer with a swinging coil. In the present form the coil is compound, being in reality one for measuring quantity and another for measuring electromotive force. The coil is movable on a horizontal axis, and therefore can be inclined at any angle. It has the advantage over a tangent galvanometer in having a suspended needle which can be rendered dead beat; the coils are also balanced so that the deflection corresponding to one volt with the high resistance coil is that which corresponds with one ampere with the low resistance coil. This instrument promises well for practical testing if made in a convenient portable form.

THE last number of the *Zeitschrift der Gesellschaft für Erdkunde* of Berlin contains a paper by Dr. F. Boas on the former distribution of the Eskimo in the Arctic-American archipelago. After referring to the discovery by Arctic travellers, in places where no human foot appears now to tread, of traces of habitations, graves, weapons, &c., he says that two theories have been broached to account for these remains. One is that the ice has encroached more and more on the sea, and driven away the people; the other that there has been a migration from the west across the archipelago. Dr. Boas rejects both of these explanations. He points out that, judging by the remains, the former inhabitants led precisely the same life as the Eskimo that we know to-day. He comes to the conclusion, after an examination of the various islands, of the distribution of traces of previous inhabitants and of the present tribes, that for numerous reasons we must abandon the theory that there was an earlier extension of inhabitants towards the north. He thinks that the remains found are those of the present tribes who have been driven from place to place by the necessity of obtaining subsistence, and refers to the

custom of several tribes to abandon huts in which death has taken place and to leave them standing. The hunting-grounds too would change from time to time according to the severity of the winter. A hard and fast boundary line cannot be laid down for inhabitants of the Arctic regions any more than for the flora. In favourable years plants are carried north and grow until a succession of severe winters again destroys them, and their remains might also lead, in the same way, to the incorrect conclusion that there had been a change in the climate of the region. Similarly with human settlements. The presence of traces of these latter in a given place show, not that the climate has become more severe, but that the place lies in that debatable land between districts favourable and unfavourable to the existence of man. Before any really satisfactory conclusion can be reached, however, he thinks we must have a thorough examination of the migration of the Eskimo; before it is possible to account for the presence of traces of the people in the far north on coasts where they do not now live, we must recollect how their wanderings depend on the physical conditions of life, on the nature of the ground, of the hunting, and the influence of the neighbouring tribes. But on all these points we lack material for a complete explanation of the facts. With respect to the comparatively great age claimed for some of these remains which have been brought by Arctic travellers to Europe, Dr. Boas suggests that all estimates as to the age of objects such as these coming from the Arctic regions must be taken with great care, owing to the different effects of the climate. He instances the remains of Parry's camp at Point Nias in Hecla Bay, which were found looking quite fresh in 1854, more than thirty years after Parry's expedition; while the cairn erected at the same time (1820) on Cape Providence was covered with lichen and moss, and looked quite ancient in 1854.

WE have received the Administration Report of the Meteorological Reporter to the Government of the North-West Provinces and Oudh for the years 1882-83. At the beginning of the present year the observatories reporting to the Allahabad Office were twenty in number, and great activity seems to have been displayed in all of them. The question of the construction of a first class observatory for these provinces has advanced during the present year, but only very slightly. It will in all probability be built at Allahabad. In addition to the ordinary observations, special observations of soil temperatures have been carried on at Allahabad and Jeypore. At Jeypore, where the observatory has practically become one of the first class, all records being made automatically, a sixth soil thermometer has been added to the five which the observatory already possesses to record the temperature at a depth of twenty feet. It is evident from the report that Mr. S. A. Hill, the meteorological reporter, is doing his level best with the means at his command. Unfortunately, however, the native observers still make mistakes, and some of the monthly means require a considerable amount of overhauling.

DR. HENRY MACAULAY, M.D., of Belfast, has recently made a suggestion which, if followed in tropical countries, will turn the tables on the sun with a vengeance. He suggests that Mouchot's sun-engine should be used to pump cold air into dwellings, factories, &c., pointing out that the temperature can in this way be reduced from 100° or more to 60°. He points out that not only will this reduce the temperature especially at night, thus rendering sleep possible, but fresh air will be guaranteed during the day, and the plague of flies and insects would be excluded. The weak point about this arrangement is that it requires ice. We think, however, that sooner or later in America, where the heat in summer is more distressing than in any other part of the world, and ice is everywhere, this arrangement, or one like it, is certain to be adopted.

THE last number of the *Proceedings of the Royal Society of Tasmania* contains several papers on the botany and zoology of Tasmania. In a presidential address the Governor, Sir J. Lefroy, remarks on the omission of any reference to the Botanic Gardens of Hobart Town by Prof. Thiselton Dyer, in a review of the botanical enterprise of the Empire, and demands more public support for these gardens. He notices also a fact which will be of some interest in England just now, viz. that of over ten thousand visitors to the Museum in six months more than half were Sunday visitors. Among the chief papers are:—Notes on a species of Eucalyptus (*E. hæmastoma*), by Mr. Stephens; type species of Tasmanian shells, by Prof. Tate; the magnetic variation of Hobart, by Sir J. Lefroy; notes on *Leontopodium catipes*, by Baron von Müller, &c. With respect to the Sunday opening of the Museum, the Council of the Society report that it is open only between the hours of half-past two and five, "and this arrangement, as will be seen by the number availing themselves of the opportunity, may be pronounced to be no longer an experiment, and to be fully justified by the quiet and orderly demeanour of the visitors."

THE voyage round the world of the Swedish frigate *Vanadis*, which we recently announced, will be shared by the Duke of Gotland, King Oscar's youngest son. The journey, which will be of about eighteen months' duration, will chiefly be a scientific one, several eminent Swedish *savants* participating in the same. From the Straits of Magellan the ship will proceed to the Sandwich Islands, Japan, China, India, and thence home.

THE steamers *Obe* and *Nordenskjöld* left Tromsö for Novaya Zemlya on the 3rd inst. Norwegian fishermen report that the state of the ice in the Arctic Sea east of the North Cape is very favourable this spring.

M. PASTEUR has been appointed head of the Sanitary Commission formed in Paris in view of the dreaded visitation of cholera.

A FRENCH scientific periodical puts forward the idea of a joint occupation of Mecca by the several European powers for the purpose of stopping pilgrimages thither and thereby preventing the further dissemination of cholera through the crowding of people in so pestilential a city, especially when the Ramadan falls in summer.

WE are asked to say that possessors of the eighth edition of Prof. Babington's "Manual of British Botany" may, by application to Mr. Van Voorst, 1, Paternoster Row, obtain gratis two pages of additions and corrections which have been prepared by the author.

LOCUSTS are reported from the south of Russia, but the very energetic measures taken by the Governors for the destruction of the eggs and larvæ will, it is believed, arrest their ravages.

THE additions to the Zoological Society's Gardens during the past week include a Tennant's Squirrel (*Sciurus tennanti*) from Ceylon, presented by Mr. A. Ross; two Rufous Tinamous (*Rhynchotus rufescens*), three Spotted Tinamous (*Nothura maculosa*) from the Argentine Republic, presented by Mr. E. M. Longworthy; two Common Buzzards (*Buteo vulgaris*), British, presented by Mr. James S. Cookson; a Land Rail (*Crex pratensis*), British, presented by Mr. J. W. Merison; a Jackdaw (*Corvus monedula*), British, presented by Mr. J. Baldwin; two Cockateels (*Calopsitta nova-hollandiæ*) from Australia, presented by Mrs. Day; three Angulated Tortoises (*Testudo angulata*), a Geometric Tortoise (*Testudo geometrica*), an Areolated Tortoise (*Testudo areolatus*), a Robben Island Snake (*Coronella phocarum*), a Laland's Ground Snake (*Typhlops lalandii*) from South Africa, presented by the Rev. G. H. R. Fisk, C.M.Z.S.; a Margined

Land Tortoise (*Testudo marginata*), South European, presented by Lord Arthur Russell, M.P.; an Indian Badger (*Arctonyx collaris*) from Assam, a Rough-billed Pelican (*Pelecanus trachy rhynchus*) from Mexico, purchased; two Red-crested Whistling Ducks (*Fuligula rufina*), a Variegated Sheldrake (*Tadorna variegata*), five Summer Ducks (*Aix sponsa*), five Chilian Pintails (*Dafila spinicauda*), bred in the Gardens.

OUR ASTRONOMICAL COLUMN

THE CONSTANT OF ABERRATION.—M. Otto Struve presented to the Imperial Academy of Sciences of St. Petersburg, in February last, a memoir by M. Nyren, of the Observatory at Pulkowa, on the aberration of the fixed stars. He states it is the result of researches made by M. Nyren during many years, with the view to determine the value of the constant of aberration, with the highest degree of accuracy which the most perfect means of observation allow. The value 20″·445, deduced by W. Struve, has been so far generally accepted by astronomers as the most exact, and has been employed in all astronomical calculations. This is the value given in his memoir upon the subject, but in 1852, by a new combination of his measures, the constant was altered to 20″·463, and with respect to this value he remarked: "Elle me paraît le vrai résultat pour l'aberration, qui doit être tiré de mes observations du premier vertical." (Preface to "Recueil de Mémoires présentés à l'Académie des Sciences par les Astronomes de Poulkova," t. i.) Notwithstanding this statement, Struve's first value was retained in our ephemerides, &c.; we have a suspicion that his correction, as he appears to have considered it, was very generally overlooked. M. Nyren was charged with the execution of a new series of observations at Pulkowa, with the same instrument employed by the elder Struve, and every endeavour was made to free the new series from all objection that it was possible to bring against the earlier one. Further, M. Nyren discussed a long series of excellent observations made by M. Wagner with the great meridian telescope in the years 1861–72, on the three stars, Polaris, δ Ursæ Minoris, and 51 (Hev.) Cephei. M. O. Struve remarks that with these two new determinations we now possess seven separate series of observations executed with the three great instruments of the Observatory of Pulkowa, and he gives the values of the constant of aberration resulting therefrom as follow:—

W. Struve, prime-vertical instrument ...	20″·463 ± 0″·017
Schweizer, meridian telescope	20″·498 ± 0″·012
Peters, vertical circle	20″·507 ± 0″·021
Cyldén, ,, ...	20″·469 ± 0″·026
Wagner, meridian telescope	20″·483 ± 0″·012
Nyren, vertical circle	20″·495 ± 0″·021
Nyren, prime-vertical instrument	20″·517 ± 0″·014

M. O. Struve considers that these values sufficiently prove that the constant of aberration is now known with a degree of accuracy which it will be difficult to surpass; it appears certain that the mean of the seven determinations deduced by M. Nyren, 20″·492, will not be liable to an error of a hundredth of a second.

If this mean value for the constant of aberration is combined with the velocity of light determined by M. Cornu and Mr. Michelson, the solar parallax is found to be 8″·784, which, M. Struve adds, only differs by a very few hundredths of a second from the most reliable determinations lately obtained by the geometrical process.

With regard to W. Struve's alteration of the constant of aberration assigned in his memoir, it may be remarked that his result depended upon observations made with the prime-vertical instrument upon seven stars, and the separate values accorded well. But, as he subsequently pointed out, this agreement of different determinations, obtained with the same instrument, only guaranteed the accuracy of the final result under the condition that there existed no common source of error. He examined all possible sources of constant error, and convinced himself that none existed which could exercise an appreciable influence. Nevertheless he said it must be admitted that there existed an agent which possibly might prejudice the exactness of his determination. Considering that the observations of the maximum of aberration fall at a time of year when the star passes the meridian near 6 p.m., while the observations of the minimum of the aberration take place at 6 a.m., it is seen that the first are made during a decreasing temperature and the last during an increasing one. "The zenith-distance of the star being determined from the time between the two corresponding transits indicated by the clock, it follows, if the clock has a defect of compensation and if its effective rate during the interval differs from the mean daily rate obtained by observations of consecutive days, that the error produced acts in the same sense upon the results obtained by different stars." It is the same if between the two corresponding passages the azimuth of the axis of rotation changes. Fortunately these two perturbing causes only exercise a minute influence upon the zenith distances to be determined. Yet, as Struve asks: "Comment prouver que cette influence n'ait point altéré la valeur trouvée de l'aberration de quelques centièmes de seconde?" He considered he had direct proof that there was no azimuthal change, but with regard to change of clock rate, as already stated, he was induced to rediscuss his series of observations with the result above given.

ON THE FUNCTION OF THE SOUND-POST, AND ON THE PROPORTIONAL THICKNESS OF THE STRINGS OF THE VIOLIN[1]

SIR JOHN HERSCHEL says: "It (the bridge) sets the wood of the upper face in a state of regular vibration, and this is communicated to the back through a peg set up in the middle of the fiddle and through its sides, called the 'soul' of the fiddle, or its sounding-post."[2]

Savart says: "L'âme a pour usage de transmettre au fond les vibrations de la table . . . son diamètre est déterminé par la qualité du son qu'on veut avoir; il est maigre quand elle est trop mince, et sourd quand elle est trop grosse."[3]

Daguin, in his "Traité de Physique," devotes a whole page to the discussion of the functions of the sound-post. The most important sentences are the following:—". . . l'âme n'agit pas comme conducteur du son. . . Il nous semble que l'on doit expliquer l'effet de l'âme de la manière qui suit. L'âme, ou les pressions extérieures par lesquelles on la remplace, a pour effet de donner au pied du chevalet un point d'appui autour duquel il vibre en battant sur la table de son autre pied. Si l'un des pieds n'était appuyé sur un point fixe, il se releverait pendant que l'autre s'abaisserait, parceque les cordes n'agissent pas normalement à la table, puisque l'archet les ébranle très obliquement, ce qui entraîne le chevalet dans un mouvement transversal quand il n'a pas de point d'appui fixe. Lorsque l'archet est dirigé normalement aux tables, cet inconvénient n'existe plus, et l'âme n'est plus nécessaire."[4]

Helmholtz says: "The vibrating strings of the violin, in the first place, agitate the bridge over which they are stretched. This stands on two feet over the most mobile part of the belly between the two '*f*' holes. One foot of the bridge rests upon a comparatively firm support, namely, the sound-post, which is a solid rod inserted between the two plates, back and belly, of the instrument. It is only the other leg which agitates the elastic wooden plates, and through them the included mass of air."[5]

The experiments[6] which follow have been made for the purpose of ascertaining whether it be any part of the function of the sound-post to convey vibrations to the back, or whether this post acts solely as a prop supporting the belly, so that its elasticity is not injured by the pressure from the strings, and also, as Daguin states, affords the firm basis which he considers necessary for one foot of the bridge.

Mr. Hill and other practical men maintain that the quality of the wood of which the sound-post is made affects the tone of the violin, as undoubtedly do very minute differences of position. If the quality of the wood is important, we must admit that vibrations are conveyed by the post.

Whether or not the sound-post exercises the function of transmitting vibrations, it is obvious (1) that it performs the important duty of contributing to the support of the belly; (2) that the nodal arrangement of the belly and also that of the back are

[1] Paper read at the Royal Society, May 24, by William Huggins, D.C.L., LL.D., F.R.S.

[2] "Encyclopædia Metropolitana," Article "Sound," p. 804.

[3] "Mémoire sur la Construction des Instruments à Cordes et à Archet," 8vo, Paris, 1819. Also Biot's "Report." *Ann. de Chimie*, tome 12, pp. 225-255.

[4] "Traité de Physique, Acoustique," tome 1, p. 575.

[5] "Sensations of Tone," translated by Ellis, p. 137. In the 4th German edition this passage remains unaltered.

[6] I wish to express my indebtedness to Mr. A. J. Ellis for some suggestions in connection with these experiments.

influenced by the pressure of the ends of the post against the upper and lower plates; (3) that Helmholtz is right, at least so far that the leg of the bridge under the fourth or G string has much more power than the other in setting the belly into vibration.

The usual way of investigating vibrations by the scattering of sand over the surface of the agitated body is difficult of application to the violin, on account of the curved form of the upper and lower plates. I found a convenient method to be by the use of what I may call a touch-rod. It consists of a small round stick of straight-grained deal a few inches long; the forefinger is placed on one end, and the other end is put lightly in contact with the vibrating surface. The finger soons becomes very sensitive to small differences of agitation transmitted by the rod.

The experiments were made on a strongly made modern violin, and in some cases repeated on a fine violin by Stradiuarius in the possession of the writer.

The sand method, and also the touch-rod, showed that the position of maximum vibration of the belly is close to the foot of the bridge under the fourth string. The place of least vibration is exactly over the top of the sound-post behind the other foot of the bridge. The back is strongly agitated, the vibrations being least powerfully felt where the sound-post rests, which is at nearly the thickest part of the back. These effects were very satisfactorily observed on a violoncello, where the phenomena are on a larger scale.

When the sound-post was removed from the violin the large difference of the amount of vibration on the two sides of the belly was no longer present, the belly was about equally strongly agitated on both sides, making allowance for the string which was bowed. The tone became very poor and thin, as is well known to be the case when the sound-post is removed. The vibration of the back was now very feeble as compared with its vibration when the sound-post was present, a circumtance in favour of the view that the sound-post conveys vibrations to the back.

A clamp of wood was prepared which could be so placed on the violin as to connect by an arch of wood outside the violin the place of the belly behind the bridge where the top of the sound-post presses with the place of the back where it rests. It was expected that the wooden arch would restore to some extent the connection of belly and back which was broken by the removal of the post, and carry, though imperfectly, vibrations from the upper plate to the back.

When this clamp was put on, the poor and thin sound was altered to the fuller character of tone which belongs to the violin when the sound-post is in its place. On testing the condition of the back its normal state of vibration was found to be in a large degree restored. If, while the strings were being bowed, the clamp was suddenly removed, the tone at the same moment fell to its poor character, and the vibration of the back as instantly diminished.

It was further observed that, if the upper part of the clamp pressed upon the belly without the lower part coming into contact with the back, the tone is altered in the direction as when the sound-post was present, but it was not until the lower part of the clamp was in contact with the back that the normal character of the tone was fully restored. A similar effect to that resulting from the pressing of one end of the clamp only was produced by firmly placing one end of a wooden rod at this part of the belly. This effect may be due to the setting-up in the belly, by pressure at this part, of the peculiar nodal arrangement which the post produces when in its place.[1]

There could be no doubt that vibrations were carried by the clamp, for the lower end was powerfully agitated when the upper end rested upon the belly. If the sole function of the sound-post is to serve as a firm prop for the foot of the bridge, it should fulfil this condition most fully when placed under the foot of the bridge. In this position of the sound-post, however, as is well known, the tone is much injured.

In order to separate that part of the function of the sound-post which serves as a support from the further function it may possess as a transmitter of vibrations, it was desirable to introduce such alterations in the structure of the sound-post as would enable it to retain its supporting power, and yet greatly modify and, if possible, stop its power of transmitting vibrations. A sound-post was made in which about half an inch of the middle was cut out, and a piece of lead inserted, also a sound-post in which instead of lead sealing-wax was put in. The effect of these compound posts which retained uninjured their prop power was to modify greatly the quality of the tone, but not to diminish its quantity in any marked degree, a result in favour of the view that the character or the wood of which the post is made does influence the tone, and that vibration is transmitted by the post. As these compound posts could transmit vibrations freely, it was desirable to contrive a post which would not carry vibrations and yet form a firm prop. A post was made with a piece of hard indiarubber inserted in the middle, but this post was found by experiment with a tuning-fork to transmit vibrations to some extent. Other materials were tried without success. A post capped at each end with pieces of sheet vulcanised rubber stopped almost completely the sound of a tuning-fork when the foot of the fork rested on the rubber over one end of the post, while the other end equally protected with rubber rested on a body capable of reinforcing the sound of the fork. This rubber-capped post was firmly fixed in position in the violin, so that it would be able to support fairly well the belly and foot of the bridge, and yet not be able to carry vibration; unfortunately it does not seem possible, from the nature of things, to have a *rigid* prop which does not transmit vibrations, but this post, with thin sheet rubber at the ends firmly forced into position, must have been fairly efficient in its supporting power. The effect on the tone was about the same as when the sound-post was removed. When the wooden clamp was put on, then the normal tone returned, and the back vibrated strongly.

These experiments appear to show that the sound-post is more than a prop, and that, besides its other functions, it does transmit vibrations to the back in addition to those which are conveyed through the sides.

Experiments with sand and the touch-rod appear to me to show that Helmholtz's statement is too absolute when he says "it is only the other leg of the bridge which agitates the elastic wooden plates." Undoubtedly it is the fourth string foot of the bridge which is the more powerful in agitating the upper plate, but the other foot appears to me also to have an influence. When the post is placed exactly under the foot of the bridge, then the belly on this side is almost without vibration; if the post is absent, then this foot appears to agitate its own side of the belly as strongly as the other foot. As there is no post on the fourth string side of the fiddle, that foot stands in a position most favourable for setting up vibrations in the belly, being nearly half way between the supports of the belly at the tail and the

neck end of the violin. The other side of the belly, on the first or E string side, where the other foot of the bridge rests, is divided into two parts by the damping effect of the end of the sound-post, namely, the part *a* and the part *b*. It is obvious that

this foot of the bridge is unfavourably placed for setting the part of the belly, *b*, into vibration, since it is so far from its central mobile part. On the other hand, its position is favourable for a portion of its energy of vibration to be transmitted through the post to the back.

Practically very small differences of position of the top of the post behind the foot of the bridge are found to alter largely the character of the tone of the fiddle, and in the case of fine instruments the setting of the post is an operation demanding much care and judgment. The explanation lies probably in the circumstance that a small difference in the position of the post will

[1] According to Daguin some similar experiments were made by Savart, but I have failed to find them in those of his papers to which I have had access. "On peut la (l'âme) mettre en dehors, en l'appuyant à une espèce d'arcade dont on colle les pieds de chaque côté du violin. . . . On peut la remplacer par la pression d'un poids convenable appuyé sur la table supérieure." "Savart a conclu de là que l'âme a pour effet de rendre normales les vibrations de la table. . . ."—"Traité de Physique," tome i. p. 575.

alter greatly the proportion of energy passing through the post to that which is absorbed into vibrations of this side of the belly. At the same time it must also alter slightly the nodal arrangement of the belly, which must have an influence on the tone. If from the form of construction, or relative quality of the wood of the upper plate as compared with the under plate, the conditions of a violin are such that the highest quality of tone of which it is capable requires a relatively larger amplitude of vibration of the back, the position of the sound-post should be nearer the bridge. In a contrary condition of things the sound-post should be farther from the bridge. The extreme range needed in different violins is about a quarter of an inch. Any shift of the post must affect the relative mobility of the two sides of the belly.

If the sound-post transmits vibrations, these will be in addition to those received from the sides of the violin. It may be, therefore, that one condition which determines the best position of the post is the degree in which from their form and material these fulfil this duty. All the sides must share in this duty, but the touch-rod shows that a large part of this action is borne by the parts of the sides which curve inwards under where the strings are bowed. It is in harmony with this view that Mr. Hill states that if the inside blocks at the corners, which are put to strengthen these parts, extend in a small degree into these curved portions, the tone is injured.

The plane of the vibrations of the strings is that in which they are bowed, which is more or less oblique to the bridge. The vibrations may be considered divided into two sets at right angles to each other, *a* and *b*.

The touch-rod shows that these vibrations exist strongly in the upper part of the bridge. I venture to suggest that the use of the peculiar cutting of the bridge, which was finally fixed from trials by Stradiuarius, is to sift the vibrations communicated by the strings and to allow those only or mainly to pass to the feet which would be efficient in setting the body of the instrument into vibration, the other vibrations which would be injurious in tending to give a transverse rocking motion to the bridge, being for the most part absorbed by the greater elasticity given to the upper part of the bridge by the cutting. Below the two large lateral cuts, the touch-rod shows a very great falling off of the vibrations *b*. In the case of a violoncello these vibrations were also very greatly reduced below the side openings of the bridge.

The violin on which the experiments were made was without a bass bar, which is a piece of pine glued to the under side of the belly on the fourth string side. This bar is regarded as strengthening the belly and also enabling it to respond better to the lower notes. The touch-rod showed no difference in the general behaviour of this violin from a fine one by Stradiuarius containing a bass bar.[1]

On the Proportional Thickness of the Strings.—As the lengths of the strings are the same, we have only the two conditions of weight and tension on which their pitch depends. It is obvious that for equal pressure on the feet of the bridge, as well as for more convenient fingering and bowing, the strings should be at the same tension. They should therefore differ in weight, so as to give fifths when brought to the same tension. The weights of the strings are inversely as the squares of the number of vibrations, which in the case of fifths is as 3 to 2, namely, as 9 to 4. As the first three strings are of the same material, it is more convenient to take their diameters, which must be as 3 to 2, that is, each string in advancing from the first string must be half as thick again as the string next to it. In the case of the fourth string, covered with wire, we must find the weight of the third string of gut, and take a fourth string of which the weight is 9 to 4 for the third string.

A good average thickness of 2nd (A) string = 0·0355 inch.
Then the strings should be— 1st = 0·0237 ,,
2nd = 0·0355 ,,
3rd = 0·0532 ,,

A gut string 0·0532 inch in diameter weighs, when of the same length as a fourth string, 0·98 grm., then the fourth = 2·20 grms.

Ruffini sells sets of strings in sealed boxes, and these were found to be in about the same relative proportion to each other as the sizes indicated on the gauges sold by several makers.

The measures of a set of Ruffini's strings were found to be :—

1st = 0·0265 inch.
2nd = 0·0355 ,,
3rd = 0·0460 ,,
4th = 1·4100 grm.

It will be seen that the first string is thicker, and the third thinner, and the fourth much lighter than the theoretical values. Therefore the tension of the first string would be greater, and that of the third and fourth strings less than they should be in relation to that of the second string. The greater flexural rigidity of the fourth string will have a small effect in the direction of making the vibrations quicker, and therefore of making the tension required less.

By means of a mechanical contrivance I found the weights necessary to deflect the strings to the same amount when the violin was in tune. The results agreed with the tensions which the sizes of the strings showed they would require to give fifths.

A violin strung with strings of the theoretical size was very unsatisfactory in tone.

The explanation of this departure of the sizes of the strings which long experience has shown to be practically most suitable, from the values they should have from theory, lies probably in the circumstance that the height of the bridge is different for the different strings. It is obvious, where the bridge is high, there is a greater downward pressure. By this modification of the sizes of the strings there is not the greater pressure on the fourth string side of the bridge which would otherwise be the case. On the contrary, the pressure is less, which may assist the setting of the belly into vibration. There is also the circumstance that the strings which go over a high part of the bridge stand farther from the finger-board, and have therefore to be pressed through a greater distance, which would require more force than is required for the other strings, if the tension were not less.

[1] In the "Early History of the Violin Family," Engel, speaking of the Crwth, says:—"Furthermore, the contrivance of placing one foot of the bridge through the sound-hole, in order to cause the pressure of the strings to be resisted by the back of the instrument, instead of by the belly, is not so extraordinary and peculiar to the Crwth as most writers on Welsh music maintain. It may be seen on certain Oriental instruments of the fiddle kind which are not provided with a sound-post. For instance, the bridge is thus placed on the three-stringed fiddle of the modern Greek, which is only a variety of the ordinary rabâb, but which the Greeks call lyra. Inappropriate as the latter designation may appear, it is suggestive, inasmuch as it points to the ancient lyra as the progenitor of the fiddle."—P. 28.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE

CAMBRIDGE.—The next examination for Minor Scholarships and Open Exhibitions at St. John's College will take place in December, 1883. There will be open for competition, besides certain Exhibitions, two Minor Scholarships of 50*l.* per annum and two of 75*l.*; also such Foundation Scholarships as shall be vacant, two of which may, after the commencement of residence, be increased in value to 100*l.* each.

Candidates may offer themselves for examination in any of the following subjects :—Classics, Mathematics, Natural Science, Hebrew, or Sanskrit.

The Examinations will begin on Tuesday, December 11.

Successful candidates will be required to commence residence not later than October, 1884. Further particulars of the Scholarships and Exhibitions may be obtained in October, 1883, on application to one of the tutors.

SCIENTIFIC SERIALS

Bulletins de la Société d'Anthropologie de Paris, tom. v. fasc. iv. 1882.—Discussion on M. Ball's case of cretinism, in which the axiom advanced by M. Lunier was generally accepted, that, while idiocy

is hereditary and congenital, cretinism is endemic.—M. Gustave Le Bon, in defending the accuracy of his determinations of the comparative weight of the brain of boys and girls against the charges advanced by MM. Budin and Manouvrier, explains his methods of determination, which, in his opinion, confirm the conclusions contained in his earliest memoir on the subject: viz. that (1) while male and female children differ very little in weight at their birth, when, if the weight of boys be taken at 100, that of girls will be 94·28, the difference between the sexes in adult life may be at least three times greater; (2) that at the same age, with equal stature and weight, the female brain will be found notably inferior in weight to that of the man.—On the cranial dimensions of the savage Stiengs, or Moïs, of Cochin China, by Dr. P. Neis, who finds that this people exhibits the low mean cranial capacity of 1400, with a cephalic index of only about 75.—M. Capitan records the results of his experiments on the methods of trepanning employed in prehistoric times. He has experimented both on the living and dead subject, using a flint instrument, with which he reproduced perforations similar to those observed in prehistoric crania. This was effected by boring and incision, as well as by scraping, and in both cases the animals operated on recovered rapidly and completely from the operation, although Broca had maintained that the removal of any part of the cranial surface could not possibly have been effected on the living subject by such instruments as were used by primitive man.—Dr. Collignon describes the nature of the human remains found at Cumières, Meuse, belonging to the Neolithic age, among which are seven well preserved skulls, and various long bones, including two platycnemic tibiæ.—Dr. Heurot's report of the ossuary of the polished stone period, discovered in 1881 at Liry, in the Ardennes, was laid before the Society by M. Mortillet, who drew attention to the extraordinary projection of the lower jaw observable in one of the crania, which in this particular seems to foreshadow the present and future evolutionary change, rather than to accord with the ordinary type of the receding anthropoidal chin of the prehistoric ages. In the course of the discussion arising out of Dr. Heurot's communication, M. Legnay described similar burial places examined by himself at Le Grand Compant, near Luzarches, and at Vaureal, Pontoise, where, as at Liry, a passage composed of upright stones, and covered in with wood, gave admittance to the true sepulchral chambers.—M. Topinard reports on his examination of *Le Questionnaire de Sociologie et d'Ethnographie*, issued by the commission appointed by the Society for its elaboration; and while he approves generally of the plan followed, which is that suggested by M. Letourneau, he has drawn attention to numerous points omitted by the latter, who, by his mode of defending the proceedings of the Society, and attacking M. Dally, gave an aggressively personal character to the discussion, very unusual in meetings of the Society. Owing to want of unanimity among the members, the method to be followed for the French system of instructions for travellers still remains undecided.—The Galibis of Cayenne, who have long been established in the Jardin d'Acclimatation of Paris have been made the subject of an exhaustive study by M. Manouvrier, whose detailed communications of the numerous observations and determinations in regard to the sociology, language, and ethnology of these tribes led to a somewhat lengthy discussion on the *rationale* and early extension of the practice of the *couvade*, which has been observed among the Galibis of French Guiana, as well as among the Basques, and appears to have prevailed under various modifications among several ancient peoples.

Rendiconti of the *Reale Istituto Lombardo*, May 31.—A comparative study of the fauna of the various Pliocene deposits in Lombardy, by Dr. C. F. Parona. As many as 275 species were examined, 248 in the Pliocene of the Northern Apennines, and 187 in the Upper Miocene, of which 117 still survive in the neighbouring seas.—On Paff's method of integration of partial differential equations of the first order, by Prof. E. Beltrami.—A contribution to the history of the adulteration of food from the earliest times, by C. L. Gabba.—On the mortality of infants during the first and second years of their lives in the various provinces of Italy, by Prof. G. Sormani. For the decade ending 1880 the average rate of mortality in the first year throughout Italy was 214·9 per 1000, and in the second 114·6 per 1000. Compared with the rest of Europe, these figures show that Italy occupies the lowest position in the scale, the death-rate being in excess even of Croatia and Slavonia (107·4) and of Russia (102·7). In the general comparative table, Ireland stands first (34·5), England occupying a medium position with an average of 59·1 per 1000.—The career of David Lazzeretti, founder of the new sect of Lazzerettists, studied in the light of documents recently discovered, by G. Barzellotti.—The telephone in its legal aspect (continued), by C. Norsa.

Bulletin de la Société d'Encouragement pour l'Industrie Nationale, June, 1883.—Report on M. Lavanchy-Clarke's workshops for the blind, by M. Legentil.—Report on M. Latry's tinted papers, by M. Ern. Dumas.—Colouring elements of madder and their metamorphoses, by M. A. Rosenstiehl.—On the saline tracts in the south-east of France, by M. P. de Gasparin.—On sewing-machines and sewing-machine industries of all sorts, as shown at the Paris Universal Exhibition of 1878, by M. Emile Bariquand.

The number for June 15 of the *Archives des Sciences Physiques et Naturelles* contains researches on the absorption of ultra-violet rays by different substances (seven plates), by M. J. L. Soret (fourth memoir).—A new contribution concerning the family of Tintinodea, by Dr. Herman Fol (one plate).—On the magnifying power and strength of dioptric arrangements, by Dr. Adrien Guébhard.—Meteorological observations at the Geneva Observatory for the month of May.

SOCIETIES AND ACADEMIES

LONDON

Geological Society, June 6.—Mr. J. W. Hulke, F.R.S., president, in the chair.—George Paul was elected a Fellow of the Society.—The following communications were read:—The estuaries of the Severn and its tributaries, an inquiry into the nature and origin of their tidal sediment and alluvial flats, by Prof. W. J. Sollas, M.A., F.R.S.E., F.G.S.—Notes on a collection of fossils and rock-specimens from West Australia, north of the Gascoyne River, by W. H. Hudleston, M.A., F.G.S.—Notes on the geology of the Troad, by J. S. Diller. Communicated by W. Topley, F.G.S. This paper gave a brief account of the results obtained by the author whilst attached to the United States Assos Expedition. Together with a geological map (scale 1 : 100,000) this was sent to Mr. Topley for the service of the new geological map of Europe (and its borders), which is now being prepared by a Committee of the International Geological Congress. The country described is that lying south and west of the River Menderé (Scamander). The sedimentary rocks may be divided into three great groups:—1. An old, possibly Archæan, highly crystalline series, forming the mountainous lands of the Ida range (5750 feet), but also appearing in smaller detached areas to the west and north-west. Probably these have existed as islands from early times, and around these the later rocks have accumulated. Mount Ida itself is almost a dome, the lowest rocks (talc schists) occupying the summit. On the northern slopes there is true gneiss. No igneous rocks enter into the structure of this mountain. At different horizons there are bands of coarsely crystalline limestone, and as far as can be seen this series is conformable throughout. 2. Resting on these old rocks and in part made up of their remains is a series of partially crystalline rocks, chiefly limestone. It is probable that this series is in large part of Cretaceous age; but it contains rocks which are older, possibly Palæozoic. Eocene fossils have lately been discovered by Mr. Frank Calvert, which also may have come from this series. The rocks in the south of the Troad, hitherto supposed to be Lower Tertiary, are now known to be of later date. Sharply marked off from these older rocks are the Upper Tertiaries; these are of two ages, occurring in two distinct areas. 3. The *Upper Miocene*, which fringes the western shores of the Troad, and forms a broader band at the north-west corner in the lower course of the Menderé. Hissarlik is built on this. These beds are marine, and belong to the *Sarmatian Stage*. The Troad is the most south-westerly point at which the *Mactra-kalk* is yet known. 4. Freshwater beds, which occur in force in the interior of the country, between the Menderé and the south coast, and in patches near the coast. These are *Upper Miocene* or *Lowest Pliocene*. Later than these are the *Pliocene beds* of the great plain of Edsemet. The igneous rocks are of various ages, but most are of Tertiary date. The oldest is a *granite* which intrudes through and alters the oldest (? Archæan) crystalline rocks. This is invaded by dykes of *Quartz-porphyry*. *Quartz-diorite* invades and alters the group of partially crystalline rocks. The oldest rocks in the newer series are the *Andesites* and *Liparites*. These, in part, are older than the Sarmatian stage, as the conglomerate at its base contains fragments of these rocks. But they are also in part of later date. Where they can be studied together the Liparite is the later of the two, as it flows through and carries up fragments

of the Andesite. The Andesite (unlike the Liparite) seems to have reached the surface, in some cases, through volcanic vents. *Basalts* and *Nepheline-basalts* are of late Tertiary date; possibly they are the latest volcanic rocks of the district, but their relation to the other eruptive rocks of the Troad cannot be definitely determined. The volcanic rocks in the isolated area between Alimadja and Lyalar are interesting because their relative ages are here well seen. The earliest was melaphyre; this was followed by mica-andesite, hornblende-andesite, augite-andesite, basalt, and late (if not last) by liparite. Mr. Topley, who in the absence of the author read the paper, explained the objects of the Assos Expedition and the geological results obtained by Mr. Diller. He gave a short account of previous literature, and mentioned some of the main points in which our knowledge of the Troad is now advanced. Mr. Topley briefly described the physical geography and general structure of the country, illustrating this by means of a section which he had prepared from Mr. Diller's map and paper.

Zoological Society, June 19.—Prof. Flower, F.R.S., president, in the chair.—The Secretary read an extract from a letter received from Mr. Albert A. C. Le Souëf, containing observations on the colouration of the plumage of the Satin Bower-bird (*Ptilonorhynchus holosericeus*).—Prof. E. Ray Lankester, F.R.S., read a memoir on the muscular and endoskeletal systems of *Limulus* and *Scorpio*, drawn up by himself with the assistance of his two pupils, Mr. W. J. Barham and Miss E. M. Beck. These investigations seemed to confirm Prof. Lankester's previously expressed views as to the near affinity of these two forms, hitherto usually referred to different classes of the animal kingdom, and to justify the association of *Limulus* with the Arachnida.—A paper was read by Dr. Gwyn Jeffreys, F.R.S., F.Z.S., on the Mollusca procured during the cruise of H.M.S. *Triton* between the Hebrides and Faroes in 1882. Ten new species of Gastropoda were described, and another species (*Fusus sabini*) was fully diagnosed. The chief interest of the paper consisted in the distinction of the Mollusca inhabiting the "warm" and "cold" areas of that sea-bed, in accordance with the views of Dr. Carpenter and the late Sir Wyville Thomson.—A communication was read from Mr. Martin Jacobi, containing descriptions of some new species of Beetles belonging to the family Galerucidæ.—Prof. P. Martin Duncan, F.R.S., read a paper on the Madreporarian genus *Phymastræa* of Milne-Edwards and Jules Haime, and gave the description of a new species obtained on the west coast of India, which he proposed to call *Phymastræa irregularis*.—Dr. J. S. Garson, F.Z.S., read a paper on the anatomy of the Pygmy Hog of Nepaul (*Porcula salvania* of Hodgson), as exhibited in a female specimen of this animal, which had lately died in the Society's Gardens. Dr. Garson came to the conclusion that this animal was not sufficiently different from the true Pigs (*Sus*) to warrant its generic separation.—A communication was read from Mr. Osbert Salvin, F.R.S., containing an account of a series of birds collected by Capt. A. H. Markham, R.N., at various points of the western shores of the Pacific, from Esquimault on the north, to the Straits of Magellan on the south, including some from the Galapagos Islands and from the island of Juan Fernandez.—Mr. E. W. White, F.Z.S., read some notes on the birds of the Argentine Republic, being a supplement to two former papers read before the Society on the same subject.—A communication was read from Mr. A. Boucard, C.M.Z.S., containing an account of a collection of birds made in Yucatan by Mr. Gaumer.

SYDNEY

Royal Society of New South Wales, May 2.—Annual meeting.—The number of new members elected during the year was forty-one, making the total number of ordinary members upon the roll to date 486. At the Council meeting held on December 13 it was unanimously resolved to award the Clarke Memorial Medal for the year 1883 to Baron Ferdinand von Müller, K.C.M.G., F.R.S., Government Botanist, Melbourne; and at the same meeting the Council awarded the prize of 25*l.*, which had been offered for the best communication on the "Influence of Australian Climates and Pastures upon the Growth of Wool," to Dr. Ross, M.L.A., Molong; and the prize for the one upon "The Aborigines of New South Wales" to Mr. John Fraser, B.A., West Maitland. During the year the Society held ten meetings, at which the following papers were read:—Annual address by H. C. Russell, F.R.A.S.—On the geology of the Hawkesbury sandstone, by Rev. J. E. Tenison-Woods, F.G.S.—On tropical rains, by H. C. Russell, F.R.A.S.—On the orbit of the late comet, by G. Butterfield.—On a method of determining the true south, by J. S. Chard.—Notes on the progress of New South Wales during the years 1872 to 1881, by Christopher Rolleston, C.M.G.—On some marine fossils of the coal-formation of New South Wales, by Rev. J. E. Tenison-Woods, F.G.S., F.L.S.—On some Mesozoic fossils from the Palmer River, Queensland, by Rev. J. E. Tenison-Woods, F.G.S., F.L.S.—On French geographical societies and the colonies, by E. M. de la Meslee.—Notes on the aborigines of New Holland, by James Manning.—On the ashes of some Epiphytic ferns, by W. A. Dixon, F.C.S.—On a fossil plant formation in Central Queensland, by Rev. J. E. Tenison-Woods, F.G.S., F.L.S.—The Medical and Microscopical Sections held regular monthly meetings. The sum expended upon the library during the year was 422*l.* 12*s.* 10*d.* At the annual meeting M. Louis Pasteur, M.D., was unanimously elected an Honorary Member of the Society, to fill the vacancy caused by the death of the late Dr. Charles Darwin, M.A., F.R.S., and Dr. Ottokar Feistmantel of Calcutta was elected a Corresponding Member.—Names of the new Council:—President, Hon. J. Smith, C.M.G. Vice-Presidents: Charles Moore, F.L.S., W. A. Dixon, F.C.S. Hon. Treasurer, H. G. A. Wright, M.R.C.S.E. Hon. Secretaries: Prof. Liversidge, F.R.S., F.G.S., Dr. Leibius, F.C.S. Members of Council: Robert Hunt, F.G.S., Dr. W. Morris, P. R. Pedley, Frederick Poolman, Chr. Rolleston, C.M.G., H. C. Russell, F.R.A.S.

PARIS

Academy of Sciences, July 2.—M. Blanchard, president, in the chair.—Obituary notices of M. Mailliard de la Gournerie, by M. Bertrand; of Mr. William Spottiswoode, by M. Dumas; and of General Sabine, by M. d'Abbadie.—On the condensation and liquefaction of gases, by M. J. Jamin.—On the tornadoes that swept over Kansas, United States, on May 30, 1879, by M. Faye. Although every tornado almost invariably takes place in the south-west quadrant of an area of comparatively low pressure (Finlay's "Report of 600 Tornadoes"), this meteorological condition is not to be regarded as their true cause. The author shows on the contrary that, like other storms and hurricanes, they are due to whirlwinds descending with vertical axis, and originating, not in the lower atmospheric strata, but in the upper currents whose direction is entirely independent of the light winds previously prevailing near the surface of the earth.—Remarks and observations on MM. Carl Vogt and Emile Yung's treatise on practical comparative anatomy, by M. de Quatrefages. For Darwin's biological tree representing all life past, present, and even future on the globe, Vogt and Yung substitute a grove composed of many distinct trees, the number and species of which still remain to be determined. But while this conception deprives the Darwinian theory of much of its seductive grandeur, evolution itself can lose nothing by abandoning an absolute system in which mere hypothesis plays far too large a part.—On a complete system of the combinations of two biquadratic binary forms, by M. C. Stephanos.—On a class of lineal equations of the fourth order, by M. E. Goursat.—On surfaces of the third order, by M. C. Le Page. A method is proposed of constructing a surface of the third order determined by nineteen points.—On the application of Ampère's method to the determination of the elementary law of electrical induction by displacement, by M. Quet.—Electrodynamic actions involving arbitrary functions; hypotheses determining these functions, by M. P. Le Cordier.—Method of unmagnetising timepieces which have become magnetised by the vicinity of a powerful magnetic field, by M. Deprez.—Action of chlorhydric acid on the protosulphuret of tin, by M. A. Ditte.—On the fusibility of salts, by M. E. Maumené.—On a new process of making a quantitative analysis of urea, by M. L. Hungounenq.—An examination of the corpuscles held in suspension in water, by M. Eug. Marchand.—Deposits of barytine, celestine, and anhydrite, their association and probable mode of formation, by M. Dieulafait. The experiences of M. Gorgeu are shown to be inadequate to explain the formation of these substances in lodes and in saline lands. At the same time they are not to be absolutely rejected, and may prove to be of great value when the chemical aspect of volcanic phenomena is taken seriously in hand.—Influence exercised by the elements contained in sea water on the development of fresh-water animals, by M. H. de Varigny. From experiments made with the spawn of frogs and other organisms, it appears that chloride of sodium (kitchen salt) is the substance most noxious to the development of fresh-water animals.—Application of heat to the preservation of wines in common use, the blends known as "vins de coupage,"

by M. E. Houdart. By this process all danger of fermentation is avoided, while the quality and appearance of the wines so treated remain unimpaired.

BERLIN

Physiological Society, June 15.—In continuation of the experiments upon the influence of temperature upon the time occupied by reflex actions, which Prof. Kronecker described at the last meeting, Prof. Ewald communicated observations which he had made upon patients who were suffering from rabies. These patients responded with a reflex jerk quicker in a temperature between 0° C. and 5° C. than in temperatures between 40°—50°, and at higher temperatures the times occupied by a reflex action again became shorter.—Dr. B. Baginsky spoke about the results of experiments which he had instituted in order to determine the function of the cochlea. It is well known that anatomical research has determined that the membrana basilaris of the cochlea, in which the terminal filaments of the auditory nerve are distributed, increases in breadth from the bottom towards the upper part; and Herr von Helmholtz had founded an hypothesis upon this to explain the differentiating perception of certain higher tones, viz. that the sound-waves that penetrate into the cochlea occasion a synchronous vibration either in the broader upper half or in the narrower lower half of the membrana basilaris, so that the higher tones would excite the fibres of the auditory nerve distributed in the lower part, and the deeper notes the fibres distributed in the upper part. In animals which are low in the scale of development there is a similar arrangement, which consists of auditory cilia of different lengths, which have the same function, as the shorter ones are intended for the higher notes, and the longer ones for the deeper notes and noises, and are set into synchronous vibration by them. This hypothesis has been experimentally confirmed in the case of the auditory cilia of the lower animals, and it had actually turned out true that deep notes produced vibrations in the long hairs, and high notes in the short ones. Herr Baginsky now undertook to test the hypothesis of Herr von Helmholtz experimentally on the cochlea of higher animals. After he had succeeded in overcoming the great practical difficulties, he wounded the top of the cochlea of the healthy ear in dogs which had been made absolutely deaf of their other ear, and then observed their hearing powers by means of the different notes of organ-pipes between c and c''''. On the third day after the immediate consequences of the operative interference had disappeared, it was found that the dogs responded perfectly to the notes c'''', c''', c'', c', but were deaf to the deeper notes. This condition remained unaltered for weeks, and when the animal that had been the subject of experiment was killed, the post-mortem examination showed that the top only of the cochlea had been wounded, and that the filaments of the auditory nerve that were distributed to that portion were destroyed. Less precise were the results of the experiments in which the lower part of the cochlea was destroyed; in these cases absolute deafness occurred in a succession of cases; in other cases, again, the dogs responded to high as well as to low notes, to the latter, perhaps, a little better; and again, in other cases, on the other hand, the dogs only responded to the notes c, c', c'', while they were deaf to the higher notes. But this condition only lasted some fourteen days; then hearing power for the higher notes set in again, and soon reached the same sensitiveness as that for the deep notes. Post-mortem examination showed in these various cases different degrees of distinction occasioned by the operation. Herr Baginsky believes that he has by his experiments, in particular by the results of lesion of the top of the cochlea, verified experimentally for the mammalian cochlea the hypothesis of von Helmholtz.—Dr. B. Fränkel spoke concerning the different views of authors as to the behaviour of the pharyngo-nasal isthmus during the phonation of vowels, and about the attempts which have been made, up to the present inconclusive, to prove the closure or the patency of the isthmus. He himself has become convinced by his observations that in the phonation of all vowels the communication between the pharynx and nasal cavity remains patent, although more or less narrowed, and he demonstrated this partly by means of a spirit-manometer, one of whose limbs was brought into connection with one nostril, at the same time closing the other nostril while he was sounding the letter, or by means of a flame towards which he directed an elastic tube which was in connection with both nostrils. Not only on pronouncing A, but also with E, O, I, and U, a current of air was seen to issue from the nose. Dr. Fränkel then discussed the various varieties of nasal speech, of which he distinguishes three anatomical varieties, and finally gave his view as to the function of the uvula, which occurs only in man and in some of the higher apes, viz. that it has got nothing to do with the shutting off the isthmus nasopharyngeus or any connection at all with speech; it serves rather to protect the larynx in swallowing by dividing mouthfuls of solid food and drink into two portions, and thus compelling them to slip down on either side of the larynx; it likewise forms an elongation of the epiglottis.—Prof. Kronecker gave a short exposition of a demonstration which Dr. Openschewsky gave to the Society. In experimenting on the influence of the vagus and upon the gastric movements, it was observed that when the peripheral end of the gastric branch of the vagus is stimulated by single currents, the contraction of the cardia does not occur until after the cessation of the stimulations, although during the continuance of these no contraction of the stomach is observed, when a certain frequency of repetition of the stimuli has been attained. This induced Dr. Openschewsky to examine more closely the inhibitory action of the vagus. It has now been known for a good many years that in high degrees of anæmia the cardia executes spontaneous rhythmical contractions; by ligature of the coronary artery this anæmia could be artificially produced and the rhythmical contractions could be produced in the cardia. If the peripheral ends of the gastric branches of the vagus were now stimulated, an inhibition of these movements of the cardia regularly occurred, which lasted as long as the stimulation of the vagus. It is thus proved that the gastric branches of the vagus contain inhibitory as well as excitant fibres, exactly as its cardiac branches; and Dr. Openschewsky proposes to work out this part of the physiology of the vagus still further.

VIENNA

Imperial Academy of Sciences, April 12.—M. Abeles, on secretion from the living kidney if floated through with blood.—E. Hussak, on cordierite in volcanic outcasts.—E. Zuckerkandl, on the communications between the arteries of the human lung.—J. Wroblewski and K. Olszewski, on the liquefaction of oxygen and solidification of carbon disulphide and alcohol.—G. Goldschmidt, on pyrene-quinone.—T. von Oppolzer, tables to determine eclipses of the moon.—J. Liznar, a note on the theory of Lamart's variation apparatus for horizontal intensity.

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THURSDAY, AUGUST 2, 1883

ZOOLOGY AT THE FISHERIES EXHIBITION[1]

II.—*Notes on the Vertebrata*

AT the request of the editor of NATURE I have drawn up this very general report on the Vertebrate animals now exhibited in the natural history sections of the different Courts at the International Fisheries Exhibition. In its compilation I have principally used the notes taken during a month's pretty close attendance at the great piscatorial show in South Kensington, and whilst doing work on the two special juries who had to examine and report on such collections. The space and time conceded preclude entirely anything like a detailed account even of this small portion of the rich and varied exhibit, whilst on the other hand books of reference could not be consulted, and strict nomenclature and systematic arrangement must be partly sacrificed. I shall, however, be content if I succeed in giving a fair general account of this special part of the Fisheries Exhibition, which cannot but interest many of the readers of this periodical to whom the sight of the exhibits themselves, some of very great interest, is not possible. I may also add that to my knowledge one group, that of Birds, will be the subject of a special article, to be published shortly in a special journal by one of our leading ornithologists, whilst on the other hand the Cetacea and Pinnipeda will be reported on in the jurors' reports by such distinguished specialists as Prof. Flower and Mr. Clark. I do not know whether any special report on the all-important and largely represented group of Fishes be imminent; I fear not; but as several highly competent ichthyologists have carefully gone over such collections in the Exhibition, I trust that so important a subject will also be laid before the scientific world by a competent reporter.

Before commencing my special task, and before taking the reader through the Vertebrate collections in the International Fisheries Exhibition, for which purpose I consider preferable a zoological to a geographical arrangement, I shall say a few words on the relative importance of the exhibits in this section contributed by different countries. Besides Great Britain and her dependencies, colonies, and possessions, such as the Isle of Man, Heligoland, Canada and Nova Scotia, Newfoundland, British Columbia, the Bahamas, Jamaica, New South Wales, Tasmania, India, Ceylon, and the Straits Settlements, the following foreign countries have contributed to the Fisheries Exhibition: France (not officially), Belgium, the Netherlands, Germany (not officially), Denmark (not officially), Sweden and Norway, Russia, Austria and Hungary, Italy (not officially), Greece, Spain, Switzerland, the United States, Chili, Venezuela, Haiti, China, Japan, Morocco, and Hawaii. Of these, however, nearly a third, viz. France, Germany, Italy, Venezuela, Haiti, Morocco, Japan, and Hawaii have no exhibit to call for our attention, while another third show so little, and that of so small a value that they hardly deserve a passing notice. In the richness, value, and beauty of the Vertebrata exhibited, the foreign countries who compete for the palm are Sweden and the United States of America, far above all the rest in this respect. Great Britain is, on the other hand, singularly defective, none of her great public institutions having taken any part in the competition; this may be partly accounted for by the close proximity of the Buckland Collection of Economic Fishery, adjoining the Fisheries Exhibition, while not much further is the new Natural History Museum in the Cromwell Road, and in this case it is much to be regretted that, at a time when many interested in fish and ichthyology have been attracted from afar by the Fisheries Exhibition, the zoological collections, and more especially the ichthyological ones, are not in a condition to be open to public inspection. However, if Great Britain is, with a single exception, meagrely represented by a few private exhibits in the Vertebrate collections, it is not so with some of her colonies and possessions, and the Courts occupied by the exhibits of New South Wales, Tasmania, and India are rich in specimens of much interest and great scientific value, while the Dominion of Canada is (in respect of Vertebrates) not far behind them.

The mammals ought in this case to be divided into two groups, those which are fished and those which fish, but I prefer to classify them scientifically rather than popularly. Carnivora mostly belong, when aquatic, to the latter group; amongst the more abundant are of course the otters, and especially our European kind, of which many specimens are in the British Natural History Gallery; Canada, India, and Chili show specimens of those belonging to their waters, and I was pleased to see in the latter Court fine specimens of my old friend *Lutra felina*, whose marine habits and agility amongst the kelp-beds of Western Patagonia I witnessed many a time. A few Polar bears are also shown, a very large and fine specimen being in the Russian Court; while Musteline Carnivora of more or less fishing propensities are to be seen amongst the Canadian exhibits. Seals and *Otariæ* form of course a prominent feature in the Exhibition; foremost in beauty and rarity is no doubt *Histriophoca fasciata* of the Behring Sea; the *Vega* exhibit shows a skull and a rather inflated and dilapidated skin, whilst a magnificent specimen is exhibited by the National Museum, Washington; these are, I believe, the first specimens of that rare mammal ever seen in this country. Some good specimens of *Cystophora*, *Ph. barbata*, *Ph. grœnlandica*, *Ph. gryphus*, are to be seen in the Canadian and Newfoundland exhibits, the latter belonging mostly, I am told, to the Liverpool Museum. Tasmania shows a splendid specimen of *Stenorhynchus leptonyx*. A large but badly mounted walrus is in the British gallery; but the enormous tusks and cranium and the life-like head of the Pacific species (*T. obesus*), of whose specific distinctness I should however greatly doubt, call for special attention in the United States department; the very beautiful sketches from life of those unwieldy creatures and of the agile fur seals, drawn by Mr. Elliott in the Pribylov Islands, deserve much praise. The *Otariæ* are represented by a fine group of *O. ursina* ♂ and ♀, the principal source of the sealskin industry, in the United States exhibit, mounted very beautifully indeed; an interesting group of *Arctocephalus cinereus* is conspicuous in the New South Wales Court, in which is a young specimen of what appears to be a distinct species; Chili has

[1] Continued from p. 291.

several interesting specimens of an *Otaria* from Juan Fernandez, a true *Lobœa dospelos*, which might be the rare *Otaria Philippii*.

The strange and uncouth Sirenia are represented by a grand specimen, one of the principal attractions to every naturalist in the entire Exhibition, the nearly complete skeleton of a *Rhytina Stelleri*, which, with other bones of that most interesting creature is exhibited by Baron Nordenskjöld, one of the many grand results of the *Vega* expedition; the National Museum of Washington shows a very fine skull of that peculiar, rare, and extinct Sirenoid. Very interesting, and more noticed by the general public, are the two fine mounted specimens, male and female, of the Dugong (*Halicore australis*), exhibited by the Australian Museum of Sydney.

The Cetacea contribute an important portion of the Vertebrate series, and now and then afford instruction of a novel and rather startling nature; thus the large skeleton of *Balænoptera musculus*, covered with luminous paint and set up in the Garden, shows some remarkable innovations in practical osteology, the natural asymmetry of the skeleton of these creatures is most vividly exaggerated, and we are shown various of the larger paired bones curiously displaced from right to left, and *vice versâ*; but this is not all, we are told that the whale before us, which by the way was noticed by no less a man than Prof. Flower, when cast upon these shores, is the Greenland Whale (*Balæna mysticetus*), and the large label thus headed further informs us that it grows to be 75 feet long, swims at the rate of four miles an hour, and possesses a tongue so thick and fleshy, that when the mouth is closed it envelops the upper jaw and all the horny laminæ (baleen plates) along it! Not far off a Berlin dealer in whalebone, Isaac Mann, shows a fine series of baleen plates belonging to several species, but he startles us with the announcement in large letters that "the whale can grow to the length of 200 feet, reach the age of 1000 years, the weight of 20 tons, and is therefore the largest of known fishes." But from the comical and amusing, let us return to more serious and interesting matter; amongst the mounted and entire specimens of Cetacea exhibited, I may mention the large and beautiful *Orca gladiator*, which forms a prominent feature in the Swedish Court, five young and fœtal porpoises preserved in alcohol, shown by the Gothenburg Museum, and by the Norwegians; the large *Beluga* in the Canadian exhibit, less life-like, however, than the beautiful cast of the same species shown by the National Museum of the United States; special notice ought to be taken of the rare *Orcælla brevirostris* from Singapore, in the Straits Settlements exhibit. Skeletons and crania of Cetaceans are more numerous, and for the high scientific value and beauty of specimens exhibited Sweden has in this respect by far the highest rank; the complete skeletons of *Orca Eschrichtii*, *Hyperoodon diodon*, and *Mesoplodon bidens*, will be examined by all zoologists with pleasure and profit, but of more special interest is that of *Ziphius Gervaisii*. This form, which differs principally from *Z. cavirostis* in the absence of the stony *mesorostral* bone, and in the size and shape of the two teeth at the apex of the mandible, is probably the female of the latter; whilst examining again that most valuable specimen yesterday, I was grieved to find that some unprincipled person had abstracted the two teeth, an act of ruthless vandalism or pseudo-scientific kleptomania much to be deplored and condemned.

Birds, of course, figure largely in the British and foreign exhibits; they are more or less aquatic, and may or may not fish or otherwise prove injurious to piscatorial interests. It is to be hoped that the public will not take for granted that every bird displayed in this Exhibition is the fisherman's natural enemy and therefore to be ruthlessly destroyed whenever the opportunity occurs. The dipper, for example, largely repays any occasional injury he may do to the fish spawn by destroying a vast number of insects which habitually feed on it.

Amongst the notable exhibits in this series in the British section is a fine collection of British waterfowl very nicely mounted, shown by T. E. Gunn of Norwich, in which a pair of hoodies attacking a wounded widgeon and a pike drawing under water a female mallard are very effective. Mr. Burton's collection of New Zealand waterfowl is also good; and especially worthy of praise is a set of beautiful photographs illustrating bird-life, and more especially the gannets on the Bass Rock and Fern Islands, exhibited by W. P. Carr of Berwick. India, Australia, and the United States show a fair exhibit of their waterfowl, especially Anatidæ, Ardeidæ, Laridæ, Procellaridæ, and Spheniscidæ; but by far the most important exhibits in this class are the rare Arctic birds from the Behring Sea and Alaska in the Swedish and United States Courts. Ornithologists will look with unmitigated delight on the splendid specimens of *Eurinorhynchus pygmæus*, *Colymbus Adamsii*, and *Rhodostethia Rossii* in the *Vega* exhibit; and on the magnificent *Bernicla canagica*, *Somateria Fisheri*, and *Somateria V-nigrum*, shown both in the *Vega* and in the National Museum of Washington exhibits; some of these species are seen, I believe, for the first time in this country. A large collection of water-birds of North America, some three hundred species, has besides been sent over in skins by the National Museum of Washington; these, however, have not been exhibited for want of space.

Reptiles contribute a small but not uninteresting series to the Fisheries Exhibition. Amongst the Chelonians the most noticeable are a fine *Sphargis coriacea* shown by the Australian Museum of Sydney; a large specimen of *Chelonia imbricata* in the Spanish exhibit from the Philippines; several large turtles, *Emys* and *Trionyx*, in the Indian show, where may also be seen several large crocodiles and a set of snakes, amidst which several species of that most difficult but interesting group the Hydrophidæ, from Karachi. The United States National Museum shows some fine casts of turtles, tortoises, snakes, and lizards, amongst the latter a very fine one of the recently described poisonous lizard of Arizona (*Heloderma*).

The Amphibia are represented by a complete set of the North American Urodela exhibited in the United States section, while a few Anura are shown by India, and in the Chilian Court may be seen a few more, amongst which is the curious *Calyptocephalus Gayi*.

Fish naturally contribute the larger portion of the Vertebrata exhibited; in the British gallery may be seen a very great number of the common freshwater game and food fishes exhibited principally by anglers and by angling clubs, mostly mounted dry, and of little or no scientific interest. A small set of freshwater and marine British

fishes shown by T. E. Gunn and Mr. Carr are noticeable; but of very great interest is the large and nearly complete collection of British fishes exhibited by Dr. Francis Day, they are of special value as being a set of types used by Dr. Day for his work on the fishes of Great Britain and Ireland at present in course of publication. A few interesting Mediterranean species of fish may be seen in the magnificent series of Invertebrata shown by Prof. Anton Dohrn, founder and head of the Zoological Station at Naples; amongst them are two specimens of *Callionymus partenopæus*, Gigl., the young of *Scymnus lichia*, *Centrina Salviani*, *Scyllium stellare*, and *Myliobatis bovina*; a *Fierasfer imberbis* is shown in the act of getting into a large *Holothuria*, whilst a specimen of the rare *Fierasfer dentatus* is of special interest. Good skeletons in alcohol of *Ceratodus Forsteri* and *Cestracion Philippii* are exhibited by Mr. Gerard, jun., and some well mounted disarticulated crania of fish are shown by Mr. Moore.

Besides a large set of the admirable casts of the more conspicuous of their food-fishes, and a splendid series of large photographs of many typical forms of their rich ichthyo-fauna, the United States (National Museum and Fisheries Commission of Washington, both under the able and energetic direction of Prof. Baird) exhibit a most interesting and complete series of type representatives of the freshwater genera of North America; the series embraces 173 species, amongst which the Ganoids, so well represented in that region, as *Amia*, *Lepidosteus*, *Spatularia*, *Scaphirhynchus*, and *Acipenser* deserve special notice. A collection of thirty-eight nominal species of American Salmonoids are also exhibited, and an interesting set they are; these two sets are mostly represented by specimens preserved in alcohol. The National Museum of Washington has also sent over a fine and highly interesting collection of the fishes of Alaska and another of those of the Gulf of Mexico and East Florida, all alcoholic specimens, and not exhibited from want of space. Prof. Brown Goode kindly showed me some of them; the former contains about 100 species, the latter 159. The Alaskan collection is of special interest, and contains many species recently described by Goode, Bean, and other ichthyologists.

In the Canadian Court a numerous series of mounted and alcoholic fish is exhibited, mostly freshwater and well known food-fishes; large specimens of Salmonids, Clupeidæ, Esocidæ, Sturgeons, and Halibuts may be seen, and a curious *Læmargus borealis* and a very large *Orcynus thynnus* deserve notice. Some very large Cod may be mentioned in the Newfoundland Court, whilst on the other side of the equator in the new continent, Chili shows a collection of food-fishes, principally marine and from Juan Fernandez, the highly esteemed "Peje Rey" (*Atherinichthys*) and *Heliastes crusma*, a large representive of our interesting Mediterranean species, may be recorded.

Sweden shows a magnificent collection of her Salmonidæ, large and beautiful specimens wonderfully preserved in alcohol in the finest of glass jars; an interesting series of types and embryos and larval fish is besides shown by the Gothenburg Museum, but of special interest is the *Vega* collection from the Arctic seaboard. In the Russian Court a good collection of mounted fish is exhibited, amongst which are to be noticed a large *Silurus glanis*, a fine *Hippoglossus*, very fine and large specimens of *Lucioperca sandra*, an excellent food-fish, which with greater profit than the black bass of America might, I believe, be introduced into British waters; besides a fine set of the various species of sturgeon which abound in Russian waters, and lastly some good enlarged wax models illustrating the development of *Acipenser* and *Petromyzon*.

Norway again deserves notice as exhibiting some very fine specimens of rare fish preserved in alcohol or mounted; I may particularly mention *Argentina silus*, *Argyropelecus Olfersii*, *Sebastes norvegicus*, with embryos taken alive from the female, *Raja niderosiensis* (the type), *Scymnus microcephalus*, and a fine Opah (*Lampris guttatus*).

New South Wales (the Australian Museum of Sydney) has one of the very best ichthyological exhibits; besides very beautifully mounted specimens, and very well preserved alcoholic ones, a set of splendid coloured drawings from nature and of natural size, and a large series of photographs of fish are exhibited. Most of the remarkable forms and of the peculiar species of the fish-fauna of Australia are represented. I may specially mention those living fossils *Ceratodus* and *Cestracion*, both represented by two species, the former *C. Forsteri* and *C. miolepis*, the latter *C. Philippii* and *C. galeatus*; *Ceratodus miolepis*, exhibited in a dry skin, is the companion specimen to the type. Amongst others of the many interesting species exhibited may be mentioned *Galocerdo Rayneri*, *Carcharodon Rondeletii*, *Crossorhinus barbatus*, *Rhinobatis granulosus*, *Odontaspis taurus*, *Trygonorhina fasciata*, *Myliobatis australis*, *Rhina squatina*, *Temnodon saltator*, the singular *Glaucosoma*, with its mussel-like opercular appendage, &c. Some of the freshwater food-fish, as *Oligorus*, *Ctenolabris*, and *Therapon*, are noticeable. A remarkable sun-fish is also exhibited; it differs from our species in shape, in the size and form of the caudal rays, and lastly in being covered with small carinate horny scales, which appear to cover the osseous granulations of the dermis; I am inclined to think that it differs from our *O. mola*, belongs to the southern hemisphere, and if so, might go by the name of *Orthragoriscus Ramsayi*, as a just acknowledgment to Mr. E. P. Ramsay, Curator of the Australian Museum, who brought it over, and to whose intelligence and activity the splendid exhibit of the New South Wales Court is entirely due.

Tasmania shows a collection of stuffed and alcoholic fishes, some very interesting. A fine *Lophotes cepedianus* deserves special notice, as also specimens of *Galaxias*, *Retropinna Richardsoni*, *Histiopterus recurvirostris*, *Phyllopteryx foliatus*, and *Pristiophorus cirratus*.

India exhibits a very large collection of mounted and spirit specimens, from Madras and Bombay principally; worthy of special mention are fine specimens of *Histiophorus gladius*, *H. belone* (?), *Cybium guttatus*, *C. Kuhli*, *Caranx sansun*, *Megalops indicus*, *Drepane punctata*, *Corinemus lysan* (so like our *Lichia vadigo* in appearance), *Polyphemus plebejus*, *Thynnus thunnina*, the beautiful *Muræna tessellata*, *Barbustor*, *Catla Buchanani*, *Wallago attu*, *Macrones seenghala*, and other peculiar freshwater forms; some interesting Elasmobranchs, as *Rhynchobatis djeddensis*, *Stegostoma tigri*, *Trygon uarnak*, and a *Dicerobatis*, very like the Mediterranean species.

Scientifically, however, the most important ichthyological collection exhibited in the Indian department is beyond doubt that shown by Dr. Day—fine specimens in alcohol of several hundred species illustrated in his great work, "The Fishes of India." Dr. Day also exhibits a set of his coloured drawings of Indian fish.

The Straits Settlements exhibit a fair sample of the sea-fish of that region, unfortunately unnamed; there are also a few freshwater fishes from Singapore.

China has a rich and interesting collection of fish, and also some very good drawings of them. Unfortunately they also are unnamed. The fishes exhibited are principally in alcohol, and come mostly from Swatow; some are very rare, and others appear to be new to science; amongst those of some interest I may mention: *Elacate niger*, *Rhynchobatis ancylostomus*, *Zygæna malleus*, *Cestracion zebra*, and some fine species of *Pteroplatea*, *Trygon*, *Raja*. One fish of special importance is *Polyodon gladius*, from Tchang.

I have now finished, and hope I have been successful in giving a fair general sketch of the Vertebrata shown in the International Fisheries Exhibition; some of the contributions might, no doubt, have been better, but on the whole we may well be content with the opportunity thus given of seeing many good things.

London, July 17 HENRY H. GIGLIOLI

STELLAR NAVIGATION

Stellar Navigation, with New A, B, *and* C *Tables for Finding Latitude, Longitude, and Azimuth by Easy Methods.* By W. H. Rosser. (Published by Norie and Wilson, 1883.)

THERE can be no doubt that star observations, when the horizon is clear and well defined, are the best means by which the position of a ship at sea can be ascertained; as, by altitudes of two or more stars, in suitable positions with regard to the observer, the latitude and longitude can be obtained at the same moment, whereas single observations of heavenly bodies only give one element, and consequently it is not possible to obtain simultaneous observations for both elements during the day, unless either the moon, Venus, or Jupiter passes the meridian whilst the sun is above the horizon.

It is true that when the azimuth of the sun is changing rapidly the latitude as well as the longitude can be obtained from two sets of observations, taken at a given interval of time, provided the alteration in the position of the ship, during that interval, can be accurately determined; but this supposes a knowledge, not only of the course and distance traversed during the interval, but also of the tidal stream or current affecting the ship, which is usually uncertain.

Any writer or teacher, therefore, who impresses on navigators and students the importance of obtaining star observations is deserving of praise, for it is impossible to take too much precaution in ascertaining the position of a ship; cloudy or foggy weather may set in at any moment, and an opportunity lost can never be recovered.

Mr. Rosser has in the *Nautical Magazine* drawn attention to the value of Sumner's method of working out simultaneous observations of two or more stars, and there is little doubt that it is the best, as it is the only method by which results obtained from simultaneous observations of three or more heavenly bodies can be readily combined. It has been for years constantly used by the naval officers employed on surveying service, and in fact by most navigators, though, perhaps, they seldom take observations of more than two stars at the same time. We however prefer three for precisely the same reason we prefer three to two chronometers.

Sumner's method may be thus briefly described. As at a given moment of time each heavenly body is at the zenith at some point on the earth's surface, so at that moment circles may be described on which its altitude will be 80°, 70°, 60°, &c. If then the altitudes of two stars are obtained at the same instant, and the Greenwich time be known, the two circles of altitude may be drawn on the earth's surface with the points where the stars are in the zenith as centres, and the point where these circles cut will be the position of the observers. In actual practice it is not necessary to draw the circles, it is merely necessary to be able to draw the arc of a small portion of each circle; for the position of the observer being generally known to within twenty miles, the arc of the circle of altitude on which he is situated can be readily drawn.

The method of obtaining this arc of altitude formerly practised was to calculate the longitude with two latitudes, using the same two latitudes for each star, which gave four resulting longitudes; then, by plotting these four longitudes on the two parallels, and drawing lines joining the longitudes given by each star, two circles of altitude were obtained, which either cut in a given point, or would do so when produced, which point was the position of the observer.

This method of calculation was however quickly discarded for a more simple one, where one latitude only was used; for as the azimuth of a heavenly body can be readily calculated at the same time as its hour angle, and he azimuth being the bearing of the place where the star is at the zenith from the observer, it is evident that a line drawn at right angles to the azimuth will be the arc of the circle of altitude on which the observer is situated, as practically the arc is, for so short a distance as twenty or thirty miles, a straight line. The two longitudes on one parallel with the azimuth enable the two arcs of altitude to be plotted as before.

The importance of Sumner's method has not as yet been pointed out in any treatise on navigation, principally because since the time of Lieut. Raper, R.N., no treatise has been written by a practical navigator. It is true the method is mentioned in Riddle's "Navigation," and was taught by him many years since, though not in the form now adopted, and we think Mr. Rosser has done good service by urging its importance and the importance of stellar navigation generally. All navigators should in our opinion obtain star observations every night and morning, during twilight, as constant practice will alone render them expert in these observations, and familiar with the positions of the stars.

The extra work entailed by such observations will be amply repaid if, when standing in towards the land, after three or four days' thick weather, a partial break in the clouds enables the expert navigator to secure a couple of star observations which give him his position and enable

him to direct his course with confidence towards his point of destination. Whilst, however, giving Mr. Rosser credit for his advocacy, we cannot but regret he has thought it necessary to pad his pamphlet with problems which are in every good treatise on navigation, and with tables which are either useless or are to be found in a more complete form elsewhere.

In "Stellar Navigation," Problems I. to X. are simply repetitions from works already published, and we notice that in the examples given of obtaining hour angle and azimuth (pp. 9, 10, and 11), Mr. Rosser seems to be unaware of the existence of Raper's tables of logarithms of the log. sine square. Problem XI. is an example of Sumner's method, and is well explained, excepting that we think it far better and quite as quick a process to calculate the azimuth with the hour angle rather than refer to another set of tables. Problem XII. is what is called the new navigation, and is merely another, and in our opinion less simple, way of arriving at the same result as Sumner. Problem XIII., or Pagel's method, is merely to obtain the position by calculation instead of by plotting on a chart the two circles of altitude, and as this can be done by two plane triangles we should hardly have thought it required explanation. Problem XIV., to compute the altitude of a heavenly body, will be found in all treatises on navigation.

The Tables A and B are useless, for they are merely a complicated method of finding the error of longitude due to an error of one mile of latitude, which can be readily ascertained by the ordinary traverse-table. Table C., on azimuths, may be, as before stated, as readily and more accurately calculated at the same time as the hour angle. Table D is a combination of two tables invariably given in all treatises on navigation.

Table I., or mean places of stars, is given in the *Nautical Almanac*, which every navigator possesses; Table II. is given more elaborately in Jean's handbook for the stars, which every navigator should possess; and Tables III. and IV. are given in the *Nautical Almanac*.

THE STUDENT'S MECHANICS

The Student's Mechanics. By W. R. Browne. (London: C. Griffin and Co., 1883.)

THIS work, we are told in the Preface, "differs from the many previous works on the subject mainly in the fulness and care with which the foundations" (of mechanics) "have been considered," and it aims at such a treatment of the subject that the student may apply its principles "confidently in attacking questions of practical importance."

The book is characterised by a considerable amount of original and independent thought, especially in the earlier portion treating of First Principles. This is largely due to the definition of matter which is given:—"Matter consists of a collection of centres of force distributed in space, &c." We are not aware of any writer who has employed this hypothesis to deduce and explain the fundamental laws of mechanics in an elementary treatise. Nor does it seem to us at all well adapted to elementary students. It is so very important that they should see that mechanics depends, at every stage, in the establishment of its fundamental laws, on experiment, and also that they should know what the experiments are and in what way they serve to establish the laws, that the deductive method adopted by Mr. Browne, which does not sufficiently exhibit this connection, would seem to be unsuitable for the purpose he has in view. For though he explicitly states, once or twice, that the science of mechanics rests on experimental evidence, he does not point out the way in which it so rests, nor where the necessity for experiments comes in. As a specimen of his purely deductive method and, at the same time, of poor logic, we have a proof given on p. 9 which reads thus:—"We have defined a force as a cause of motion. Hence we see that, if a force has produced motion, it will be represented to us by the motion it has produced. . . . But motion is measured in terms of velocity. Hence, other things being equal, forces are measured by the velocities which they cause or generate." By the expression "other things being equal" must be understood (Art. 30) that "the things they act upon must be equal" (in what respect—of weight, volume, or mass—is not stated, although, from an illustration previously given, we are, presumably, to infer that their weights must be equal). If we substitute for *force*, *amplitude of vibration*, and for *motion generated*, *intensity of illumination*, all through the above proof, the reasoning will be equally plausible, and the conclusion false. Of course all that can be inferred from the fact of force having caused motion, apart from experiment, would be that the velocity might be expressed as a function of the force.

A possible source of much confusion to the student exists in the old-fashioned division of forces adopted in this book into statical, moving, and accelerating forces. The confusion will be increased by the introduction, in addition, of the more modern word "acceleration." In Art. 348 we have f called the acceleration in the formula $P = Mf$, whilst g is called the accelerating force of gravity; whilst in Art. 422 the actual tractive force P exerted by an engine on the following train is called an accelerating force.

The proof in Art. 359 is incomplete, owing to its not recognising the fact that the sum of an infinite series of vanishing quantities may be a finite quantity.

A valuable feature of the book is the prominence that is given to, and the early introduction of, the theory of the conservation of energy. The friction of machines is deduced from this principle in a very simple manner. The theorems of statics are very clearly put before the reader, and much that is suggestive and valuable is contained in the articles on elasticity and on the action of railway-brakes.

The book is one which may be read with profit by a student who is already familiar with elementary mechanics and is not liable to be confused by the peculiarities alluded to above, but does not seem to be adapted to students who approach the subject for the first time.

OUR BOOK SHELF

Manual of Taxidermy. A Complete Guide in Collecting and Preserving Birds and Mammals. By C. J. Maynard. Illustrated. (Boston: S. E. Cassino and Company, 1883; London: Trübner and Co.)

THIS small volume of 100 pages of thick paper contains the ordinary instructions for skinning, preserving, and

mounting birds and mammals, given very briefly, but probably with sufficient detail to serve as a guide to beginners. The author appears to be a dealer in natural history accessories, and the book has rather the aspect of a trade advertisement from its recommending the almost exclusive use of a "preservative" prepared and sold by the author, the composition of which he keeps secret. As a practical guide to English collectors in foreign countries it is very inferior to Mr. Ward's "Sportsman's Handbook," which was reviewed in NATURE last year (vol. xxvii. p. 146). A. R. W.

LETTERS TO THE EDITOR

[*The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, or to correspond with the writers of, rejected manuscripts. No notice is taken of anonymous communications.*

[*The Editor urgently requests correspondents to keep their letters as short as possible. The pressure on his space is so great that it is impossible otherwise to insure the appearance even of communications containing interesting and novel facts.*]

The Meteorological Council and Falmouth Observatory

THE Meteorological Council contemplate closing on December 31 next the Primary Observatories at Glasgow, Armagh, Stonyhurst, and Falmouth, which have been in full operation since 1868, and continuing only those at Kew, Aberdeen, and Valentia.

The Falmouth Observatory has a geographical position which insures it the first record from the south, and the position of the instruments is considered satisfactory by scientific men. It is superintended and managed by the Royal Cornwall Polytechnic Society, who for the small sum of 250*l.* per annum provide suitable buildings, an observer, assistant observer, gas, and the other necessary outgoings, thus supplementing by local effort the Treasury grant.

The Meteorological Office have been satisfied with the manner in which the Observatory has been managed. The accompanying report, which Prof. J. Couch Adams of Cambridge sent to the Meteorological Council at their own request, deprecates, on scientific grounds, the retrograde step contemplated by the Council, and I am requested by my Committee to invite through you the assistance of scientific men generally to prevent the discontinuance of so important an observatory as the one at Falmouth. EDWARD KITTO,

Secretary to the Royal Cornwall Polytechnic Society

Falmouth, July 30

Copy of the Document submitted to the Meteorological Council by Prof. J. Couch Adams, F.R.S., on July 5, 1883.

To the Members of the Meteorological Council.

In compliance with the wish expressed by some members of the Council at the interview of June 27, I have great pleasure in explaining my view on the matter then discussed more fully and clearly than I was able to do *viva voce*.

1. First I will say a few words about the relative value from a scientific point of view of a continuous record of meteorological phenomena when compared with occasional observations of the same phenomena.

In my opinion the continuous record would be in this case incomparably the more valuable. When we know the laws of variation of an observed quantity, occasional observations at intervals which may be settled beforehand are sufficient to determine all the constant quantities which enter into the expression of the law. On the other hand, when the law of variation is in a great measure or altogether unknown, as is the case with most meteorological phenomena, a continuous record may throw more light on the law or laws of variation than would be afforded by any amount of occasional observations.

I have no hesitation in expressing my belief that if we ever attain to a knowledge of the principal laws which regulate the weather, it will be as a result from continuous records, and not from occasional observations.

2. In the second place, in order to study the laws of variation of any particular phenomena, it is important to have continuous observations at different places which are not so far distant from each other as to make the circumstances of the phenomena at the different stations differ too widely from one another.

In this way only will it be practicable to study and trace the progress of a wave of disturbance of any kind across a given country. From this point of view I do not think that seven stations judiciously distributed over the surface of the British Isles are at all too many. Hence I should regard the proposed abandonment of four out of these seven stations as a retrograde step which is greatly to be deprecated.

3. In the first place I come to the circumstances which relate to the Falmouth Observatory in particular. The unique situation of Falmouth, nearly at the mouth of the English Channel, and considerably to the south-west of any of the other meteorological stations will render continuous observations made there peculiarly valuable. Most of our storms and other atmospheric disturbances come from the south-west, and therefore they would first affect and be recorded by the instruments at Falmouth. Valentia is the only other station which can compare with Falmouth in this respect, and I should consider the observations at Falmouth more valuable, as its more southerly situation enables us better to trace the progress of any disturbance across the southern and the central parts of England by comparison with other observations in those parts, while Valentia is too much to the north to answer this purpose.

4. Next I will consider the objection which has been brought against further continuing these observations, viz. that they have already been continued for twelve years, and nothing of importance has been deduced from them. Considering the complicated nature of the phenomena we are concerned with, it is not to be wondered at that little or no progress has been made in twelve years in unravelling their laws. Even in astronomy, if the fate of the Greenwich Observatory had depended on the results deduced during the first twelve years of its existence from the observations made there, the consequences to the progress of the science might have been disastrous. The fact that we already have twelve years' continuous observations at a given place makes any additional observations at the same place much more valuable. Thus twenty-four years' continuous observations at the same place would be much more valuable for any theoretical deductions than twelve years' observations at one place and other twelve years' observations at a different place.

5. There can be no doubt that one of the principal astronomical conditions by which meteorological phenomena are affected consists in the varying motion of the moon in declination, and this again depends on the position of the moon's node, which takes between eighteen and nineteen years to perform a complete revolution.

Hence it would be desirable that meteorological observations should be continued at the same place during one or more revolutions of the moon's node.

This is already well recognised to be necessary in the case of tidal observations. And here I may incidentally remark, though it does not directly affect the Meteorological Council, that Falmouth would be a very important station for making continuous observations of the tides.

6. If the present grant were withdrawn from the Falmouth Observatory, the Cornwall Polytechnic Society have not the means of keeping it up, and the abandonment of the Observatory would be a heavy blow to the cultivation of meteorological science in Cornwall and the West of England generally, where there are many local stations which regard Falmouth as their scientific centre. This is a matter which ought not to be indifferent to the Meteorological Council. No doubt it is no part of the duty of the Council to subsidise local efforts, unless indeed by means of such efforts the objects of the Council can be better and more economically carried out than would otherwise be done. I submit that this is the case in the present instance. The difference between the expenditure at Valentia, where the Meteorological Office has to defray the whole cost of the establishment, and the expenditure at Falmouth affords some indication of the advantages to be derived from local efforts.

7. Lastly, if it is absolutely necessary to reduce the expenditure on some branches of the work undertaken by the Meteorological Office, it may be inferred from what I have already said that in my opinion the continuous records are almost the last branch in which any reduction should take place.

(Signed) J. C. ADAMS

Determination of "*H*"

IT has occurred to me that the following notes of a rough determination of the value of the horizontal component of the

earth's magnetism, according to the method described by Mr. Andrew Gray (NATURE, vol. xxvii. p. 32), might not be without interest to some readers, as showing the amount of accuracy which can be obtained. The experiments were made by one of my students at this College about four months ago.

The form of reflecting galvanometer which lends itself best to these experiments is one devised by Prof. Stuart, in which the needle is centrally situated between two rectangular pieces of wood carrying the coils. To the sides of these, two boards can be easily attached by brackets, so as to be in the same plane as the needle, and quite horizontal, and in this position do not interfere with the light falling upon or reflected from the mirror. The reflecting magnet is then north or south of the needle, and perpendicular to it.

The magnets were made from thin knitting needles (about No. 19, B.W.G.), cut to the proper length, and made glass hard. They were made in two lengths, 8·5 and 12·5 cm., but the longer ones were slightly warped in hardening, and did not give concordant results. The scale was at a uniform distance of 62·5 cm. from the mirror, and in reading the deflections four observations were made and again repeated after noting the times of oscillation, as described by Mr. Gray. Each of the deflections given below is therefore the mean of *eight* observations.

The following are the details of the experiments :—

Denomination of magnet.	A.	B.	C.
Length	8·5 cm.	8·5 cm.	8·5 cm.
Weight	0·6760 grm.	0·6924 grm.	0·6900 grm.
Time of oscillation..	4·88 sec.	4·71 sec.	4·76 sec.
Deflection at 15 cm.	7·1 cm.	7·7 cm.	7·6 cm.
,, 13 ,,	10·6 cm.	11·5 cm.	11·2 cm.

From these results we obtain, by aid of the formula :—

$$H = \sqrt{\frac{4}{3}\frac{\pi^2 l^2 w}{(r^2 + l^2)^{\frac{1}{2}} T^2 \tan\theta}},$$

the following values for H :—

0·17705
0·17635
0·17828
0·17754
0·17725
0·17770

Mean = 0·17736 ± 0·00048,

showing an amount of accuracy which may, I think, be compared with that obtained with much more expensive and delicate apparatus.

T. S. HUMPIDGE

University College of Wales, Aberystwyth, June 27

The Lachine Aërolite

THE most remarkable fall of an aërolite that has yet been recorded took place at Lachine, about eight miles from Montreal, on Saturday, July 7, 1883. I give the following account from the Montreal *Daily Star* of July 11 :—

"The fall of the aërolite transpired during a rain shower on the forenoon of Saturday, and there were no premonitory indications to show that the air was more than usually charged with electricity. The person who witnessed the fall of the aërolite more clearly than any one else was Mrs. Popham, wife of Mr. John Popham, insurance agent. Mrs. Popham was seated in her house up stairs sewing, when all of a sudden the apartment became illuminated with a blinding flash of light. The lady instantly glanced out of the window, when to her astonishment she beheld a huge mass of fire descending towards the earth in a diagonal direction. This brilliant body had a solid nucleus that appeared to the eye about four feet square, and a strange, indescribable noise was caused by its flight through the air. Simultaneously, as it seemed to Mrs. Popham, she received a paralysing shock that affected her from head to foot, as if the entire contents of a highly-charged battery had been discharged into her body at once. The astonishing brilliancy of the meteor caused a temporary loss of sight, and it was fully half an hour before the lady could distinguish surrounding objects. When Mrs. Popham first beheld the falling mass she fancied that it was about to strike the house, and is still of the opinion that it must have passed alarmingly close. The lady took several hours to recover from the shock, and when Mr. Popham returned home several hours after he found her partially prostrated from its effects.

"Mr. McNaughton, a brother of Mrs. Popham, was sitting down stairs reading when the flash came. He jumped up, and, looking out of the window under the trees towards the river, he plainly saw the fiery ball strike the water at a little distance from the shore, causing a mountainous upheaval and sending splashes in every direction.

"Mr. Horace Baby also saw the glare caused by the flight of the meteor, although he did not actually see the body itself. He said that he felt a tremendous shock, and that he could feel the electricity oozing out of his finger-ends for some time after.

"Mr. C. P. Davidson, Q.C., was sitting down to lunch at the time, and describes the crash as being tremendous. The Rawlings family also felt the shock severely, as indeed did half the village. Mr. Popham's cottage stands about seventy feet from the water's edge at Stony Point, and it is thought that the aërolite fell into the stream about twenty or thirty yards from the shore, in about twenty feet of water. Owing to the high winds since the occurrence the water has been so muddy that it has been impossible to locate the whereabouts of the meteor. An attempt, however, will shortly be made to bring it to the surface."

I will send further details when they come to hand.

E. W. CLAYPOLE

New Bloomfield, Perry Co., Pennsylvania, July 15

Cold and Sunspots

YOUR correspondent, Mr. C. J. B. Williams, is wrong in the statement he makes in NATURE, vol. xxviii. p. 103, concerning the cold in California in the month of March. The month was the warmest March we have had for some years, the mean temperature being 3°·5 above the average, and 2°·8 above the average for the whole of the Pacific coast. February, on the contrary, was a very cold month, the mean temperature being 3°·6 below the average. I believe it will be found that the mean temperature of a hemisphere is not affected by sunspots. That the seasons, however, are influenced by the state of the sun's surface I have no doubt, but this only in a secondary manner. In a paper read before the California Academy of Sciences in 1870 (see *Proceedings*, vol. iv. p. 128), I pointed out that our extreme seasonal climates were caused by the prevalence of broad belts of north and south winds which would extend continuously from east to west for 1500 or 2000 miles, and would blow over the same surface for months together, causing extreme seasons with temperatures above the average where the south current prevailed, and cold winters where there was a northerly current.

As a general rule when there is a cold winter on the Pacific coast the winter in the Eastern States is mild. The following figures taken from the U.S. Meteorological Reports will illustrate what I mean :—

Mean Temperature for February 1883

Below the Average	°	Above the Average	°
North Pacific States ...	−4·3	North Atlantic States	+2·2
Middle Pacific region	−4·3	Middle Atlantic States	+4·3
South Pacific region ...	−2·1	Florida	+6·3

Thus while on the whole of the Pacific coast the temperature of the whole was from 4°·3 to 2°·1 below the average, on the Atlantic coast the temperature was from 6°·3 to 2°·2 above the average.

Towards the end of February the north current that had been prevailing over the western regions of the continent during the whole of the winter shifted to the east, and this change of longitude was accompanied by some of the worst cyclones that have visited the central and middle States for years.

During the month of March, whilst we were under the *régime* of a south current, the temperature in the Eastern States was low, the temperature in Massachusetts for March being 7°·3 below the average.

My own belief is that the connection between the character of our seasons and sunspots will have to be worked out through the influence of the sun on the regional distribution of air currents.

San Francisco, Cal., July 3 JAMES BLAKE

Intelligence in Animals—Can a Viper Commit Suicide?

HAVING occasionally caught a viper, and kept it for a time in a glass case, one of the platelayers called me last Thursday and said "there was a fine 'Long Cripple' (a local name for a

serpent of any kind) lying on the bank a few yards down the line." I went to the place indicated, and there was a very large viper basking in the sun, but when I got near, it began to move away, and to prevent its escape I gently pressed a stick across it while I sent the man to fetch a glass jar to secure it in; but when it found its progress arrested, it began in a very spiteful manner to dart its nose forward, striking at the stick and stones and anything that was within its reach, but I could not see that it opened its mouth to make a real bite; but when it found with all its wriggling and twisting it was unable to free itself, it turned its head round upon itself, and about four inches from the head it opened its jaws and gave itself a bite, and when the fangs were well into the skin, it gave an extra squeeze, as if it intended to make sure that the operation should be thoroughly and effectively performed. It then deliberately withdrew its fangs, and in so doing it turned its head first one way and then the other, so as to withdraw one fang at a time.

Its head then went forward, and its body and tail became straight, and there lay the viper apparently lifeless, but I noticed a slight tremor in the skin and scales, which gradually passed from the head to the end of the tail. I took it up with my hand and placed it in the glass jar, and stood the jar in the window where the rays of the sun were hot, and in twenty five minutes the viper began to show signs of life, and in an hour it was as lively as if nothing had happened.

I should be glad to know whether it has come to the knowledge of any of the readers of NATURE that any human being or any animal has died from the bite of a viper. In my boyhood I have known sheep being bitten in the under jaw near the lip, and the animal's head has swollen very large, but invariably the sheep were well again when seen early on the following morning.

Some twenty years ago I saw a man who had been bitten in the hand by a viper, and his arm swelled and turned purple in places, and he was sick and faint for some hours, but he told me he was as well twenty-four hours after the bite as he was before.

R. LANGDON

Silverton Station, Cullumpton, Devon, July 28

A Cat and a Chicken

THE account I extract below was given in a local paper dated May 30 last:—

"*Strange Attachment.*—A curious instance of the above was brought to our knowledge by Mr. Hibbs, of the 'White House,' Swanage. A hen sitting on thirteen eggs hatched out twelve chickens on the 15th inst., but during her sitting four stray eggs had been laid in her nest, and as the eggs had not been marked these could not be removed. The hen with her little brood were not taken from the nest till two days later, when one of the stray eggs was found to be just bursting its shell. Mrs. Hibbs, in trying to assist the little stranger by removing the shell, somewhat injured it, and thinking it would die, and not liking to kill it herself, she thought that her cat (which happened to have a kitten a few days' old) would make short work of it. Strange to say the cat commenced to remove all the shell from the hatching chick, and then to shelter it with her kitten; since which she has carefully looked after it, and it is certainly a pleasing and unusual sight to see the little chick nestling between the forepaws of its foster mother with the kitten in close proximity. Mr. Hibbs tried to put the chicken with the rest of the brood, but the cat was so uneasy until the chicken was restored to her, that Mr. Hibbs has decided to let her have her own way, and bring them up together."

I kept the paper by me, intending, if I could verify the incident, to send the report of it to you. But under pressure of other writing it was not till a week ago that I addressed a letter to Mr. Hibbs. Last night I received from Mr. James Andrews of Swanage the following reply:—

"*Faircross, Wyke Regis, Weymouth, July* 24, 1883

"DEAR SIR,—David Hibbs of Swanage has forwarded me your letter of the 19th inst., asking me to reply to it. This he has done, I presume, as I had put his paragraph to the paper a little into 'ship-shape' for him

"I am a resident at Swanage, and the bank manager there, and can vouch for the details of the 'Strange Attachment' just as recorded. I went round at Hibbs's request when the chicken was four days old. The old cat was lying down—the kitten asleep—and the little chick nestling with the cat, who would lift up her foreleg whenever the chick came near, to allow the chick to nestle under its arm, when it would close its arm around it in a most amusing and affectionate way, and seemed to be much more anxious about it than her own kitten. They began feeding the little chick at the first by sprinkling sop on the hair of the cat, which the chick would pick off. I do not know whether Hibbs has replied to you as well, as he did not say, but I hope the above will be sufficient.—JAMES ANDREWS."

It is to be noted that these aberrations from inherited habit—to which we have given the convenient name of instinct—occur almost invariably under the strong solvent of the maternal στοργή; but that they should occur at all points strongly towards the essential oneness and common origin of all life—however widely it may have deviated later along its ancestral lines of descent.

HENRY CECIL

Bregner, Bournemouth, July 25

Primæval Man and Working-Men Students

I RECEIVED a letter with great pleasure a fortnight ago from four new correspondents, who said they were working-men of Plaistow who had read my notes on Primæval Man in NATURE, had studied the Pitt-Rivers collection, and wished to show me their finds in Essex and have the North-East London position personally explained to them. Sunday having been mentioned as a convenient day, and this being approved by me, my correspondents (Messrs. W. H. Smith, Amos Herring, W. Swain, and Philip Thornhill) came here on Sunday morning, July 29. The stones brought were of great interest, mostly belonging to the Essex positions published by me. One example was a superb, rather large, wedge-shaped, pointed, slightly abraded, and ochreous implement found at Leyton; two were from Plaistow, a locality almost unrepresented in collections; one from West Ham, and other pieces from Wanstead. A somewhat small ovate specimen of great interest was found by one of my correspondents in the gravel excavated for the New Albert Dock, the extension of the Victoria Dock. The object of the greatest interest was a rude scraper-like tool made from a somewhat large piece of tabular flint, and found in gravel excavated between Loughton Railway Station and the "Robin Hood" Tavern, undoubtedly artificial and palæolithic; this ancient gravel is I think usually placed in the Glacial series; the find must be accepted as genuine. I may say here that on the 23rd of this month I found another implement and six flakes in gravel brought from Ware.

After my friends had looked over the collection here, listened to a few hints, and received a gift each of an implement from my own store in pleasant remembrance of the visit, we went to see some of the small excavations still open near Stoke Newington Common, in one of which the line of the "Palæolithic Floor" was distinctly visible, covered with about two feet of "trail and warp" and surmounted by humus. We then went into the Lea Valley, the meaning of the wide and deep excavation since palæolithic times being well understood by my visitors.

38, Kyverdale Road, N. WORTHINGTON G. SMITH

A Remarkable Form of Cloud

THE peculiar cloud formation observed by Mr. Hopkins and communicated to NATURE, vol. xxviii. p. 299, was also seen by me on Sunday, July 22, at 10.35 p.m. What I saw accords almost perfectly with the description given by Mr. Hopkins; but there was one rather important exception. Starting from a little above the horizon in the north-north-west I observed the position of another arch of cloud, clearly defined, strictly parallel to the principal arch, and ending somewhat abruptly about 20° from the zenith. The main streak was separated from it by about three times its width, and the intermediate space was quite clear. Both clouds appeared comparatively dense, and were situated at a moderate elevation. I did not notice any change in their appearance, nor did I see them break up.

It seems not improbable that currents of air from the north-north-west, passing through an otherwise tranquil but vapour-laden atmosphere of a much lower temperature than the surrounding air, may have originated these streaky bands of cloud by condensing the aqueous vapour suspended along their course into definite form.

ARTHUR EBBELS

Clapham, July 31

WITH reference to Mr. Hopkins's letter in NATURE last week (p. 299), I may say that I observed the bow-like band of

cloud, and noticed that it had what I may compare to a bow-string stretched from end to end. On Thursday, July 19, from 11 to 12 p.m., the whole sky was divided by such bands converging east and west. This was noticed by many persons in Essex, where I was staying. E. C. WALLIS

31, Meadow Road, S.W.

ON MOUNTING AND PHOTOGRAPHING MICROSCOPIC OBJECTS[1]

II.

THE prepared slide fixed in a clip should be placed on a hob or in a cool oven (not above 50° C.) for two days, by which time the excess of balsam round the edge of the cover will have become brittle, and can be removed with the point of a scalpel or penknife. Any balsam still remaining can be cleaned off with methylated spirit and a clean soft rag. The final cleaning of the slide may be done with soap and water. As the balsam itself serves to secure the cover to the slide, no cement or varnish is needed, and it remains only to label the object.

After successfully mounting this object, no difficulty will be experienced in applying the same methods to other small insects and parts of insects, such as antennæ, spiracles, feet, wings, ovipositors, corneas, tracheæ, &c. The two last cases, however, require careful dissection.

Animal hairs are best mounted in balsam, and the only special treatment they require is soaking for a short time in ether to remove grease.

The siliceous skeletons of diatoms and spiculæ of sponges and Holothuriæ require cleaning from extraneous matter by treatment with strong acids, but space will not allow a description of the details of their preparation.

The mounting of the organs and tissues of the higher animals and plants should not be attempted until tolerable facility has been acquired in the preparation of the simpler objects previously mentioned, as their structure is usually revealed only by the somewhat difficult process of cutting thin sections of them.

Most animal substances require hardening before they can be cut. Hardening may be thus effected. The perfectly fresh tissue is to be cut into pieces about the size of Spanish nuts, and soaked in ten times its bulk of a solution, consisting of one part of methylated spirit, and two parts of a ½ per cent. solution of chromic acid. At the end of twenty-four hours, and again after every third day, the solution is to be changed. After a week or fortnight the pieces should be well washed in methylated spirit, and will then be hard enough for cutting.

The next process is to embed the tissue in some substance firm enough to afford it support, yet soft enough to be readily cut with it. A good material for this purpose is a mixture of three or four parts of solid paraffin (paraffin candles), three of lard, and one of paraffin oil. It should be heated just sufficiently to keep it fluid, and the hardened tissue from which the excess of alcohol has been drained should be soaked in it for a quarter of an hour if of moderately close texture. If of very open texture—lung or testis, for instance—it must be soaked for about half an hour in rectified alcohol, and for a like period in absolute alcohol, to remove all traces of water. Then after displacing the alcohol by a quarter or half an hour's immersion in oil of turpentine, the tissue may be placed in the melted wax, which being readily miscible with the turpentine, will gain access to all the interstices of the substance.

A mould must then be prepared by gumming a piece of paper round a cork or cylinder of wood, the paper being allowed to project about three-quarters of an inch. Into this mould the substance is to be put, and the space filled up with some of the melted wax. When quite cold the paper may be stripped off, and the preparation will be ready for cutting with a razor, wetted with spirit to prevent adhesion of the sections.

The sections as they are cut are to be floated off the razor into methylated spirit, from which they may be transferred to a staining fluid.

The object of staining is in most cases not simply to impart a general colour to the object, but to take advantage of the fact that different parts are affected in different degrees by the same dye and are thereby clearly discriminated. Thus if an ammoniacal solution of carmine be employed, the structures which are first and most deeply stained are nuclei, axis cylinders of nerves, and ganglion corpuscles. To a less extent it stains the protoplasm of gland-cells and connective tissue corpuscles. But if the action be too long continued, the whole will be deeply and uniformly stained, and the selective power will be lost.

Carmine solution may be prepared by dissolving with the aid of gentle heat 2 grammes of carmine in 4 c.c. of ammonia and 48 c.c. of distilled water. Continue the heat or expose to the air until the smell of ammonia has almost disappeared, and then keep in a well-corked bottle. When required for use, a few drops of this solution should be added to a watch-glass full of water.

Logwood resembles carmine in its action and is by many preferred to it. It may be prepared as follows:—12 grammes of extract of logwood and 36 grammes of alum, both in fine powder, are to be mixed with 60 c.c. of distilled water, stirred well with a glass rod and filtered. Add to filtrate 5 c.c. rectified alcohol. Dilute with two or three times its volume of distilled water when used. When the tissue has been hardened with chromic acid, the sections should be soaked for a few minutes in a 1 per cent. solution of sodic bicarbonate to neutralise the acid before staining in logwood.

No general rule can be given for the length of time the section must remain in the staining fluid. It will vary from a few minutes to as many hours, and the section must be removed and examined with the microscope from time to time to see when the process has gone far enough.

When sufficiently stained, the excess of staining fluid is to be drained off and the section passed through rectified spirit 60 O.P., oil of cloves, and oil of turpentine, remaining about five minutes in each, and may then be mounted in balsam as already described.

For displaying tesselated epithelium in mesenteries, lungs, and blood-vessels, nothing can be more beautiful than staining by oxide of silver reduced from the nitrate. The perfectly fresh membrane or the section of hardened tissue as the case may be must be well washed with distilled water and then soaked for five minutes in a 5 per cent. solution of nitrate of silver. It is then again to be washed and exposed in distilled water to sunlight until it assumes a brown colour. The necessary exposure will vary from ten minutes to an hour or more. After a final wash in distilled water, it may be treated like objects stained by other methods. By this treatment the tissue assumes a general pale brown tint and the outline of every cell is sharply marked out by a deep brown deposit of argentic oxide in the intercellular substance.

Many vegetable tissues, such as cork, pith, succulent leaves, and some fruits, tubers, and roots, can be cut without previous preparation, and for such as are too soft to be cut in the fresh state the process of hardening is simpler than that employed for animal substances. Dehydration by simply soaking for a day or two in methylated spirit usually suffices.

Stems of plants usually require softening before cutting, and this softening can be effected if the wood is young by two or three days' immersion in methylated spirit to remove resinous matter, followed by maceration for from four days to a week in water. When the wood is old or unusually hard, the maceration must be prolonged or the

[1] Concluded from p. 303.

specimen may be boiled for a short time. Longitudinal sections may be cut by gluing the piece of stem to a cork to afford a hold upon it.

The preparation of sections of minerals and rocks is usually considered a very difficult matter, but much may be accomplished without the aid of the usual lapidaries' wheel for cutting and the revolving lap for grinding the sections, if the microscopist provides himself with a flat piece of lead six to ten inches square, and two pieces of boiler plate of the same size, planed on one side. A chip of the rock may be ground flat on the leaden lap, charged with coarse emery and water, and the process continued with emery of moderate grain on one of the iron plates, and the finest flour emery on the other. The flat side being then cemented with balsam (undiluted) to a piece of plate-glass about an inch square, the process of grinding may be repeated on the other side of the chip, until it becomes perfectly transparent. It may then be detached from the glass by soaking in benzole, and mounted in balsam in the usual way.

When the sections are to be mounted dry, which is very rarely the case, the fine scratches left by the flour emery must be removed by giving the section a final polish on a hard and flat oilstone reserved for the purpose and wetted with clean water only.

When it is desired to preserve the natural colour of objects, especially of such as contain chlorophyll, the necessary preliminary treatment with alcohol raises an objection to the balsam process, and another objection is that some tissues are rendered too transparent, and many of their finer features are obliterated by the highly refractive balsam.

In these cases the object must be mounted in some aqueous medium, the best and most convenient being a preparation of glycerine and gelatine, which forms a transparent jelly when cold, but is easily liquefied by heat. It is best to buy this "glycerine jelly," as it is troublesome to make on a small scale. When required for use it must be liquefied by standing it in a cup of hot water.

In general, objects to be mounted in glycerine jelly should not be embedded, but if any support is needed in cutting, this should take the form of two pieces of cork hollowed out to the shape of the object.

Water in the objects no longer presents any difficulty in this method of mounting, but air has still to be contended with, and the methods adopted for its elimination in the balsam process are no longer applicable. Some objects may be freed from air by boiling in water for a few minutes, but many would be spoilt by such treatment. Recourse must then be had to the air-pump, or, if this instrument is not accessible, to a very simple process depending on the great solubility of air in water.[1]

A wide-mouthed bottle of about four ounces capacity, with a closely fitting *solid* stopper, is completely filled with water, which at the time is, and for half an hour previously has been, boiling, in order to expel all traces of dissolved air. The stopper being then inserted without inclosing a single air-bubble, the bottle is set aside until cool enough to receive the sections, which are then to be put into it. A few drops of boiling water are then to be added to make good the inevitable loss in removing the stopper; the bottle is to be again closed, wiped dry, and securely sealed with melted paraffin. After twelve hours it may be opened, and the whole contents turned into a white porcelain shallow dish. The sections can then be easily seen, and picked out with a section-lifter, and should be soaked for half an hour in a 50 per cent. solution of glycerine before mounting.

The process of transferring the object to the slide, applying the liquefied jelly, and lowering the cover, are exactly the same as in the balsam method, and the slide should be set aside in a clip for a few hours for the jelly to solidify. In cold weather it is advisable to warm the brass table by means of a spirit lamp, or the jelly may viscify too quickly.

When quite cold and set, the excess of jelly may be cleaned from the edges of the cover glass, and the slide may then be ringed with asphalte while running in the turntable. Two or three subsequent coats of asphalte and the attachment of labels will complete the slide.

The objects for which glycerine jelly is most suitable are the lower forms of vegetable life—Algæ, Desmidiaceæ, Characeæ, Hepaticæ, Fungi, Lichens, Mosses, &c., and cuticles and sections of plants of all kinds. Many animal tissues are also better seen in it than in balsam.

It is but seldom that other preservative media are required, and it will be found that almost all objects may be suitably preserved by one of the three methods here described.

Closely related to the preparation of objects for microscopic examination is their delineation by photography, an art of the greatest value on account of its freedom from bias and personal equation, and as a means of lecture illustration with the aid of the lantern it must be appreciated by the numbers who have experienced the difficulty of demonstrating microscopic structure to many persons.

This application of photography, which is almost as old as the photographic art itself, extending back to the days of Daguerreotype, owes its recent development and simplification mainly to the introduction of gelatine plates, and the object of Mr. Malley's work [1] (which, however, should be called Photomicrography, for it does not treat of the production of microscopic photographs, as its name would imply) is to show how in an ordinary room, with an ordinary microscope, photographic camera, and paraffin lamp, photographs can be taken which will bear comparison with those obtained in the old days by the aid of sunlight reflected from expensive heliostats, electric arcs, magnesium and lime light, microscopes of special construction, and rooms specially set apart for the work. It therefore appeals to a large class of persons—those who would wish to practice the art, but lack either the sunlight hours or the expensive illuminators and apparatus formerly considered necessary.

The microscope, camera, and dark room, with their accessories, and the method of working with the Swan incandescent lamp and sunlight are described in detail, but the reader is perplexed by references to an illustration which cannot be found in the book. Four Woodburytype reproductions of photomicrographs of Aulaucodiscus, Pleurosigma, and Surirella, scales of Lepisma, and Bacilli in human lung, accompany the work.

The instructions for taking negatives by the wet collodion and gelatino-bromide processes and the production of positives, enlargements, &c., are clear and concise, but we must enter an emphatic protest against the author's opinion that in object-glasses for photomicrography, depth of focus or penetration is to be sacrificed to angular aperture. Penetration and flatness of field are really of greater importance in lenses for photographic than for visual purposes, for in viewing an object under the microscope the observer has the power of focusing in rapid succession, and by imperceptible gradations, points at different depths and different distances from the centre of the field; but a photograph represents only such structures as were in focus at the time of exposure, and once taken, the focus is unalterable. It is therefore desirable to secure as great a depth of focus and as flat a field as possible—qualities which are incompatible with large apertures.

Mr. Malley very properly advises his readers not to walk about during the exposure of a plate, but the extension of the prohibition to speaking also is surely an unnecessary restraint.

[1] The writer cannot remember where he has seen this process described, but he can testify to its efficiency.

[1] "Micro-Photography," by A. Cowley Malley, B.A., M.B., &c. (Lewis, Gower Street.)

PROPOSED ZOOLOGICAL STATION AT GRANTON, NEAR EDINBURGH

AT the half-yearly meeting of the Scottish Meteorological Society held at Edinburgh on Thursday last week, Mr. John Murray, convener of the Society's Fisheries Committee, submitted the following Report :—

"The Fisheries Committee of the Council appointed in February last have had under their careful consideration the matters remitted to them by the Council, viz. the carrying out of investigations in accordance with the terms of the grant of 1500*l.* made to the Society by the Executive Committee of the International Fisheries Exhibition held in Edinburgh in 1882. The Committee recommends (1) to continue and extend the river observations and the observations made by the District Fishery officers through the Scottish Fishery Board, and to discuss all observations made to the end of the fishing season of 1883, which are yet undiscussed.

"2. To obtain the assistance of a few naturalists in making observations at several of the chief fishing centres and principal inland lakes. Prof. Herdman has consented to reside at Loch Fyne for a month, and to arrange for observations for a year. Mr. Hoyle is in like manner to go to Peterhead, and Mr. Beddard to Eyemouth. The Rev. Dr. Norman has during the present month been engaged in examining a large number of the Scottish lochs. Instructions have been drawn up for the guidance of these gentlemen, and a sum not exceeding 50*l.* has been placed at the disposal of each for the expenses immediately connected with the investigations. These observations are of a strictly tentative character, but will certainly lead to additions to knowledge, and are, moreover, necessary as a basis for further investigations.

"3. The Committee have had under consideration the recommendation of the Executive Committee of the Fisheries Exhibition as to the foundation of a zoological station. A number of the members of Committee have examined the capabilities of the old Granton Quarry, which has been for many years in direct communication with the sea, as a suitable position for a zoological station.

"The convener has drafted the following scheme, which in the opinion of the Committee would, if carried out, afford excellent facilities for biological researches and meteorological observations bearing upon these inquiries :—It is proposed to inclose the Granton quarry, which has an area at high water of about ten acres, and depths varying to sixty feet, so as to regulate the inflow and outflow of the tide in such a manner that while admitting abundance of sea water at each tide, fish and other animals will be prevented from escaping out of the inclosure. This will be done by means of stakes and wire with other kinds of netting. The quarry will then be stocked with all kinds of fish and marine invertebrates. When it is desired to separate fish or other animals for special study this will be done by floating or fixed wire and wood cages.

"A barge, about 64 feet by 27 feet, of great stability, will be moored in the inclosure; upon this will be built a house with laboratories, workrooms, and a library; it will also be furnished with a small windmill to pump up sea water into a tank on the roof. The water in this tank will be conveyed by pipes to the various tiled tables, glass jars, and aquaria of the establishment. A small cottage will be built on the shore for the accommodation of the keeper and engineer, with one or two spare rooms. A steam pinnace for dredging and making observations in the Firth of Forth and the North Sea will be attached to the station.

"A naturalist will be appointed whose duty will be to make continuous observations and experiments, assisted by the engineer and keeper. There will be ample accommodation for four other naturalists to work at the station and carry on investigations; and, so far as the accommodation will permit, British and foreign naturalists will be invited to make use of the station free of charge.

"Towards the carrying out of this scheme the Duke of Buccleuch has liberally granted a lease of the quarry at a nominal rent, with permission to erect a cottage on the shore; and Mr. Howkins, his Grace's local commissioner, has promised all the assistance in his power to further the undertaking. A gentleman who takes a warm interest in the progress of research in Scotland has offered 1000*l.* to construct the barge and fit it up with laboratories and workrooms. Mr. John Henderson (of Messrs. D. and W. Henderson, shipbuilders, Glasgow) has undertaken to provide the plans and specifications of the barge and laboratories gratuitously; Mr. J. Y. Buchanan has promised to fit up one of the rooms on the barge as a chemical laboratory suited to the requirements of the station; Mr. Thomas Stevenson, the Society's Honorary Secretary, has agreed to give his professional services in inclosing the quarry gratuitously; and Mr. John Anderson, of Denham Green, has undertaken to provide the station with a salmon and trout hatchery. The convener will furnish the laboratories with apparatus, and place his large zoological library at the service of workers. A number of gentlemen have promised to support the undertaking when once commenced; and the convener believes that within a few months he will be able to announce that the station has been presented with a steam pinnace and with funds for the erection of a cottage on the shore—the only desiderata to complete the scheme.

"In these circumstances the Committee, believing that this scheme deserves their hearty support, recommend, for the year ending November 1, 1884, a grant from the Fishery Fund not exceeding 300*l.*, and 250*l.* for each of the two subsequent years, towards the expenses of the station, on the conditions that the biological and meteorological observations and the investigations above referred to, relative to the Scottish fisheries, be carried on, and that a report on the work done be annually furnished to the Council of the Society."

The above grants were agreed to, and it was announced that the works at Granton would be commenced at once. It is expected that by the beginning of November the proper work of the station will be begun. Already, we understand, several distinguished naturalists have signified their intention to avail themselves of the altogether unique facilities which will be afforded by this zoological station for the successful prosecution of biological research. It is gratifying to observe the heartiness with which the funds required for carrying out this admirable scheme are being provided, and it cannot be doubted that the 800*l.* still required for the steam pinnace, the 500*l.* for the cottage, and the 200*l.* for inclosing the quarry will also be soon provided by some of our more generous patrons of science.

ELEVATION AND SUBSIDENCE; OR, THE PERMANENCE OF OCEANS AND CONTINENTS

IT has been observed, and with increasing frequency within the last few years, that wherever considerable weight is added on any part of the earth's surface, a corresponding subsidence of its crust almost invariably follows. It is generally admitted that nearly the whole of the sedimentary rocks, enormous as their known thickness is, were deposited in shallow water, and therefore in slowly subsiding areas. The Palæozoic rocks consist mainly of sandy and muddy sediment, with occasional intercalated zones of limestone. They everywhere bear witness to comparatively shallow water and the proximity of land. Their frequent alternations of sandstone, shale, conglomerate, and other detrital materials, their abundant

rippled and sun-cracked surfaces, marked often with burrows and trails of worms, as well as the prevalent character of their organic remains, show that they must have been deposited in areas of slow subsidence, bordering continental or insular masses of land.[1] Vast thicknesses of strata have been continuously deposited at or near the sea-level. The coal-measures present a series of alternating layers of vegetable matter and brackish water sediments, reaching in the South Wales district a thickness of upwards of 10,000 feet, whose accumulation must have been accompanied almost foot by foot by a corresponding subsidence. The Cambrian sediments accumulated in the British area to a thickness of 23,000 feet apparently without any great change in the depth of the sea in which they were formed; and throughout the deposition of the whole of the Silurians, subsidence seems to have kept pace with sedimentation. The Permian again furnishes many instances of sedimentation at or near the sea level sustained throughout great thicknesses, and of frequent alternation of marine and freshwater deposits. Among Mesozoic rocks, the New Red Sandstone furnishes an example of isolated basins of deposit to which the sea found repeated access, though a thickness in places of 3000 feet had accumulated in them. The German Triassic basin is for the greater part of its thickness a succession of terrestrial deposits containing plant-remains. The Jurassic and Cretaceous systems were deposited during interrupted depression of the sea bottom, while the Tertiaries abound with local instances in which subsidence has kept pace with sedimentation.

The washing of sea-coasts and removal of material shown by the discoloration of the sea for miles round the shore in stormy weather, shows that the process of accumulation of sediment still progresses on a very large scale.[2] It has been ascertained that nearly the whole of this must be redeposited within a distance of thirty miles. If the waves have no disturbing power at a greater depth than 40 feet, and could therefore neither deepen the sea-bed nor prevent its silting up to within that depth, our shores should be surrounded by enormous tracts of shoal water, whose bottom might be grooved or deepened by local currents, but whose average depth would not exceed 40 feet, or even less, since many rocks are so protected by seaweed that their further degradation when once below the reach of surf must be inappreciable. There is no cause therefore capable of generally deepening the sea round coasts beyond some such limit as this, except subsidence, and this can only be ascribed with any semblance of probability to the accumulating weight of sediment. The prevailing tendency on sea-margins is and must be towards depression, and there are few residents on the sea-coast who would be unable to contribute valuable observations on this point. It must however be remembered that while raised beaches are conspicuous objects, depressed beaches could obviously hardly ever attract attention, even if the shingle had not been removed by the surf, and further, most, if not all, of the existing raised beaches may have been formed during the general elevation of the land that took place at the close of the glacial period.[3] Other observers have recorded numerous submerged forests on the coasts of Cornwall, Devon, Somersetshire, and Wales. An elevation of the coast may, on the other hand, be sometimes accounted for when due consideration is given to the surrounding conditions.[1] It may, for instance, conceivably be produced on any shores where considerable sediments are forming at some distance out to sea or where masses of cliff are being washed away.

The extreme sensitiveness of the earth's crust to any changes in the distribution of weight on its surface is, however, best exemplified by those local depositions and removals of matter which have attracted more general attention at the present day. The chief of these is the transfer of matter by river action from large tracts, and its accumulation in such limited areas as plains, estuaries, and deltas. Borings of 400 and 500 feet have shown that these often consist of long successions of silts, which alternating layers of sheils and of vegetable matter prove to have been deposited at or near the sea-level, and the Wealden and Eocene formations in the British area show that such accumulations may exceed 1000 feet in thickness. In the case of deltas, subsidence must keep pace almost foot by foot with the accumulation, and be confined to the area over which the sediment is being deposited, for any more rapid subsidence would check its growth and convert it into an estuary. This sinking is apparently of universal occurrence.

A similar instance of the transfer of weight from larger areas and its precipitation on a very circumscribed area[2] is seen in coral atolls and reefs. The explanation of their formation given by Darwin requires a gradual subsidence keeping pace with their growth, which takes place within twenty fathoms of the surface only. This theory, simple and admirable as it is, accounting satisfactorily for all the observed phenomena of coral growth, has been contested by Mr. Murray, who has shown that atolls might be merely incrustations of volcanic peaks. But his theory seems improbable by contrast, for it demands 290 volcanic peaks at the sea-level in the Pacific coral area alone, every foot of which has been completely concealed by coral growth, though few volcanic craters are known so near the sea-level outside this area. We seem thus to have in coral growths another evidence of subsidence keeping pace with the increase of weight, sometimes, as soundings prove, to a depth of 1000 feet or more. The replacement of a column of sea water 100 fathoms in depth, by a column of limestone, would increase the pressure per square fathom from 619½ tons to 1487 tons, so that it is easy to realise how vast must be the increased pressure on such an area as that occupied by the great reef of Australia, 1250 miles long and 10 to 90 miles broad.

The sands, gravels, and clays, with marine shells and erratic boulders, prove that a great submergence took place during the Glacial Period, while Europe was under an ice sheet 6000 feet thick in Norway, and diminishing to 1500 in Central Germany. The extent of the submergence has been perhaps understated at 600 feet in Scandinavia, and was at least 1350 feet in Wales. A corresponding re-elevation accompanied the disappearance of the ice. It has often been supposed that the sinking of the west coast of Greenland is similarly due to its ice-cap.

It is probable that great outflows of lava may in like manner occasion subsidence—though it is by no means

[1] "Text Book of Geology," Geikie, 1882, p. 647.

[2] M. Marchal has estimated that the sea deposits annually 600,000 cubic metres of sediments in the Bay of Mont St. Michel, and 10,000,000 on the coasts of Flanders, Zealand, and Norfolk.

[3] My own experience on the south coast is that the weight of evidence points to a general sinking, for vestiges of submerged land vegetation and traditions of submergence are very frequent. At Bournemouth I have seen heath plants and roots, fresh-looking except for the incipient formation of pyrites, cast up from a tract of moorland now below the sea-level. Poole Harbour would long since have been left by the sea if there were no subsidence, and a landing-stage with rings found below low-water mark furnish valuable data as to the amount that has taken place in historic times. The Solent must have been originally a harbour like that of Poole, continually silting, sinking, and enlarging, the depression travelling west and cutting one river after another from the sea until the western channel was at last opened. The immense accumulations of mud in its channel seem to have dragged the land into a sort of trough with raised sides, so that the Yar, Medina, and Brading Rivers flow inland instead of out to sea. On its margins we find there have been oscillations of level, caused perhaps by alterations in the position of the sediments through changing currents. The inroads of the sea at Pagham and Selsea show the downward movement to have extended along the whole of the Hampshire coast.

[2] An elevation, for instance, has taken place on the Kentish coast which has closed the Stour to navigation and caused the sea to retreat from Stourmouth, Richborough, and Sandwich, and which is also marked by the great exposures of Eocene along this part of the coast above low-water mark, and which could hardly exist where exposed to strong tidal and wave action, unless the abrading process were counteracted. The immense deposits, taking place at a distance from shore, brought down by the Thames, must lead to considerable subsidence in its estuary and consequently some corresponding elevation along its shores. The Thames sediment is of unknown depth, but on its margins at Sheerness the alluvial mud is 80 feet thick, and at Upchurch, opposite Queensborough, 75 feet.

[3] But 38 per cent. of solids preexisted in the water displaced by the rock.

so well ascertained a fact. I have, however, observed in Iceland that lava-streams very frequently terminate in or flow under lakes or gulfs of the sea, though water presents no obstacle to their continued progress. Lakes have been filled in solid by outpourings of lava, and had those I observed existed previous to the flows the lava must have entered them in a more abrupt manner, and it seems therefore likely that they are depressions caused by the weight of the lava. But there are also instances in which the actual depression produced by the weight of lava-streams can be seen. A great lava flow has at some period debouched from Skjaldbreith, and from two other nameless craters to the south-east, on to the historic plain of Thingvállir, forty square miles of which is water. At its northern end the lava is still in its original position upon the slopes, but the whole central mass in the plain has torn itself away from the sides and sunk a hundred feet, leaving vertical cliffs of solid lava of that height on its flanks.

Again, near Mývatn there is an immense tract of lava, the latest contribution to which, estimated by Mr. Lock at 31,000,000,000 cubic feet, welled out in 1875. This tract, known as the Örœfi, presents a somewhat analogous instance, for the centre of the flow has also broken away from its flanks and sunk. Mývatn, a lake of some thirty miles in extent appears to have been formed by the weight of lavas which have poured on to the plain from nearly every side. Another recent stream in the same neighbourhood, whose source and age are unknown, follows the course of the Skjálfandafljót to the sea and terminates in a deep gulf. It appears that, as long as lava-flows occur in mountainous regions or in narrow valleys, any subsidence occasioned by the additional weight is difficult to detect, but as soon as it enters on to plains the subsidence is marked. It may also be that valleys in undulated or folded strata, being inverted arches, would resist pressure, while even in valleys of erosion much of the pressure must be exerted obliquely against the mountain masses instead of wholly vertically as on a flat surface. It has been suggested that the discharge of masses of lava at the surface would leave cavities in the interior and thus occasion subsidence, and it has even been anticipated that Iceland would bodily disappear from this cause, like the island of Friesland, from the maps; but there is no evidence of any such cavities having existed in old basaltic formations or in volcanic districts, and it is far more probable that the escaped matter is pressed out by other lava which immediately replaces it.

Dr. Fisher believes that all plains in proximity to mountain chains, upon which the material provided by their denudation is spread out, sink under the weight of the material and cause a compensating elevation of the neighbouring mountains. The sub-Himalayan range consists of subaërial deposits from 12,000 to 15,000 feet thick brought down by torrents, and which must have been deposited on a level and continuously sinking plain. "The conclusion seems irresistible that corresponding to the long, though occasionally interrupted, depression of these plains, a correlative elevation of the great range which has supplied the deposits has been going on."[1] If, as in the Himalayas, the region be one of approximate equilibrium, and much sediment is brought off the mountains and spread over the plains, the mountains become after a while too light and the plains too heavy,[2] and accordingly the mountains rise and the plains sink to restore the contour. This appears to be what has happened.

These comprise nearly all observable instances in which weight has been transported from elsewhere to areas where it did not previously exist, and are sufficient to prove that in such cases a subsidence more or less equalling in amount the vertical thickness of such added matter—except in the case of ice, which is of a much lower specific gravity—nearly invariably follows. Can it be reasonably maintained that these subsidences and the reelevations, which seem invariably to accompany the removal of weight, whether by melting of ice, as in the glacial period, or by denudation, are not the result of the increase or diminution in pressure? If the accumulation of sediment were due to the subsidence, instead of the subsidence to the accumulated sediment, as recently suggested by Dr. Geikie, it would be most improbable that they would so frequently bear such near proportion the one to the other. In none of these instances has the subsidence exceeded the accumulation, as must sometimes have been the case if the sediment merely accumulated because a subsidence quite independent of it happened to be in progress.

Such subsidences would only be possible with a substratum somewhere of viscous matter. Professors Shaler and Le Conte and Mr. Fisher, and many other very able geologists, have advocated the existence of a fluid or viscous layer between a solid interior of great density and a consolidated crust. If, Mr. Fisher maintains, it requires great pressure to solidify the materials at the temperature of the solid interior, a melting temperature may exist at some depth before the pressure is sufficient to solidify. Although Prof. Geikie and many other geologists do not admit the continuous existence of such a layer, it is difficult to see how they escape the conclusion. In his text-book[1] Prof. Geikie states that "from the rate of increment of temperature downwards it is obvious that at no great depth the rocks must be at the temperature of boiling water, and that further down, but still at a distance which relatively to the earth's radius is small, they must reach and exceed the temperatures at which they would fuse at the surface." Further on he explains that the crystalline rocks of the Highlands of Scotland and of the Green Mountains of New England are mechanical sediments metamorphosed chiefly where they are most highly contorted, or have been subjected to the greatest pressure. Strata of sedimentary origin which have accumulated to thousands of feet in thickness may be depressed deep beneath the surface and brought within the influence of metamorphosis,[2] and be eventually reduced to a soft and pasty condition, and protruded into some of the overlying less metamorphosed masses in the form of granite veins, or be erupted to the surface in the form of lava. This is an absolute admission that at some depth, relatively not great, pressure converts solid into viscous or fluid strata. He further states that "There can be no doubt that the lines of equal internal temperature (isogeothermal lines) for a considerable depth downward, follow approximately the contours of the surface, curving up and down as the surface rises into mountains, or sinks into plains;"[3] so that it seems difficult to understand why the particular line of temperature or of pressure at which most rocks melt, should not be continuous.[4] Like conditions must produce like results, and if the mere pressure of overlying strata can anywhere or at any depth render rocks molten or fluid, they will become molten or fluid wherever the required pressure occurs. A nucleus kept solid at a temperature higher than its melting-point, through excess of pressure, cannot pass into a crust whose solidity is due to lowness of temperature, through absence of pressure, without the existence of that intermediate stage of pressure or temperature requisite to produce a melted zone or layer. Prof. Geikie in fact himself admits "that the nucleus though practically solid, is at such a temperature and pressure that any diminution of the pressure by corrugation of the crust or otherwise, will cause the subjacent portion of the nucleus to melt."[5] But as the pressure diminishes gradually throughout the crust from the enormous amount on the solid nucleus to the merely atmospheric pressure

[1] "Physics of the Earth's Crust," p. 82. [2] *Ib.*, p. 83.

[1] *L.c.*, p. 289.
[2] Geikie, "Text-Book of Geology," p. 387. [3] *L.c.*, p. 287.
[4] Fisher maintains that mountain chains have solid roots, far exceeding their bulk above ground, projecting into the liquid layer. [5] *L.c.*, p. 263.

at the surface, how can the conclusion be avoided that there is everywhere a point in the earth's crust at which it must be just sufficient to keep rocks at the melting point. It seems utterly impossible, if it is once conceded that pressure does render rocks fluid, to avoid the conclusion that there everywhere exists a viscous substratum following to some extent the contour of the earth's surface.

Such a condition is precisely that which will alone explain the undoubted fact that the addition or removal of even comparatively small weights produces corresponding changes in the previous level of the earth's surface. "The deposition of 1000 feet of rock will, of course, cause a corresponding rise in the isogeotherms,"[1] that is, of the liquid layer, and "denudation of the land must lead to a depression of the isogeotherms, and a consequent cooling of the upper layers of the crust." Dr. Fisher[2] proves mathematically, in fact, that a liquid layer and no other condition can explain the movements that have taken place in the earth's crust, and satisfactorily account for volcanic action.

It appears in the present state of knowledge almost impossible to estimate the depth at which a viscous layer could exist. The estimates that have been made vary from 1000 miles to only 50,000 feet. On the one hand, however, if it is a fact, as Dr. Geikie surmises, that sedimentary formations of Silurian age have been fused and rendered viscous mainly by the mere superincumbent pressure of more recent sedimentary formations, the depth at which a viscous layer can exist must be less than the lowest estimate yet formed. On the other, the observed increase of temperature, not exceeding at most 1° F. for every 50 feet of depth, the melting temperature of rock, 2000° to 3000° F., would not be reached at a less depth than 100,000 feet. This is obviously too great a depth to account for some of the observed facts of geology, and is without any allowance for the increasing density of rocks at great depths, or for the many unknown agencies which may contribute at such depths to lower their melting temperature. The inert weight of 25,000 feet of rock of the density of slate, the thickness which according to Dr. Geikie has reduced rock to a viscous state, is about 2000 tons to the foot. I am not aware that any estimate has been made of the actual amount of heat that would be produced under such conditions. If, as must be the case, any relatively small increase of pressure produces a displacement in the molten layer, a compensating elevation must take place elsewhere, and if its effects are so considerable when the weights are relatively small, the results of pressure applied to oceanic basins must be infinitely great. The theory that oceanic basins have been permanent has been embraced by many of the ablest geologists, and since sediment has been forming in them uninterruptedly, at however slow a rate, since Eozoic times, its aggregate vertical thickness by now must be colossal. The pressure of water alone upon the rocks forming the bed of the greatest depths of the ocean (say 4000 fathoms) would equal 6195½ tons upon a square yard, and this pressure exists on a bottom which is at or near the freezing-point. The effect would be as if on land the pressure of the first 7000 or 8000 feet of rock generated no heat whatever, or rather as if the heat were intercepted by an icy layer, which also might conduct it away, with the result that the molten layer would rest under a greater weight under the ocean, where the rocks have been observed to be denser, than it does under the land. This extra weight, even if small, would tend to render the greatest depths of the ocean permanent, but lines of current, where sedimentation was less rapid, would present lines of relatively less resistance, which, becoming more and more elevated, would in time form submarine ridges or banks or dry land, until the extreme tension might possibly become relieved by the eruption of volcanic matter. The lines of absolutely least resistance would, however, most frequently perhaps coincide with sea-margins, because these would often be the nearest lines free from the pressure of accumulating sediment. While, therefore, actual shore-lines may be depressed by local sedimentation, there may be inland a far more important tendency to elevation. The recent mountain chains, whether volcanic or otherwise, follow at a distance the contours of coasts, and it is likely that such apparent exceptions as the Alps, Urals, and Himalayas were in proximity to coast-lines at the time of their formation.

To this extent, I believe, the permanence of ocean basins can be maintained, but the past and present distribution of both plants and pulmonate mollusca, which alone in terrestrial life seem to have any antiquity as species, appear to be wholly against any further extension of it.

That such considerations, theoretical as they seem, may have a practical value to geologists, a recent journey to Iceland abundantly proved. There is not only there, but in the Faroes, evidence of a period of quiescence between two great basaltic formations, during which plants grew and lignite was formed. It even appears that this quiescent period extended synchronously from Ireland to Greenland. During this time the Lower Eocene flora, splendidly represented at Reading, seems to have migrated through increasing temperature as far north as Greenland, for the Reading plants are almost wholly those which were thought to be characteristic of northern Tertiary floras and distinctive of Miocene time. A connection between Europe and America in these high latitudes has also been inferred on many grounds to have existed at about the same period. Does it not seem as if the elevation of land (which permitted these floras thus to migrate, and which probably raised the Eocene temperature by excluding the Arctic Ocean from the Atlantic) caused these stupendous eruptions of basalt to cease—for elevation on such a scale must mean relief from tension—and that its submergence during the Miocene led to, or was caused by, the renewal of the basaltic flow? The horizon in Iceland is marked by only very scattered sedimentary tuffs and lignites, and is far less marked than in the Faroes, but in the region of Akreyri it can be traced even from a distance by the highly-laminated beds of light-coloured trachyte, which seem to have ushered in the new volcanic activity. It would be impossible on internal evidence to assign most of them to any definite age, and it is only perhaps on broad considerations such as these that their geological position may hereafter be fixed, though their immense antiquity may be inferred by the denudation which has furrowed, since their deposition, nearly the whole surface of the island into deep troughs and high ridges, out of what were formerly continuous tabular sheets of basalt.

It would be interesting to ascertain whether the great basaltic outpours of Oregon and the Deccan preceded or accompanied any marked changes of level in adjoining areas.

The question has been asked as an objection to this theory, What possible mechanical properties can we attribute to the upper strata of the earth which will permit them to sustain the whole of the Himalayan plateau and North and South America above the sea-level, and yet will cause a continuous subsidence in an estuary in which sediment is being deposited? Such subsidence, it is maintained, could only occur with a substratum somewhere of viscous matter, and if such viscous matter exists, why does it not flow under the stresses due to the weight of continents and mountains?

It is difficult to meet this objection except by appealing to the facts. It is apparent that continents, and especially mountain masses, have been upheaved from below

[1] Geikie, *l.c.*, p. 287, 1° F. for every 50 feet.
[2] "Physics of the Earth's Crust."

through a pressure which the earth's crust is not rigid enough to resist, and that so long as this pressure is sustained they must remain at least stationary. There is no proof anywhere that the pressure that caused the elevation is now removed, but there are frequently indications, such as earthquakes and landslips in mountain chains, that it exists and is even on the increase. On the other hand, there is no evidence of any kind to show that some, especially of the older mountain chains, are not sinking, though subsidence in such cases would be very difficult to detect. Besides this it is conceivable that when the force which has squeezed the crust into folds has ceased to be exerted it is not flexible enough to regain its original horizontal position, but will remain in folds, and as there is no increased thickness, and consequently no addition of weight, but on the contrary a continual loss from denudation, there is no reason why they should not retain their position upon the hypothesis of a continuous molten layer subjected to greatest pressure at its lowest levels. Dr. Fisher even assumes that the mere removal of weight from them by denudation, and its accumulation on their flanks, would suffice to cause a continuous upheaval. The deflection of the plumbline has shown that the density of the crust beneath mountains must be less than that below the plains, and the relatively slow rate at which heat increases in boring through them shows also that the pressure there cannot be so great. Though strata are compressed into a smaller area through the folding, it is doubtful whether the aggregrate pressure on the liquid layer in such regions is at all increased, while in elevated plains it obviously cannot be so, as there is in that case no direct increase of weight. It thus seems as if it were as necessary that the crust of the earth should yield to increasing pressure as that the sea should roughen under the wind, and the apparently arbitrary upheavals and depressions are brought under a definite law. The greatest depths of the ocean would ever deepen and its superficial area tend to diminish, while that of the dry land would increase, and its mountain chains reach higher elevations. The theory appears in harmony with the truths of geology and of astronomy, for the records of Palæozoic times show neither evidence of great depth of sea nor mountainous elevation on land, the organic remains pointing to a little varied surface. The highest mountains are geologically the most recent, and evidence of deep seas increase towards the Cretaceous period, while our satellite, whose evolution may have progressed more quickly than ours, has relatively far greater, more numerous, and more abrupt elevations than the earth.

Somewhat similar conclusions to these have been arrived at in the "Physics of the Earth's Crust," by Dr. Fisher. Without presuming to compare the present superficial treatment of the subject with that great and philosophical work, some important differences will be observed between the views there expressed and these, as well as some entirely new observations and extensions of the theory. The views advocated are still so far from being generally accepted by geologists that their publication in NATURE will doubtless put many in possession of facts and inferences which are in a general way only accessible to those who have leisure to gather them from less popular publications. J. STARKIE GARDNER

THE ISCHIA EARTHQUAKE

ONE of the most disastrous earthquakes on record occurred in the little Island of Ischia, in the Bay of Naples, on the evening of July 28. It was only in March 1881 that a similar catastrophe occurred at the same place. The island is a favourite summer resort of Romans and Neapolitans, and Casamicciola, where the destruction was greatest, was crowded with strangers. The full extent of the loss of life has not yet been ascertained; but up to the present it is estimated that at least 4000 have been killed, and very large numbers wounded. The earthquake occurred at half-past nine, when strangers and natives were enjoying themselves in various ways under a cloudless sky with not a breath of air stirring. Not the slightest warning seems to have preceded what occurred; in the space of fifteen seconds Casamicciola was a heap of ruins, while a similar fate overtook the smaller towns of Forio, Laco Armino, and Fontana Serrata. At present we can only record the facts of the case; when further details are to hand it may be possible to throw some light on the real cause of the catastrophe. Besides the first shock, which lasted fifteen seconds, other two were noticed immediately after. Prof. Palmieri is stated to have expressed the opinion that the catastrophe was caused by a sinking in of the level, and not by an earthquake. On the 31st there was another slight shock; while Vesuvius is in a state of active eruption. A Rhenish journal states that on Saturday night, about the time when the Ischia earthquake occurred, a tremendous motion of the earth was distinctly felt at Wiesbaden. On the morning of the 31st also, it may be noted here, a shock of earthquake was felt in Oporto, lasting two seconds, with direction east and west; it naturally caused great consternation. Two shocks are reported to have occurred on the same day at Gilroy, California. With regard to the volcanic Monte Epomeo in the Island of Ischia, we may say that its last recorded eruption took place in 1302.

We are glad to learn that Dr. Dohrn, director of the Naples Zoological Station, who was in Ischia at the time, escaped unhurt.

THE AGRAM EARTHQUAKE [1]

IN connection with the Ischia Earthquake, the official report of the Agram Earthquake of three years ago may not be without interest. The detailed report by Herr Hantken von Prudnik contains all the information which he had been able to collect regarding the severe earthquake with which the district surrounding the town of Agram in Croatia was visited on November 9, 1880. Herr von Prudnik gives not only an exhaustive narrative of his own observations of the effects of the earthquake, made a few days after its occurrence, but also some account of careful observations made by inhabitants of the district where the earthquake actually took place; and his memoir is full of most interesting matter to seismologists. The district is situated in an area within which earthquakes are of very frequent occurrence, for Herr von Prudnik gives a long list with descriptive notes and dates, beginning with March 26, 1502, and coming down to Nov. 9, 1880, but most of them within the present century, of earthquake-shocks, some of which seem to have been severe, which have been felt in the locality. A few self-registering seismographs erected in suitable places in the district would yield, we think, much valuable information and would detect many of the smaller motions, partaking rather of the nature of tremors, which are no doubt frequent, but which, although of great seismological importance, remain unnoticed where such appliances are not in use.

With regard to the earthquake of November 9 itself, the shock seems to have been very severe, causing as it did, besides loss of life, a vast amount of damage to public and private buildings, especially churches. The details of the damage done, given by Herr von Prudnik, are very interesting, and illustrate very clearly the conclusions which have already been arrived at by seismologists as to the effects of the conformation of the ground in the neighbourhood of a building, and of the structure of the building itself, in diminishing or in aggravating the

[1] "Das Erdbeben von Agram im Jahre 1880." Bericht an das k. ung. Ministerium für Ackerbau, Industrie, und Handel, eingereicht von Max Hantken von Prudnik, gewesenem Director der k. ung. geologischen Anstalt. (London: Trübner and Co., 1882.)

destructive action of an earthquake. For example, we find that in some cases well-built and substantial churches and houses suffered severely, while crazy erections, considered to be almost on the point of falling to pieces, received little or no disturbance. This apparent paradox is of course explained by the fact that the sudden backward and forward motions of the ground on which a building stands, although they may be, and in general are, of limited extent, bring very severe stresses to bear on high masses of masonry, which although it may be of the very best construction has little strength to resist the strains produced; while more loosely put together, and, in ordinary circumstances, insecure structures are capable of yielding to the necessary extent and escape unharmed. Again, when an earthquake consists of approximately periodic movements of the ground, buildings or parts of buildings, whose natural period of free oscillation coincides with, or is some multiple of the period of the disturbance, yielding to the repeated and conspiring impulses, oscillate with increasing range, until return to the equilibrium position is no longer possible and they collapse in ruins.

A phenomenon observed in connection with many other earthquakes, the rotation of upright pillars such as gravestones and monuments, on their bases, was very remarkable in this. Herr von Prudnik does not accept the explanation which has been offered by Mallet and others that the rotation is due to vorticose movements of the earth's surface; and he offers an explanation which, though not quite clearly put dynamically, seems to point to the true theory. The cause of the phenomenon no doubt is that the first sufficiently severe shock causes the body to tilt over in the direction from which the shock proceeded, and immediately after, the shock, although rectilinear in direction, makes the body turn round on the corner or portion of an edge on which it for the moment rests. This explanation has been tested with model gravestones and obelisks placed on a table, which could be shaken so as to imitate the motions of the ground during an earthquake, and found to answer perfectly.[1] The circumstance that in the earthquake at Agram, as elsewhere, the gravestones at one particular place were for the most part rotated in one direction accords well with this explanation, as no doubt the gravestones there were all set so as to face in one direction.

Herr von Prudnik is not of opinion that the earthquake was due to volcanic agency, but thinks that it was produced by the yielding to mutual stresses of the materials underlying the Slamen mountain, which lies along the middle of the area in which the destructive effects were most marked. This mountain occupies an area roughly elliptical in shape, about 4·5 kilometres (6 Meilen) long by 3 kilometres broad, and is composed for the most part of slate, limestone, and dolomite surrounded with strata consisting mainly of marl. To this mountain all the effects point as the locality in which the earthquake originated; but here again we think the use of self-registering seismographs would be of great service in giving definite information. This would also give most valuable information as to the velocities of propagation of earthquake motions in strata of different materials. In the present case the disturbance travelled from Agram to Vienna in twelve seconds, which gives a velocity of propagation of 2·2 kilometres per second. It is not stated, however, how the exact times were observed.

Among the details of the many interesting phenomena, we find a very careful account of an outbreak of "mud volcanoes" at Reznik, a place about 8 kilometres west-south-west of Agram; but for details as to this and many other important points, we can only refer our readers who are interested in seismology to the memoir, which will well repay perusal.

[1] *Vide* Milne and Gray on "Earthquake Observations and Experiments," *Phil. Mag.*, November 1881.

NOTES

WE are enabled to give the text of the telegram received in Stockholm this week from the Swedish circumpolar observation party, which has wintered at Spitzbergen. The news is the first received from the expedition since October last:—"Cape Thordsen, July 4th, 1883. This message will be forwarded to-morrow to Capt. Startschin with the boat fetching our first mail this year. The wintering of the expedition has in every respect been attended with success, particularly as the scientific researches have throughout been carried on exactly in accordance with the regulations formulated by the International Polar Commission. Hydrographical and magnetic studies have also been pursued on the ice in the Ice Fjord, as well as parallax measurements of clouds, and observations as to the temperature of the air, the snow, and the earth. The winter has on the whole been mild; the greatest cold occurring on January 2, when the thermometer registered 35·5° C. below freezing point. Storms have been few. Since September last the following buildings have been erected:—A hut on a mountain at an elevation of 270 metres, containing the anemometer and the wind-fan, which were read by a self-registering electrical apparatus; two astronomical observatories; another magnetic hut; a bath-house, a forge, and a wood storehouse. The dwelling house and working room have also been enlarged. The following game was shot during the winter: 61 ptarmigans, 9 reindeer, 18 wild geese, 20 foxes, and some wild fowl. With continuous labour, plenty of food and drink, and frequent baths, the members of the expedition have throughout enjoyed excellent health. Descriptions of the nature, our labour and life here during the wintering will follow."

AT the meeting of the Scottish Meteorological Society held on Thursday last week it was announced that upwards of 4500*l.* had been already subscribed to establish the Meteorological Observatory on the top of Ben Nevis. The subscriptions vary in amount from 200*l.* to one penny, and the subscribers include Her Majesty the Queen and all classes of her subjects, and town councils and other corporate bodies in all parts of the United Kingdom. The road to the top of Ben Nevis is nearly half finished. The building will be commenced early this month, and it is contemplated that the portion to be completed this season will be ready at the end of October for the three observers, who will begin their regular observations on November 1.

MR. MUNDELLA in presenting his educational budget the other night had nothing but essential progress to report. The cry of overworking the children was introduced by some of the speakers, but Sir John Lubbock pointed out that monotony and not overwork was the real weakness of the present system, and that the tendency was to cultivate the memory at the expense of the observing faculty. The real remedy, as he pointed out, is to introduce greater variety into the elementary course, and above all to make practical science teaching an essential part of the curriculum.

FROM a statement issued with reference to the Rolleston Memorial we learn that the total sum subscribed is 1183*l.* 5*s.* 0*d.*, to which is added 59*l.* 7*s.* 5*d.*, dividends paid on sums invested from time to time in Consols before the list was closed. From this total have been deducted secretaries' expenses, charges for printing, advertising, &c., 36*l.* 16*s.* 9*d.*, leaving a capital sum of 1205*l.* 15*s.* 8*d.* invested in 1200*l.* Three per Cent. Consols. This sum has now been transferred to the chancellor, masters, and scholars of the University of Oxford, and accepted by them as the Rolleston Memorial Fund. The fund, it has been decided, will be expended in the institution of a prize to be awarded every two years for original research in any subject comprised under the following heads:—Animal and Vegetable Morphology, Physiology and Pathology, and Anthropology, to be selected by

the candidates themselves. The period during which this prize may be obtained by a candidate is limited to ten years after the date of matriculation; and with a view to render the prize as widely associated with Prof. Rolleston's name as possible, it is open to the members of the Universities of Oxford and Cambridge.

A CORRESPONDENT writes to us that he has received from a resident at Zagazig, in Egypt, a curious fact concerning cholera, which, if not noticed before, may be of interest. The resident stated that the town of Zagazig was perfectly healthy, and that the swallows and sparrows were flying about as usual, and so long as they remained he considered they were quite secure from any attack, but when they left he would not be long before he followed them. He remarked further that the birds had been observed by old hands to depart before the approach of cholera during the last four epidemics. Our correspondent asks what can be the cause of this, and we shall be glad if any of our readers can answer the question.

A CORRESPONDENT makes the following statement:—"Kentish men who drink chalk water are large boned, whilst those people who drink soft water are the reverse. At Glasgow, where the water is supposed to be very soft, there are said to be more bandy-legged children than at any other place." Is this so?

M. PASTEUR has written to the *Voltaire* a letter justifying the step taken by him in advising the Government to send a mission to Egypt in order to study the generation of cholera. He believes that this plague is produced by some description of microzyme; but he admits that this minute organism has not been discovered yet.

M. BARTHÉLEMY ST. HILAIRE has just finished the printing of his translation of the "Natural History of Animals," by Aristotle, which will be published in a very few days; it consists of four large octavo volumes.

THE managing committee of the Vienna International Electric Exhibition, which recently announced that, in consequence of the delay in the arrival of exhibits, the opening of the Exhibition, originally arranged for the 1st inst., would have to be postponed, has now fixed the ceremony for the 16th.

THE International Medical Congress of the present year will open at Amsterdam on September 4, and will be attended by a number of the most distinguished physicians and medical men of Great Britain, France, Belgium, and Germany. Amongst the British physicians papers or addresses have been promised by Sir Joseph Fayrer, M.D., and Dr. J. Ewart, on the treatment of imported and tropical diseases in countries belonging to the temperate zone; Dr. F. de Chaumont, of Netley Hospital, on the best measures of quarantine; Dr. E. Waring, of London, on the remedies used by the natives of tropical countries against the most dangerous epidemics; Dr. J. B. Scriven, on quinine injections and malaria fevers; Dr. Norman Chevers, late Professor at Calcutta, on tropical epidemics and the influence of tropical climates upon them; and Dr. Dyce Duckworth, of London, on the education of physicians for the Colonies.

THE fifty-first meeting of the British Medical Association began on Tuesday at Liverpool with the address of the President (Dr. A. T. H. Waters of Liverpool). On Wednesday the Council met to consider invitations for 1884 and to nominate a President Elect.

THE Gardens of the Zoological Society of Philadelphia in Fairmount Park are, we believe, the most nearly complete and best organised Zoological Gardens on the American Continent. Their eleventh annual report, now before us, shows a considerable amount of progress since their last anniversary. The number of visitors to the Gardens in the twelve months ending on the last day of February 1883 was 252,866, being nearly 10,000 more than in the preceding corresponding months. The income of the Society during the same period was rather over $50,000, while the expenditure seems to have been some $8000 less. During the same twelve months 423 living specimens were added to the collection, the total number of animals in the gardens at the date of the report being estimated at 687, of which 306 were Mammals, 338 Birds, and 43 Reptiles and Batrachians. These figures, no doubt, cannot rival those of the Zoological Society of London. But it must be recollected that our Society has been founded upwards of fifty years, is supported by some 3300 members, and has a population of 4,000,000 to draw upon for its visitors, not to count the strangers who are perpetually seeing the "sights of London." Among the special additions to the menagerie to which attention is invited in the report is an example of the Coast Fox (*Vulpes littoralis*) received from Yucatan, and stated to be probably the first to be exhibited in a living state. This rare fox has, we believe, never been obtained by the Zoological Society of London, and we rather doubt whether there is any example of it in the British Museum.

THE Committee of the Sunday Society have resolved to petition the Prince of Wales to use his influence as President to have the Fisheries Exhibition open to the public on a few Sundays before the final close of the collection.

AMONG a number of very munificent bequests that have been left to Paisley by the late Mr. Brough, we, says the *British Medical Journal*, observe that he has directed that 300*l.* is to be spent annually in establishing and maintaining a science lectureship in that town, with all the necessary adjuncts and accessories. The subjects to be taught are left to the trustees to fix, but the testator himself recommends that one of them should be physiology.

A VIOLENT shock of earthquake was felt at Catanzaro, in Calabria, on the morning of July 25.

WITH reference to the volcanic eruption on Krakatan Island off the coast of Java, brief reports of which were received by telegraph, and then noticed in NATURE, the following particulars have since been received. During Sunday, May 20, and Monday, May 21, the eruption was very heavily felt at Batavia, also more or less on Tuesday, May 22; but the earthquake shocks have since ceased, although the mountain is still apparently vomiting fire and smoke. The following report is from Anjer, dated May 23, 3.47 a.m.:—On Sunday morning last, from six to ten o'clock, there was a tremendous eruption, with continuous earthquakes and heavy rain of ashes. On Sunday evening and Monday morning it was continued. The eruption was distinctly seen here till nine o'clock this morning, and smoke was seen until twelve o'clock; afterwards it cleared up a little, and at this moment the air is clouded again. Capt. Ross reports from Anjer that on May 22 he was sailing near Java's first point and tried to get Prinsen Island in sight, but found that it was surrounded by clouds. Then he steered for Krakatan, but found it to be the same there. The captain observed that the lower island or mountain situated on the north side of Krakatan was totally surrounded by smoke, and from time to time flames arose with loud reports. Fire had broken out in several places, and it is very likely that the trees in the neighbourhood have caught fire. The mountain of Krakatan has been covered all over on the north side with ashes. The captain could not make out the condition of the mountain, as he kept away as far as possible, being afraid of the wind falling, and the vessel being drifted on to the island. The strongest fire was seen on the evening of May 22, with heavy explosions and detonations. The fire was also seen at that time at Anjer, but on account of the heavy smoke nothing could be perceived, as

all the islands remained clouded. The captain did not experience any shower of ashes. The master of the steamer *Conrad*, which arrived at Batavia on May 24, reports having passed Krakatan on the north side the previous night, and met with heavy rains of ashes, covering the decks, &c., with about 1½ inch of ashes. He also had to cut his way through nearly 1½ metres of pumice-stone, which occasioned a delay of almost five hours.

WE have already referred in NATURE to the excellent scientific work being done by the French in the Indo-Chinese peninsula, as evinced by the large number of scientific missions which have been despatched from France to those regions. As a farther example of the pains taken in France to obtain a thorough knowledge of the country in which she seems destined to play so large a part, we may refer to a periodical published by the Government of Saigon, entitled *Cochin-chine Française: Excursions et Reconnaissances*. The fifteenth part is now before us, and as each part contains about two hundred pages the amount of information accumulated in these volumes is considerable. Speaking broadly, and slightly altering a well-known Latin maxim, it may be said that nothing relating to the vast territory between the mouths of the Brahmaputra and the Canton river, between the Bay of Bengal and the China Sea, is outside the scope of this journal. As a rule the papers are of a highly scholarly and scientific kind. Thus the last number contains the second part of a long and richly illustrated paper on the coins and medals of Annam and French Cochin China, by M. Silvestre, inspector of native affairs in Saigon; a short history of the Portuguese in Cambodia; an account of the typhoon of last November at Hué, the capital of Annam, with barometrical tables, by the surgeon to the French Legation there; a long paper on the vegetation and forest administration of British Burmah; and finally one of a series of very interesting papers on the customs and popular superstitions of the Annamites. The present instalment deals with marriage customs. The efforts of the Colonial Government to sustain and encourage the study of Indo-China does not, however, close with the publication of this excellent journal, for we observe the advertisements of a large number of works relating to that country in the magazine under review. Among these are a weekly journal for the natives, an annual summary of facts relating to Cochin China, various maps, medical reports, &c. Whatever may be thought from other points of view of the action of France in Annam and Tonkin, there can be no doubt that the increase of French power there carries with it a large increase to knowledge, for the Colonial Government of France appears to know how to organise and stimulate research in the countries over which it exercises rule.

THE telegraph has made another step in advance in China. It has had the honour of being mentioned in a memorial to the throne. Li Hung Chang recently mentioned in a report to the Emperor that he received certain information by telegraph. And, more wonderful still, that mysterious and awe-inspiring document, an Imperial decree, written with the vermilion pencil, has actually been despatched by telegraph, for the Viceroy of Canton reports recently in a memorial that a decree had been conveyed to him in this way.

THE German system of *privat docenten*, or University teaching by outsiders, is to be tried in France. A decree provides that any doctor of letters or sciences, or correspondent or member of the Institute, may apply to the Minister of Education for permission to lecture on his respective subject, the license being renewable annually. The lectures may be public or private, at the professor's option, and the expense falls on him, while he can charge the students what he pleases. The same system is applied to the medical school.

WE have received the *Transactions of the Norfolk and Norwich Naturalists' Society* for 1882-83. In the first paper, on the scenery of Norfolk, Mr. Horace Woodward gives a history of the geological strata of the county, shows how the scenery was influenced by the action of water and the introduction of various forms of life, and how affected by the artificial changes brought about by man. There is also an interesting paper by Mr. Stevenson on the dusky petrel, and a paper by Mr. Southwell on the bottle-nosed whale and the history of the seal fishery. Mr. Clement Reed's paper on the discovery of Lithoglyphus in the Weybourn Crag is very interesting, from the fact that this freshwater shell is found now in Europe only in the Danube. Mr. Young gives his observations on the habits of the bearded tit, which birds he had kept in confinement for twelve years. Mr. Bidwell's list of British birds in whose nest the egg of the cuckoo has been found is the most complete yet published. The President contributes part x. of the fauna and flora of Norfolk, a list of the marine algæ.

THE exhibition of the Society of Agriculture and Insectology of Paris has just come to an end with a ministerial visit and distribution of prizes at the Palais de l'Industrie. Thousands of visitors have flocked to this hall in order to visit the interesting collection. A special building will be erected for the Society in the Park de Montsouris, and a sum of 32,000 francs has been already voted for this purpose by the city of Paris. A menagerie of living insects is to be established.

ACCORDING to the Austrian *Monatschrift für den Orient* the production of tin in the protected state of Perak, in the Malay Peninsula, for the year 1882 was 7000 tons, about equivalent to that of Cornwall. Forty thousand Chinese are employed in the Malacca tin mines.

THE additions to the Zoological Society's Gardens during the past week include a Macaque Monkey (*Macacus cynomolgus* ♂) from India, presented by Mr. J. W. Lucking; a White-throated Capuchin (*Cebus hypoleucus* ♂) from Central America, presented by Mr. F. Hoey; a Leopard (*Felis pardus*) from Somali Land, East Africa, presented by Mr. Frederick Holmwood; four Babiroussas (*Babirusa alfurus* ♂ ♂ ♀ ♀) from Celebes, presented by Dr. F. H. Bauer, C.M.Z.S.; a Two-spotted Paradoxure (*Nandinia binotata* ♂), a Royal Python (*Python regius*) from West Africa, presented by Dr. D. Hume Hart; two Short-headed Phalangers (*Belideus breviceps* ♂ ♀), two Crested Pigeons (*Ocyphaps lophotes* ♂ ♀), a Modest Grass Finch (*Amadina modesta*) from Australia, two Bicheno's Finches (*Estrelda bichenovii*) from Queensland, a Funereal Cockatoo (*Calyptorhynchus funereus*) from New South Wales, a Saisset's Parrakeet (*Cyanorhamphus saissetti*) from New Caledonia, a New Zealand Parrakeet (*Cyanorhamphus novæ-zealandiæ*) from New Zealand, presented by Mr. T. H. Bowyer Bower, F.Z.S.; an Australian Cassowary (*Casuarius australis*) from Australia, presented by Capt. Mann; four Black Guillemots (*Uria grylle*) from Ireland, presented by Mr. H. Becher; a South American Rat Snake (*Spilotes variabilis*) from Brazil, presented by Mr. C. A. Craven, C.M.Z.S.; two Peacock Pheasants (*Polyplectron chinquis* ♂ ♂) from British Burmah, deposited.

WEATHER PROGNOSTICS AND WEATHER TYPES[1]

THE object of the first paper was to explain the best known popular prognostics by means of the most recent discoveries in meteorological science.

A great advance has been made in meteorology during the last twenty years owing to the introduction of daily synoptic charts of the distribution of atmospheric pressure, temperature,

[1] Abstract of two papers read before the Meteorological Society: "On Weather Prognostics," by Hon. Ralph Abercromby and W. Marriott; "On certain Types of British Weather," by Hon. R. Abercromby. (*Quarterly Journal of the Meteorological Society*, vol. ix. No. 45.)

wind, rain, &c. From these it is evident that there is a distinct relation existing between the distribution of pressure and the direction and force of the wind, and temperature and weather generally. A glance at a number of the charts shows that there is nearly always present either an area of low pressure called a cyclone, usually having a circular form, and as a rule moving in an easterly or north-easterly direction; or an area of high pressure, called an anticyclone, also nearly circular in form but almost stationary in position. The wind in all cases also blows nearly parallel with the isobars, having the region of lowest pressure on the left hand. This has given rise to the following simple law propounded by Dr. Buys Ballot for the northern hemisphere,

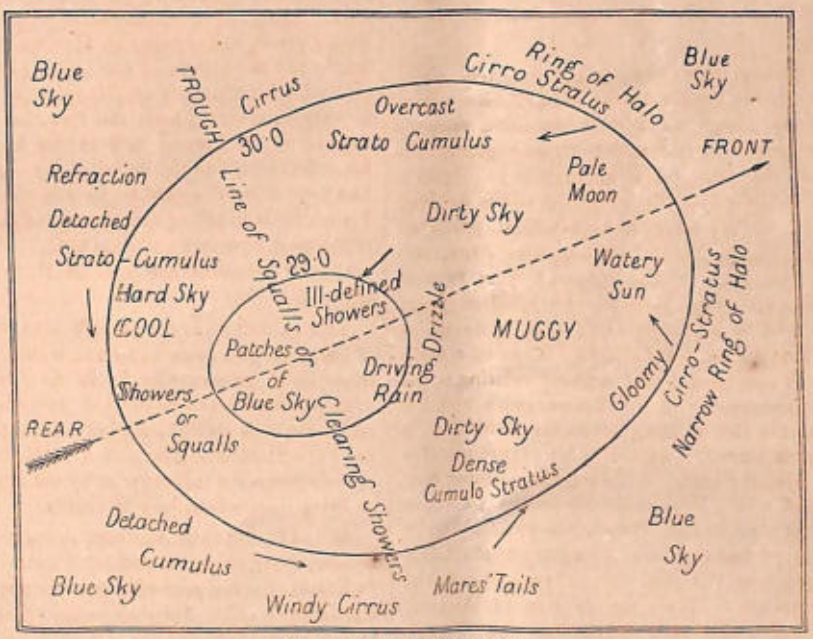

FIG. 1.—Cyclone Prognostics.

viz. "Stand with your back to the wind, and the barometer will be lower on your left hand than on your right." In cyclones the wind circulates round the isobars in the opposite way to which the hands of a watch move, but exhibits usually a little indraft; while in anticyclones the wind circulates round them in the same way as the hands of a watch, but exhibits usually a little outward motion. The velocity of the wind in all cases depends mainly upon the closeness of the isobars; for the closer the isobars the greater is the difference in pressure, and consequently the stronger the wind.

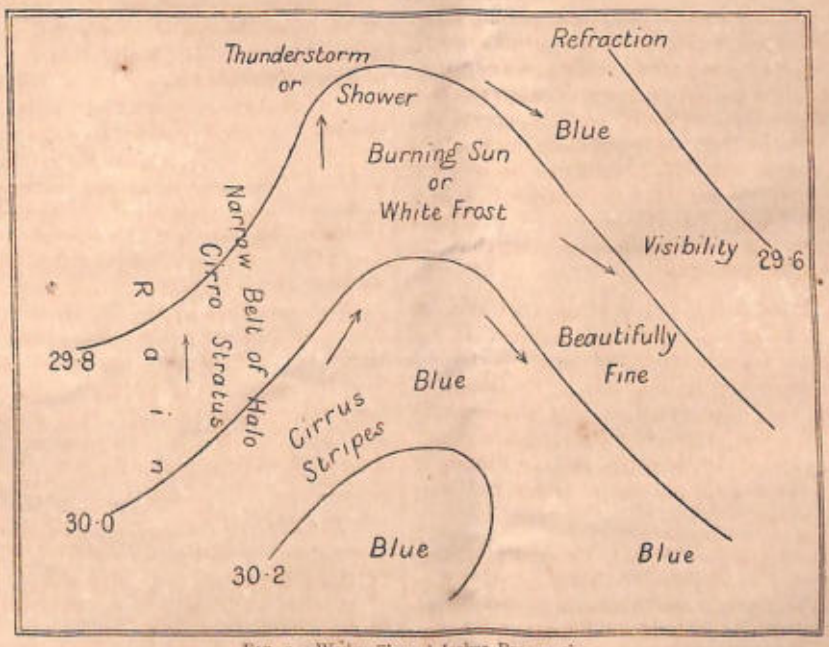

FIG. 2.—Wedge-Shaped Isobar Prognostics.

Since therefore nearly all our weather is of the cyclonic or anticyclonic type, and is entirely dependent upon the form and closeness of the isobars, it is by the aid of isobaric charts that the authors have attempted to explain a number of popular prognostics, and to associate them with certain kinds of weather. The method of research actually adopted has been for many years past to take notes of any good observation of any prognostic and put them by in a portfolio with the nearest synoptic chart available; or preferably with the nearest both before and after. When a sufficient number had been collected they were

analysed, and the remarkable result has been arrived at that the greater number of prognostics are simply descriptive of the weather and appearance of the sky in the different portions of the various shapes of isobars seen on synoptic charts; and that they indicate foul or fair weather just as they precede the shifting areas of rain or blue sky which are mapped out by the isobaric lines.

These charts not only show the success of the prognostics, but also explain wherein they sometimes fail, by tracing the changes of each particular condition of weather. Hitherto the only prog-

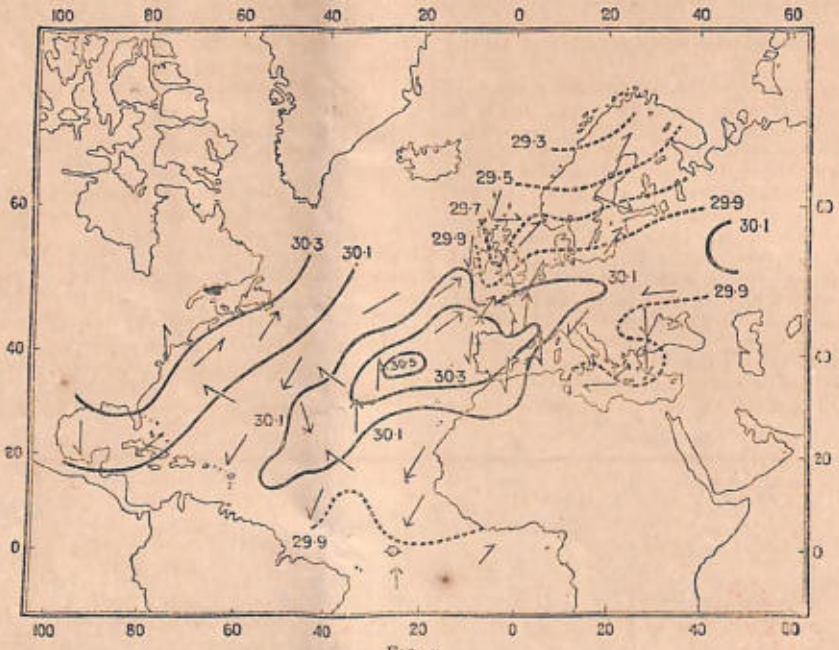

FIG. 3.

nostics which have been accounted for have been those due to excessive damp, but by means of isobaric charts many others can be readily explained. It must not be supposed that the modern methods diminish the value of prognostics, for even in forecasting weather from synoptic charts they are of great value, and will always be exceedingly useful to solitary observers who have only a single barometer to depend upon besides these prognostics, as for instance on board ship.

Though this way of treating prognostics is a great advance on the older methods, still there remains what may be called a

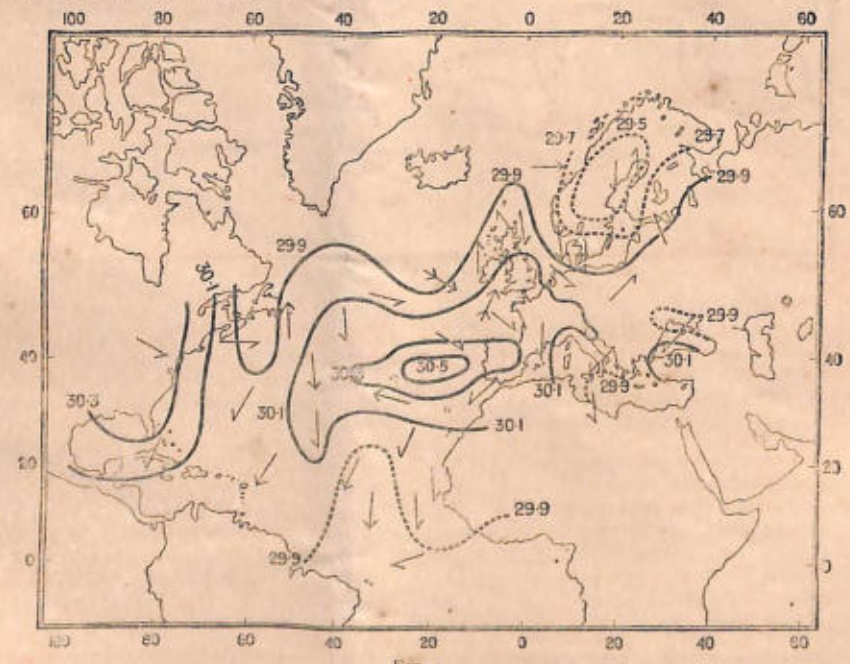

FIG. 4.

higher line of explanation. There is no doubt that the different shapes of isobars are the product of different phases of atmospheric circulation, just like the eddies and backwaters of a river, and that the appearance of the weather is the product of the complex vertical and lateral movements thus set up. For instance, there is no doubt that the principal cause of rain in a cyclone is the condensation of the ascentional current of air round its centre, while Ley and others have shown that many of the well known forms of clouds are due to the action of upper currents moving in a different direction to those on the surface, and with a different

velocity. Similarly the bright dry weather of an anticyclone is certainly due to the descending current found round its centre, and so on for every shape of isobars. Any reference to these movements was, however, intentionally omitted by the authors, as these movements are still to a certain extent only partially understood, and it was their desire to rest the explanations which they gave exclusively on observation without reference to any theoretical considerations.

In a cyclone the broad features of the weather are a patch of rain near the centre, surrounded by a ring of cloud. But if we write down on a diagram, as in Fig. 1, the details of weather and kind of cloud in the different portions of the cyclone, we find that many of the best-known prognostics owe their value to the fact that they are characteristic of the front of a cyclone, and that after they have been observed, the rainy portion must pass over the observer before the sky becomes clear again. Sometimes a cyclone, after crossing a portion of the British Isles, dies out, and then the prognostics will fail in some districts.

The prognostics of settled fine weather are shown to be characteristic of anticyclones, which are nearly stationary for several days, and even weeks, together.

Though the bulk of British weather is made up of cyclones and anticyclones, there are two other distributions of pressure, marked out by wedge-shaped isobars and straight isobars respectively, which are associated with many well-known sayings. The chief interest in these prognostics consists in the contrast which they present to cyclone prognostics, as in many cases they are associated with fine and dry weather as opposed to the damp of an approaching cyclone.

In the front of wedge-shaped isobars (which are frequently found between a retreating and advancing cyclone) the weather is beautifully fine, of the sort of which we should say that it was "too fine to last"; or, if it lasted a whole day, we should call it a "pet day."

During the day the sun is hot, at night white frost forms. Great visibility, with a blue sky, and unusual refraction, are often observed.

On the west side of the wedge-shaped area, as the new cyclone comes on, the blue sky gradually assumes a dirty appearance, accompanied by a halo, and gathers into cloud, and later on rain begins to fall; while in the southern portion the rain is often preceded by cirrus stripes, either lying with the wind, or sometimes at right angles to it.

"Cirrus at right angles to the wind is a sign of rain."

These are all shown in the diagram (Fig. 2).

Some very interesting rain prognostics are also associated with straight isobars. While those in a cyclone are preceded by an almost ominous calm, and a dirty, murky sky, these are associated

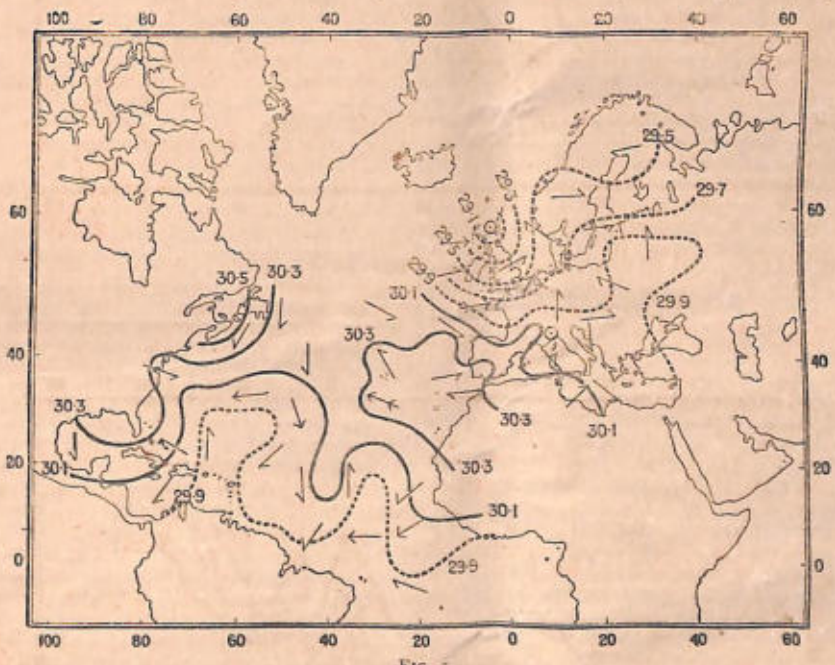

FIG. 3.

with a hard sky and blustery wind, of which it would be ordinarily remarked that "the wind keeps down the rain," or that, "when the wind falls, it will rain." While also the prognostics which precede cyclone rain hold good for the reason that they are seen in front of the rainy portion, those associated with straight isobars hold good because, though there is little rain actually with them, the area which they cover to-day will probably be covered by a cyclone to-morrow—the conditions being favourable for the passage or formation of cyclones.

Altogether, about 100 prognostics are associated with these four shapes of isobars.

The use and position of prognostics relative to forecasting from synoptic charts was stated thus:—

Theoretically, when the isobars are well-defined, we ought to be able to write down the prognostics which might be visible, but practically we cannot do so. Besides, there are sometimes cases of isobars which have no well-defined shape, but with which thunderstorms or heavy showers often occur. These, as is well known, hardly affect the barometer, but are abundantly forewarned by the commonest prognostics, and as the rainfall is usually heavy in them, the failure of the forecast which omits to notice them is very conspicuous.

The scope of the paper precluded entering into the complicated question of the non-cyclonic rainfalls in this country. It was only stated that the prognostics which precede them are rather those associated with broken weather, such as bright sunrise or heavy clouds banking up without the barometer falling, than the muggy, dirty weather of a cyclone front. The warning they give is also much shorter, rarely more than three or four hours, if so long.

The other paper is an attempt to classify certain types of British weather.

It is familiar to many observers that the weather in this country frequently occurs in spells of several weeks' duration, during which there is a remarkable persistence of the general type of weather overriding both a considerable fluctuation from day to day, and a considerable local variation from place to place.

For instance, the wind will often back to some point of south with a high temperature, a dull sky and rain, and then veer to some point of west with a cooler air and brighter sky; and after a day or so of fine weather it will back again to the south with bad weather, perhaps this time rising to the intensity of a gale, and subsequently veer towards the west with finer weather, and so on for weeks together.

The changes only vary in intensity and detail, not in general

character, while the feel of the weather and the look of the sky remain through all of them what are customarily associated with westerly winds.

Similarly the wind will often blow persistently from some point of east, fluctuating between south-east for fouler weather and north-east for finer weather, and back again with many variations for several weeks, during which the predominant features of the weather are always characteristic of east winds. The frequent recurrence of particular types of weather at particular seasons of the year is also a matter of common observation; the north-east winds of March, the cold north winds of the middle of June, and the wet west winds of September are well-known instances.

If we examine a large number of synoptic charts we find that relatively to Europe the general position of the great areas of high pressure frequently remained constant for a lengthened period. Further examination shows that the constancy of these positions coincides with persistent types of weather similar to those above mentioned, the fluctuation of type being due to the passage of cyclones, while the local variation depends on the position of the cyclone centres and on the innumerable local conditions which modify any general type.

Over the North Atlantic and Europe the distribution of atmospheric pressure presents certain constant features, namely—

1. An equatorial belt of nearly uniform low pressure.

2. A tropical belt of high pressure rising at intervals into great irregular elevations or anticyclones.

3. A temperate and Arctic region of generally low pressure, but in which occasionally areas of high pressure appear for a considerable period.

The equatorial belt constantly covers the Sahara and the Amazon valley, and always narrows over the Atlantic at about 30° west longitude, where it often does not reach higher than 10° north latitude. The shape and depth of this area are tolerably constant.

The tropical belt comprises a region of high pressure rising at variable intervals into great anticyclones. Their position is generally variable, with the exception of one, which is always found over the central Atlantic. This anticyclone forms a very important factor of the weather of western Europe, and will be constantly referred to as "the Atlantic anticyclone." Its extension south and west is tolerably constant, while towards north and east it is variable, sometimes rising as far as 60° north and stretching over Great Britain and continental Europe.

The temperate and Arctic region extends from the tropical high pressure belt to the pole. The pressure, though ordinarily low, is perpetually fluctuating by reason of the incessant passage of cyclones; yet occasionally persistent areas of high pressure appear in certain portions of it.

With reference to western Europe there are at least four persistent types of weather—

1. The southerly, in which an anticyclone lies to the east or south-east of Great Britain, while cyclones coming in from the Atlantic either beat up against it or pass towards north-east.

2. The westerly, in which a tropical belt of anticyclones is found to the south of Great Britain, and the cyclones which are formed in the central Atlantic pass towards east or north-east.

3. The northerly, in which the Atlantic anticyclone stretches far to the west and north-west of Great Britain, roughly covering the ocean. In this case cyclones spring up on the north or east side, and either work round the anticyclone to the south-east, or leave it and travel rapidly towards the east.

4. The easterly, in which an apparently non-tropical anticyclone (or one disconnected with the tropical high-pressure belt) appears in the north-east of Europe, rarely extending beyond the coast-line, while the Atlantic anticyclone is occasionally totally absent from the Bay of Biscay. The cyclones, then, either come in from the Atlantic and pass south-east between the two anticyclones, or else, their progress being impeded, they are arrested or deflected by the north-east anticyclone. Sometimes they are formed to the south of the north-east anticyclone, and advance slowly towards the east, or in very rare instances towards the west.

The details of the southerly and westerly types are given in the paper. Here we can only reproduce the three diagrams of the westerly type, Figs. 3, 4, and 5, in which the general characteristics of the type, just mentioned, are readily seen.

The value of the recognition of type groups is shown in the following ways:—

1. They explain many phenomena of weather, and many popular prognostics.

For instance, besides showing the nature of spells of good, bad, dry weather, &c., they explain by reason of their persistence such prognostics as why "grouse coming down into farmyards are a sign of snow." Also why the prognostics, "When a river like the Tweed rises without any rain having fallen," or "Irregular tides are signs of rain," have a significance for the future; for though both are caused by past bad weather at a distance, yet the persistent type will almost certainly sooner or later bring more bad weather over the place of observation.

Then the recurrence of hot and cold periods, many of them well known, are shown to be due to the recurrence of a similar type of pressure distribution about the same season of the year. Particulars of seventeen such are given, and the manner in which the knowledge of them can be utilised in forecasting is stated thus: that though the forecaster is not justified in stating that any period will occur absolutely, still when about the time of its usual recurrence the synoptic charts show signs of the expected type, then the forecasts for a few days ahead can be issued with greater confidence. For instance, suppose that about November 6—a cold period—the charts begin to show traces of the northerly type, then, but not before, there would be good grounds for saying that a period of cold weather, which usually occurs at this season, has already set in, and may be expected to last for five or six days, the forecaster being thus enabled to issue a much longer forecast than can as a rule be safely attempted.

2. Type groups are of the utmost value in forecasting, for when the existence of the type is fairly recognised then the general features of the weather are at once given, as well as the probable motion of the cyclones which are formed during the continuance of the type. Unfortunately in many cases no certain indications can be given of an approaching change of type.

3. Statistical results can be corrected by their means, for they give a true test of identity of recurrent weather, which no single item, such as heat, cold, rain, &c., can do.

4. They enable geological questions to be treated, such as the influence of changing distribution of land and sea on climate, in a more satisfactory manner than in any other method.

The general principles of prognostics and types hold all over the world, but the details in these papers apply to Great Britain only.

RALPH ABERCROMBY

OUR ASTRONOMICAL COLUMN

THE GREAT COMET OF 1882.—It appears quite possible that as the moon draws away from the morning sky towards the end of the present month, this comet may be again observed with our larger instruments. Its distance from the earth has been increasing from soon after perihelion passage in September last, and a maximum takes place at the beginning of September next, when the distance is 5·988; the earth then for a time overtakes the comet, and the distance diminishes to 5·709 on December 1. The intensity of light, however, is greatest at the end of August, and the comet then rises at a sufficient interval before the sun to render observation feasible. It will at least be of much interest to ascertain if the comet can be reached with our most powerful telescopes. The only comet which has been hitherto observed under similar conditions is the celebrated one of 1811, which, it may be remembered, was observed by Wisniewsky at Neu-Tscherkask, in August 1812.

The following places are deduced from the elliptical elements calculated by W. Fabritius of Kiev (*Astron. Nach.*, No. 2514), from a wider arc of observation than any other orbit yet published:—

At Greenwich Midnight

	R.A.	N.P.D.	Log. distance from Earth.	Log. distance from Sun.
	h. m. s.	° ′		
Aug. 28	7 25 58	98 32·0	0·7773	0·7306
30	7 26 44	98 41·6		
Sept. 1	7 27 28	98 51·4	0·7773	0·7339
3	7 28 10	99 1·4		
5	7 28 49	99 11·5	0·7771	0·7372
7	7 29 26	99 21·7		
9	7 30 0	99 32·1	0·7768	0·7405

Dr. Julius Schmidt last saw the comet at Athens on April 28; in a letter addressed to NATURE, Mr. A. S. Atkinson of Nelson, N.Z., states that with a 4-inch refractor he saw it with certainty on May 6. Assuming the theoretical intensity of light on the latter date to be unity, the intensity on August 28 is 0·35.

THE ASTRONOMISCHE GESELLSCHAFT.—The next meeting of this society will be held at Vienna, in the apartments of the Academy of Sciences, from September 14–17, under the presi-

dency of Prof. Auwers ; the secretary is Prof. Schœnfeld, director of the Observatory at Bonn.

The last part of the *Vierteljahrsschrift* contains reports of the proceedings during the year 1882, from twenty-eight continental observatories, public and private. Also a portrait of the late Prof. Plantamour of Geneva.

EPHEMERIDES OF THE SATELLITES.—The last number of the *Monthly Notices of the Royal Astronomical Society* contains Mr. Marth's extensive ephemerides of the satellites of Saturn (excepting *Hyperion*), Uranus, and Neptune for their next oppositions, as well as data to facilitate the reduction of physical observations of Jupiter. *Hyperion* will have been omitted from want of reliable elements. Prof. Newcomb, however, is in possession of manuscript tables, which he has utilised in the *American Ephemeris* for 1883 ; we extract the early portion of his table : I represents inferior, and S superior, conjunction ; E, east, and W, west elongation ; the times are for the meridian of Washington (5h. 8m. west of Greenwich) :—

	h.		h.		h.
Aug. 18,	2·9 E	...	Sept. 8, 10·6 E	...	Sept. 29, 17·0 E
23,	10·9 I	...	13, 18·4 I	...	Oct. 5, 0·6 I
28,	18·8 W	...	19, 1·9 W	...	10, 8·0 W
Sept. 3,	2·7 S	...	24, 9·5 S	...	15, 15·5 S

SCIENTIFIC SERIALS

Journal de Physique Théorique et Appliqué, July, 1883.—On the theory of electromagnetic machines, by J. Joubert.—Experiments on the aurora borealis in Lapland, by S. Lemström.—Note on a spectroscope with inclined slit, by M. Garbe.—A differential thermometer for class demonstration, by H. Dufour.—An addition to Atwood's machine, by A. Béquié.—The determination of the ohm by dynamometric methods, translated by M. Brillouin.—Electrochemical figure, with diagram, translated by Adrien Guébhard.

Rendiconti of the *Royal Lombard Institute of Sciences and Letters*, June 28, 1883.—On the theory of the potential, by Prof. E. Beltrami.—Note on the latitude of Milan, deduced from calculations of distances from the zenith observed near the meridian, by M. E. G. Celoria. In this concluding paper the author fixes the exact latitude of Milan (centre of the large tower of the observatory), at 45° 27' 59"·34 ± 0"·09 . . . A_1.—On the kinematic significance of wave surface, by Dr. G. A. Maggi.—Observations on the figure of the planet Uranus, by E. G. V. Schiaparelli. Besides calculating its ellipticity, which agrees with the conclusions of Mädler and Shafarik, the author determines the presence of spots and changes of colour on the surface of Uranus.—Results of a microscopic analysis of the drinking water at Cadempino, Canton of Ticino, Switzerland, by Prof. L. Maggi.—A case of policheiria (abnormal number of claws) in a freshwater crab (*Astacus fluviatilis*, Rond.), by Dr. E. Cantoni. Appended to the paper is a bibliography of crustacean teratology.—Remarkable results obtained by the treatment of pulmonary tuberculosis with iodoform, by Prof. G. Sormani.—On a Russian scheme of international exchanges, by Prof. E. Vidardi.

SOCIETIES AND ACADEMIES

LONDON

Royal Society, June 21.—"Supplement to former Paper entitled—'Experimental Inquiry into the Composition of some of the Animals Fed and Slaughtered as Human Food'—*Composition of the Ash of the Entire Animals and of certain Separated Parts.*" By Sir John Bennet Lawes, Bart., LL.D., F.R.S., F.C.S., and Joseph Henry Gilbert, Ph.D., LL.D., F.R.S., V.P.C.S.

In a former paper (*Phil. Trans.*, Part II. 1859) the authors had given the actual weights, and the percentage proportion in the entire body, of the individual organs, and of certain more arbitrarily separated parts, of 326 animals—oxen, sheep, and pigs—in different conditions as to age, maturity, fatness, &c. They called particular attention to the wide difference in the proportion by weight of the stomachs and intestines in the three descriptions of animal ; the proportion of stomach and contents being very much the highest in oxen, considerably less in sheep, and little more than one-tenth as much in pigs as in oxen. On the other hand, the intestines and contents contributed a less proportion to the weight of the body in oxen than in either sheep or pigs ; the percentage by weight in pigs being nearly twice as high as in sheep, and more than twice as high as in oxen. With these very characteristic differences in the proportion of the receptacles and first laboratories of the food the other internal organs collectively, as also the blood, contributed a pretty equal proportion by weight of the entire body, in the three descriptions of animal.

Ten animals had been selected for the determination of the chemical composition, namely—a fat calf, a half-fat ox, and a fat ox ; a fat lamb, a store sheep, a half-fat sheep, a fat sheep, and a very fat sheep ; a store pig, and a fat pig. In these, in the collective carcass parts, in the collective offal parts, and in the entire bodies, the total nitrogenous substance, the total fat, the total mineral matter, the total dry substance, and the water, were determined ; and the results were recorded and discussed in detail.

It was shown that, as the animal fattened, the percentage of nitrogenous substance decreased considerably, whilst that of the fat and of the total dry matter increased in a much greater degree. It was estimated that the portions of well fattened animals which would be consumed as human food would contain three, four, and even more times as much fat as dry nitrogenous substance : and comparing such animal food with wheat-flour bread, it was concluded that, taking into consideration the much higher capacity for oxidation of a given weight of fat than of starch, such animal food contributed a much higher proportion of non-nitrogenous substance, reckoned as starch, to one of nitrogenous substance than bread. In fact the introduction of our staple animal foods to supplement our otherwise mainly farinaceous diet did not increase, but reduced the relation of the flesh-forming material to the respiratory and fat-forming capacity of the food.

Finally, the actual amount and the percentage of total ash in most of the internal organs and some other separated parts were given. It was shown that the percentage of total mineral matter, like that of the nitrogenous substance, decreased not only in the entire body, but especially in the collective carcass parts, as the animals matured. It was the object of the present communication to record the results of the complete analysis of the ashes of the collective carcass parts, of the collective offal parts, and of all parts of each of the ten animals. Forty complete ash analyses had been made.

As was to be expected, more than four-fifths of the ashes consisted of phosphoric acid, lime, and magnesia ; these making up the largest amount in the ash of the oxen, less in that of sheep, and less still in that of pigs. Potash and soda were also prominent constituents. Assuming, for the purposes of illustration merely, that one of phosphoric acid was combined with three of fixed base, the ashes of the ruminants showed an excess of base ; whereas, according to the same mode of calculation, the ashes of the pigs showed no such excess.

It was, unfortunately, only in the case of the offal parts of the pigs that the ash of the chiefly bony and that of the chiefly soft parts had been analysed separately. The results showed a considerable excess of acid, especially phosphoric, in the ash of the non-bony portions ; presumably, in part at any rate, due to the oxidation of phosphorus in the incineration. In further reference to the point in question it may be stated that, although the oxen and sheep show a higher percentage of total nitrogenous substance than the pigs, yet, owing to the relatively small proportion of bone in the pigs, the amount of ash yielded from the non-bony parts is higher in proportion to that from the bones in their case than in that of the ruminants.

Comparing the percentage composition of the ashes of the entire bodies of the different animals, the chief points of distinction were that in the ash of the pigs there is a lower percentage of lime and a higher percentage of potash and soda than in the corresponding ash of the ruminants ; there is a somewhat higher percentage of phosphoric acid in the ash of the pigs and of the oxen than in that of the sheep ; and there is a higher percentage of sulphuric acid (and somewhat of chlorine also) in the ash of the pigs than in that of the other animals.

A table showing the quantities of total ash, and of each individual mineral constituent, in each of the ten animals analysed was given. Not much stress was laid on the amounts in the particular animals analysed, as the actual weights and condition of animals coming under similar designations may vary considerably.

It was of more interest to consider the amounts of the mineral constituents in carcass parts, in offal parts, and in all parts per 1000 lbs. fasted live-weight, of each description of animal.

It was shown that a given live-weight of oxen carried off much

more mineral matter than the same weight of sheep, and a given weight of sheep much more than the same weight of pigs. With each description of animal the amounts of phosphoric acid, lime, and magnesia, are less in a given live-weight of the fatter than of the comparable leaner individuals. Of both potash and soda, again, the quantity is less in a given live-weight of the fatter animals. The same may be said of the sulphuric acid and the chlorine; in fact, in a greater or less degree, of every one of the mineral constituents.

It was estimated that the loss to the farm of mineral constituents by the production and sale of mere fattening increase was very small. It was greater of course in the case of growing than of only fattening animals. In illustration, the amounts of some of the most important mineral constituents removed annually from an acre of fair average pasture and arable land in various products were compared. Such estimates could obviously be only approximate, and the quantities will vary considerably. With this reservation it may be stated that, of phosphoric acid, an acre would lose more in milk, and four or five times as much in wheat or barley grain, or in hay, as in the fattening increase of oxen or sheep. Of lime, the land would lose about twice as much in the animal increase as in milk, or in wheat or barley grain; but perhaps not more than one-tenth as much as in hay. Of potash, again, an acre would yield only a fraction of a pound in animal increase, six or eight times as much in milk, twenty or thirty times as much in wheat or barley grain, and more than 100 times as much in hay.

From the point of view of the physiologist, it would doubtless have been desirable that the selection of parts for the preparation and analysis of the ash should have been different, and more detailed. The agricultural aspects of the subject had, however, necessarily influenced the course of the inquiry; and the extent of the essential work had enforced the limitation which had been adopted. The results must be accepted as a substantial contribution to the chemical statistics of the feeding of the animals of the farm for human food.

PARIS

Academy of Sciences, July 23.—M. Blanchard, president, in the chair.—Historic importance of Nicolas Leblanc's discovery of the method of extracting artificial soda from marine salt, by M. Dumas. To this great discovery, which the author compares with that of the steam-engine by Watt, is traced the vast development of the chemical industries during the last hundred years. The present annual consumption of the carbonate of soda resulting from Leblanc's process is estimated at from 700,000,000 to 800,000,000 kilograms in Europe and America. Yet the name of the discoverer had almost been forgotten till recently revived by the municipality of his birthplace, Issoudun, which now proposes to erect a monument to his memory.—Active or dynamic resistance of solids (continued). Graphic representation of the laws of longitudinal thrust applied to one end of a prismatic rod, the other end of which is fixed, by MM. de Saint-Venant and Flamant.—Method of distributing the heat developed in the process of forging, by M. Tresca.—Description of the new apparatus about to be fitted up in the Paris Observatory for the purpose of studying the movements of the sun, by M. C. Wolf. This mechanism, which is based on the same principle as that adopted by G. and H. Darwin in the Cavendish laboratory, Cambridge, is intended more especially for the observation of solar oscillations and deviations from the vertical.—On the present outbreak of cholera in Egypt, and on the probability of Europe escaping its ravages, by M. A. Fauvel. Every day tended to diminish the chance of an invasion, and should the epidemic be staved off for the next four or five weeks there would be little cause for further apprehension, as it was expected from past experiences that Egypt itself would be entirely free within six weeks at the outside. With regard to the prediction confidently made in many quarters, that the epidemic would reach the mainland through England, the author remarked that on the contrary it had on all previous occasions found its way to England from the Baltic ports on the mainland. He regarded Greece and Spain as in any case free from danger, and thought that in case it appeared on the French seaboard it might easily be prevented from spreading inland by carefully isolating the patients. He considered that the two cities most exposed to its attacks were Constantinople and Trieste, the former through Syria and Asia Minor, the latter through the arrival of immigrants escaping from Egypt. Notwithstanding the recent disclosures made on the spot, he still holds the view that the cholera was originally introduced into Egypt from Bombay in consequence of the suspension of the precautionary measures formerly adopted by the Egyptian Government against the epidemic.—On the origin of the nitrogen existing in combination on the surface of the earth, by MM. A. Müntz and E. Aubin. Nitrogenous combinations are due in the first instance to the electric phenomena of which the terrestrial atmosphere is the seat. These phenomena appear to have been much more intense in remote geological epochs than since the appearance of animal and vegetable life on the earth. Hence it would seem that we are now depending on a constantly diminishing stock of combined nitrogen, and the process of diminution must go on unless atmospheric electricity prove to be a source of sufficient reparation.—On the adaptation to viticulture of the sandy tracts of the Landes and Gironde in the south-west of France, by M. A. Robinson.—Experimental researches on the action of a liquid introduced by a special process into the tissues of the vine for the purpose of destroying phylloxera, by M. P. de Lafitte. Sulphate of copper diluted in water is recommended as best answering all the conditions, and consequently as the surest antidote to the evil.—On some linear differential equations of the fourth order, by M. Halphen.—On certain special solutions of the problem of the three bodies, by M. H. Poincaré.—On some recently observed solar perturbations, by Admiral Mouchez.—On a universal galvanometer without oscillatory action, adapted for the measurement of currents of great intensity or of high tension, with illustration, by M. Ducretet.—On the nitric derivatives of hydride of ethylene, by M. Berthelot.—On some derivatives of mannitic hexylene, by M. Wurtz.—On the products derived from the bacterian fermentation of albuminoids, by MM. Arm. Gautier and A. Etard.—On the supposed transformation of brucine into strychnine, by M. Hanriot.—On the heat-generating power of coal, by M. Scheurer-Kestner.—On the physiological properties of the bark of the dundaké (a West African shrub) and of dundakine, by MM. Bochefontaine, B. Feris, and Marcus.—On the nervous chords in the foot of the heliotides, by M. H. Wegmann.—On the temperatures of the sea observed at Concarneau and Douarnenez, by M. Goez.—A reply to M. Certes on the subject of the method proposed by him for examining corpuscles held in suspension in water, by M. Eug. Marchand.

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THURSDAY, AUGUST 9, 1883

TWO "EMINENT SCOTSMEN"

James Nasmyth, Engineer. An Autobiography. Edited by Samuel Smiles, LL.D. (London: Murray, 1883.)

The Life of John Duncan, Scotch Weaver and Botanist, with Sketches of his Friends and Notices of his Times. By William Jolly. (London: Kegan Paul and Co., 1883.)

WE do not know in what particular direction Dr. Smiles has exercised his editorial functions in the charming autobiography of Mr. Nasmyth. The "pruning-knife" which the latter advised him to use freely was surely not needed; the inventor of the steam-hammer gossips so delightfully about himself that we should have been glad had he gone on to a much greater length. On the other hand it is a pity that Mr. Jolly had not obtained the services of some judicious editorial pruner. He himself has evidently not had the leisure to write briefly, and his book is therefore a somewhat heterogeneous collection of materials much in want of rearrangement and cutting down.

Mr. Nasmyth's autobiography, we venture to think, is likely to become a classic in the section of literature to which it belongs. The genial simplicity, the unconscious and perfectly just self-appreciation with which the great engineer and student of science talks of his career and his work, enlists from the first the reader's sympathy and interest. His father, Alexander Nasmyth, a painter of high rank and the founder of the Scottish landscape school, was himself a genius in mechanics; and an atmosphere of mechanical invention pervaded his happy home in Edinburgh. He was one of the select party on board Symington's steamer on Dalswinton Loch in 1788; and among his fellow-passengers was Robert Burns, a fact new to us. Mr. Nasmyth gives us a delightful sketch of his father and his happy family and the simple Edinburgh life of the time. He himself was born in 1808, and educated at the High School of Edinburgh. From his earliest years he delighted in mechanical invention, and was great at making "peeries" and toy cannon. He naturally, as his father's son, learned the use of the pencil, and insists strongly on the great value of drawing to a mechanical engineer. He himself, throughout life, has made almost daily use of his skill in this art, and by the facility with which he could record his ideas and incipient inventions in this form, saved himself much writing, and preserved much that would otherwise have been lost. He left the High School in 1820, when only twelve years of age, though afterwards he attended classes at Edinburgh University. At this early period he says of himself:—

"I was constantly busy; mind, hands, and body were kept in a state of delightful and instructive activity. When not drawing, I occupied myself in my father's workshop at the lathe, the furnace, or the bench. I gradually became initiated into every variety of mechanical and chemical manipulation. I made my own tools and constructed my chemical apparatus, as far as lay in my power. With respect to the latter, I constructed a very handy and effective blowpipe apparatus, consisting of a small air force-pump, connected with a cylindrical vessel of tin plate. By means of an occasional use of the handy pump, it yielded such a fine steady blowpipe blast, as enabled me to bend glass tubes and blow bulbs for thermometers, to analyse metals or mineral substances, or to do any other work for which intense heat was necessary. My natural aptitude for manipulation, whether in mechanical or chemical operations, proved very serviceable to myself as well as to others; and (as will be shown hereafter) it gained for me the friendship of many distinguished scientific men."

He had moreover taken part in really practical work in some Edinburgh workshops, and at the age of seventeen he was constructing small steam-engines and models for illustrative purposes, and two years later he invented a very efficient road steam-engine. The great event in Nasmyth's early life, however, was his engagement in the great engineering works of Henry Maudsley, of London, in 1829. Maudsley was, indeed, so impressed with what he saw of the young Scotchman's intelligence, knowledge, and skill, that he at once took Nasmyth into his confidence as his personal assistant. In London, as in Edinburgh, Mr. Nasmyth made many friends among those whose friendship was best worth having; through Brougham, for instance, he became acquainted with Faraday, whose friendship he retained to the end of the latter's life.

In order that he might be able to live upon his rather scanty wages, Nasmyth invented an ingenious cooking-stove, a sketch of which he gives, and by means of which he was able to cook a "capital dinner" at 4½*d*. Long before this his attention had been given to the contrivance of accurate cutting-tools, and one of the first things he did for Maudsley was to construct a nut-cutting machine. A visit to the north of England, in 1830, one of the objects of which was to see Stephenson's "Rocket," gave him the first idea of settling ultimately in business for himself in the neighbourhood of Manchester. And so indeed he did in 1832, in a very small way, for his means at the time were limited. Business rapidly increased, and he had shortly to remove to new premises at Patricroft, where in 1836 the great Bridgewater Foundry was in complete and efficient action. For twenty years after this Mr. Nasmyth continued at the head of his constantly growing establishment, adding to his inventions, and extending his operations at home and abroad. The result was that at the early age of forty-eight years he felt himself in the happy position to be able to retire entirely from business and devote his life to those scientific and artistic pursuits which had been to him a constant source of pleasure. Indeed it was his full and accurate knowledge of the science of his art, combined with his native insight and common sense, that enabled him to achieve so many mechanical triumphs.

Mr. Nasmyth naturally enters in considerable detail into the history of the steam-hammer, with which his name is so intimately associated. The conception and completion of the invention seems to have been the work of a very brief time. He was incited to it, so early as 1839, by the difficulty which Mr. Humphries, the engineer who had charge of the construction of the *Great Britain* steamship, found in finding forges powerful enough to weld the paddle-shaft of that vessel. Mr. Humphries wrote to Mr. Nasmyth on the subject, and, says the latter:—

"This letter immediately set me a-thinking. How was

it that the existing hammers were incapable of forging a wrought-iron shaft of thirty inches diameter? Simply because of their want of compass, of range and fall, as well as of their want of power of blow. A few moments' rapid thought satisfied me that it was by our rigidly adhering to the old traditional form of a smith's hand hammer—of which the forge and tilt hammer, although driven by water or steam power, were mere enlarged modifications—that the difficulty had arisen; as, whenever the largest forge hammer was tilted up to its full height, its range was so small that when a piece of work of considerable size was placed on the anvil, the hammer became 'gagged'; so that, when the forging required the most powerful blow, it received next to no blow at all, as the clear space for the fall of the hammer was almost entirely occupied by the work on the anvil.

"The obvious remedy was to contrive some method by which a ponderous block of iron should be lifted to a sufficient height above the object on which it was desired to strike a blow, and then to let the block full down upon the forging, guiding it in its descent by such simple means as should give the required precision in the percussive action of the falling mass. Following up this idea, I got out my 'Scheme Book,' on the pages of which I generally *thought out*, with the aid of pen and pencil, such mechanical adaptations as I had conceived in my mind, and was thereby enabled to render them visible. I then rapidly sketched out my Steam Hammer, having it all clearly before me in my mind's eye. In little more than half an hour after receiving Mr. Humphries' letter narrating its unlooked-for difficulty, I had the whole contrivance, in all its executant details, before me in a page of my Scheme Book, a reduced photographed copy of which I append to this description. The date of this first drawing was the 24th November, 1839."

The paddle-wheel of the *Great Britain* was, however, never forged, as about that time the substitution of the screw for the paddle-wheel as a means of propulsion was attracting much attention. Indeed, Mr. Nasmyth could get no English firm to take up his invention, and was naturally surprised to find, on a visit he made to France in 1842, that his steam-hammer was in full operation at Creuzot, M. Schneider having copied the design from Mr. Nasmyth's drawing when on a visit to Patricroft. Very naturally Mr. Nasmyth on his return to England lost no time in protecting his invention by patent; its career since is well known.

As we said, Mr. Nasmyth retired from business in 1856, twenty-eight years ago, bought a "Cottage" in Kent, a picturesque place near Penshurst, to which he gave the characteristic name of Hammerfield. Long before this he had learned to take an interest in science, especially in geology and astronomy. His investigations into the structure of the moon are well known, and these, as well as his examinations of the sun's surface, have been conducted with telescopes of his own construction. His elaborate work on the moon, with its magnificent series of views of its surface, has long been classical, and his contributions to the subject of the sun's heat are well known. His imagination, when not engaged in devising mechanical contrivances and contributing to scientific theory, has often blossomed into fancy which has found expression in exquisite pictures of fairy-land and other regions of the unseen. Altogether Mr. Nasmyth's long life has been one of almost unchequered success; from the first he has clearly seen what he wished to accomplish, and with scientific precision has devised the most effective means of realising his aims. Not the least delightful and instructive of his many works is the one before us, which we commend to the study of all young engineers, as well as to all who wish to read the story of a successful life simply and pleasantly told.

John Duncan's career, as told by Mr. Jolly, is a complete contrast to that of Mr. Nasmyth. He never rose above the humble station in which he was born, nor apparently ever wished to do so. He had all along to struggle for a bare living, and was essentially unpractical. What little education he had was self-acquired, and it was never much so far as book-learning goes. His love of flowers was a passion. He amid many discouragements managed to acquire a mastery of systematic botany, and his collection of Scottish plants, now in the possession of Aberdeen University, is of real value. Every moment he could spare was devoted to adding to his collection, and partly as weaver and partly as harvester he traversed most of his native land. In other respects he was a man of superior mind, though in no sense a genius, and by no means to be compared with Robert Dick or even Thomas Edward. Mr. Jolly has narrated in our own columns the main facts of Duncan's career. Had he been more happily situated he would certainly have done real service to science. It is some consolation to think that his merits were recognised before he died, and that his last days were surrounded with comforts and attentions to which throughout his previous life he had been a stranger. As we have said, Mr. Jolly has made too big a book of the materials he has collected, and although it abounds in interest, it would have been more creditable to his literary skill had he taken the trouble to rid it of redundancies.

THE HEAVENLY BODIES

The Heavenly Bodies; their Nature and Habitability. By W. Miller, S.S.C. Edinburgh, Author of "Wintering in the Riviera." Pp. 347. (London: Hodder and Stoughton, 1883.)

FEW subjects could be mentioned more remote from the common interests and pursuits of life than what has been usually called the "plurality of worlds," an expression now so long restricted to one well-ascertained meaning as to have lost any ambiguity that might have been charged upon it. The question is one of mere curiosity, and leads to no direct result; but it has always carried with it an attraction irrespective of its unpractical nature, and has exercised the ingenuity of so many minds that its literature is of no inconsiderable extent. To this the book now in our hands is the most recent contribution. It is not the work of an astronomer, as the author himself has informed us; but as his profession leads him to the examination of evidence this need not be considered a material disadvantage. His position, however, in this respect would have been improved by a little more care in the collection of his data, which in some instances, such as Mädler's "central sun," the satellites of Uranus and Neptune, the polar flattening of Mars, and the observations of Schiaparelli, are somewhat in arrear; and it may be the case that those more intimately conversant with the subject would estimate the

comparative value of the evidence somewhat differently. He has taken a very commendable degree of pains in collecting the opinions of former writers; though we have met with no notice of worthy old Derham, or the quick-eyed but fanciful Gruithuisen; but the natural result is the revival of a good deal of antiquated matter that can hardly claim a hearing before a modern tribunal; such as the assumptions of the Cosmotheoros (which by the way he invariably cites as "Cosmothereos") or the affected *niaiseries* of Fontenelle. In fact, excepting for those who would find interest or amusement in specimens of almost all that has been said upon the subject, however absurdly nonsensical, or needlessly pugnacious, the book would gain by a process of winnowing and compression and "weighting," if we may be permitted to use a technical expression. And there can be no question as to the advantage of a more careful revision of the press.

As regards the author's own share, there is much deserving of attention. He writes in an excellent spirit; in espousing the negative side of the question, there is no unfairness towards his opponents; and though some of his arguments carry little weight—for instance that drawn from what seems to him the "dismal," "horrible," "terrifying" aspect of the moon—others are well considered and expressed; and some collateral questions are handled in a way which demands attention, and will well repay it. With regard to the point in hand, if the present volume may not be thought to have done much to decide the controversy, it may be doubtful whether any future successor may do much more. The matter is in reality out of reach. The data are insufficient; and we venture to doubt whether any future generation may be able to attain more satisfactory ones. Long-continued and patient investigation may be fairly expected to throw some light upon the supposed final quiescence of the lunar surface; and possibly on the existence, under certain circumstances, of slight obscurations which might indicate the existence of a very attenuated atmospheric envelope; but this would still leave us at an immense and hopeless distance from any certain proof of habitation. As to the other heavenly bodies our position is worse still. The observations of Schiaparelli, supported to some extent by those of others, and at any rate deserving of respectful attention, tend to divest Mars of some of his supposed similarity to our own globe; and the conclusions hitherto attempted to be drawn as to the condition of the other planetary surfaces are, we venture to think, still less satisfactory. Opinion at present can be little better than conjecture; and it is uncertain at the best whether it will ever be permitted to us to make a further advance. The most ingenious analogical reasoning is not demonstration, and the decision of the finest telescopes would be invoked in vain. An interesting inquiry might be entered upon as to the prospects of opticians and observers; the conclusion possibly might be that their future is somewhat cloudy and obscure. At least we might venture to predict, from past experience, that the accomplished solution of any one of the mysteries which now confront us would only prove a prelude to problems still more insoluble, and proof still more convincing of the comparatively bounded character of all human knowledge.

OUR BOOK SHELF

United States Commission of Fish and Fisheries. Part vii. Report of the Commissioner for 1879.

THE contents of the present volume, embracing details of the work done by the United States Fishery Commissioner for the year 1879, are quite as varied and even of greater interest, if that be possible, than the preceding reports. The specific objects of the methodical inquiry which has now been going on for over twelve years, has for its object to report progress in regard to the propagation of food-fishes in the waters of the United States, as also to afford information as to the decrease in the stock of food-fishes. As has been already stated in the columns of NATURE, in which previous reports have been reviewed, the inquiry which has been so long in progress is being conducted in a thorough and searching way; it embraces the consideration of every topic calculated to throw light on the economy of the American fisheries. Nothing that can be deemed illustrative is neglected—the literature devoted to the natural history of food-fishes, or to descriptions of the fisheries of other countries, especially those of Europe, has been largely utilised in preparing the reports, with the result of making the volumes which have been issued a perfect encyclopædia of fishery information. The contents of the present report embrace a full account of the work overtaken in 1879 and the early part of 1880. The fishes which have been more particularly dealt with in the period noted are the Californian Salmon (*Salmo Quinnat*), the Atlantic Salmon (*S. Salar*), the Mountain or "Rainbow" Trout of California (*S. Irideus*), as also the Schoodic Salmon (*S. Salar*, var. *Sebago*). Various details are also given of what has been done in carp culture, as also of experiments made with the Striped Bass (*Roccus lineatus*), and the Shad (*Alosa sapidissima*). This fish is dealt with quite in wholesale fashion, the figures quoted being really marvellous, as many as 16,062,000 of young shad being distributed, a complete record being kept of the places to which they were forwarded; in the previous year the distribution of this fish reached the figure of fifteen and a half millions. Among the distinctive articles contributed to the present volume are some of rare importance; we may refer to that by Prof. Barlow on "The Marine Algæ of New England," which is both interesting and exhaustive; it extends to 210 pages of the volume now before us, and is illustrated by a series of well-executed drawings. Another paper of importance, full of curious information, is that of Mr. A. E. Verrill, "On the Cephalopods of the North-east Coast of America"; it is also profusely illustrated with fine drawings. "The Propagation of the Eel" is a contribution which is sure to attract attention; the article is by Dr. Otto Hermes, and was read before the German Fishery Association; although brief it contains many features of interest in connection with the natural history of the curious animal of which it treats, and describes most distinctly the differences of the two sexes. The author of this paper announces that the old eels, both males and females, die soon after the spawning season; "the extraordinarily rapid development of their organs of generation exhausts them to such a degree that they die soon after having spawned." This is the reason why they are never seen to return to the rivers. Among the miscellaneous contents of the present report will be found instructive essays on the food of marine animals, by Prof. E. Möbius. In the appendix will be found a very readable account of the herring fisheries of Iceland, as also a short treatise on the fisheries of the west coast of South America. One of the most scientific papers which is given is one containing a reprint of a series of extracts from the investigations of the Commission for the Scientific Examination of the German Seas—it contains much that will prove of interest both to naturalists and economists. It may be safely said alike of the

present and the preceding reports, that they contain a mass of information on fish and fisheries of a kind which has never been before brought to a focus, and in issuing such a guide to all interested, the United States Government has set us an example which we ought at once to follow. The volume is published at Washington, and is printed at the Government Printing Office.

LETTERS TO THE EDITOR

[The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, or to correspond with the writers of, rejected manuscripts, No notice is taken of anonymous communications.

[The Editor urgently requests correspondents to keep their letters as short as possible. The pressure on his space is so great that it is impossible otherwise to insure the appearance even of communications containing interesting and novel facts.]

Cyanogen in Small Induction Sparks in Free Air

AMONG the "Notes" in NATURE for July 19 (p. 281), where the products of combustion are given for various illuminants in common or uncommon use, and where coal-gas, oils, and candles have a fearful amount of both water-vapour and carbonic acid charged against them, the return for electric lights both in the arc and incandescent shapes is given as 0·0 for each; a return which is there considered to show "the great supremacy of electric lighting over all the other methods of illumination when considered as a matter of health."

Now this I believe is most happily true of the incandescent electric lights hermetically sealed in their vacuous glass globes; but who, on second thoughts, would presume to say that it is so with the arc lights, consuming their carbons visibly in the open air? The solid carbon gradually disappears from view, every one allows, and if it has not combined in gaseous condition with the oxygen of the atmosphere, like that of wax candles, it must have mainly combined with the nitrogen, and formed the far more deleterious compound gas, cyanogen, the basis of prussic acid: and that such gas or hydrocyanic acid is produced in the electric arc was set forth by Prof. James Dewar in the *Royal Society Proceedings* for June 19, 1879.

Leaving the great arc lights, therefore, to such a master of the subject, chemical, physical, and electrical, as the Jacksonian Professor in the University of Cambridge, I would request to be allowed to mention here a spectroscopic proof, which I have not seen mentioned before, that cyanogen is also formed in every induction electric spark worked under atmospheric pressure.

In plate 1 of M. Lecoq de Boisbaudran's admirable "Spectres Lumineux" he gives beautifully engraved views of the spectrum of the induction electric spark first at the positive pole, then at the negative pole with a "mean length" of spark, which was in his case probably about one inch; its extreme length with his induction coil and bichromate battery, in its best condition, being two inches.

Now the spectrum he gives for the positive pole is neither more nor less than the low temperature spectrum of nitrogen; that is as we see nitrogen in a gas-vacuum tube, with all its numerous and delicately shaded bands as such, though it is bioxide of nitrogen according to M. Thalén.

But the spectrum which M. Lecoq de Boisbaudran gives for the negative pole has in addition to the above, and besides the red hydrogen line, a number of other most distinct lines and bands, including one line in the violet, which he dignifies with the letter α, and which is certainly the grandest thing in the whole spectrum.

In his printed pages I do not find that the celebrated French spectroscopist gives any explanation of the origin of either that line or the other supernumeraries, the hydrogen line excepted. But on turning to my own paper on "Gaseous Spectra" printed in vol. xxx. of the *Transactions of the Royal Society, Edinburgh*, in 1881, I find on pp. 119 and 122, last column, that almost every one of the lines and bands which I had separated there from the impurities or dissociated elements of the tube's contents and had put down as due to the compound gas "cyanogen" is coincident in place and character with some one or other supernumerary in M. Lecoq de Boisbaudran's spectrum of the negative pole. My spectrum places are indeed very rough, owing to the small amount of dispersion then employed, viz. one simple prism of white flint with a refracting angle of 52°; but the testimony of the whole is cumulative, and, considering

Spark at the Negative Pole in the Open Air by M. Lecoq de Boisbaudran, with a rather Wide Slit

Colour Region.	W. N. Place approx. in Brit. inch.	Intensity approx.	Appearance approx.	Description.
Orange	41,300	2		Narrow band.
Citron	44,850	3		Stronger band with hazy line.
Green	48,600 49,300	4		Group of bands and hazy lines.
Green	50,100 50,800	3		Broad band with stronger edges.
Glaucous	53,800 54,700	4		Larger and stronger than the preceding.
Blue	55,200	2		Very thin line.
Violet	59,400	8		**Most powerful line, the α of the spectrum.**
Violet	59,500	5		A darkening of the nitrogen band.
Violet	59,900 60,400	5 5		Broad band, with strong terminal bars.

Cyanogen's Concluded Spectral Lines by C. Piazzi Smyth, with a rather Narrow Slit

Colour Region.	W. N. Place approx. in Brit. inch.	Intensity.	Appearance.	Description.	Reference page.
Orange	41,146 41,552	2 2		Cyanogen? Cyanogen	121
Citron	44,878	2		True cyan. group	120 & 121
Green	48,582 49,350	4 3		Sharp line begins a band of lines. Isolated line.	120 120 & 122
Green	49,996 50,728	2 3		Cyanogen. Do.	120 and 122
Glaucous.	53,963 54,570	3 2		Not nitrogen nor carbon. Cyanogen?	122
Blue	55,271	2		Cyanogen?	120
Violet	59,405	5		Grand line, followed by a band, characteristic of cyanogen.	120 & 122
Violet	59,985 60,356	2·0 0·2		Cyanogen. Cyanogen?	120 & 122
Violet	60,541	1·0		Nitrogen?	120 & 122

the totally independent manner in which my results were arrived at, and the certainty with which they were stated on their own merits, perfectly overwhelming.

Thus—of the line which I now identify with that one which is

facile princeps in M. Lecoq de Boisbaudran's spectrum of the negative pole, and was therefore termed *a* by him, though to the confounding of his series of Greek letters in the positive pole's spectrum—I wrote of it in 1880 as "grand line peculiar to cyanogen," "the powerful violet line (viz. the above) at 59,405 W.N.B. inch, may become useful as a reference for place to many observers," and "grandly strong violet line, followed by a band; specially characteristic of cyanogen."

But a better view of the testimony of the whole case will be found in the above pair of tables, in the first of which I have collected, in a rude way of my own, all the lines and bands which are supernumerary in M. Lecoq de Boisbaudran's negative, as compared with his positive, pole; and in the second I have entered my former conclusions from gas-vacuum tube observations of what spectral lines and bands are peculiar to the compound gas cyanogen.

C. PIAZZI SMYTH

15, Royal Terrace, Edinburgh, July 25

The Earliest Known Plotting Scale

THE Babylonian statues recently acquired for the Louvre by the mission of M. de Sarzec are of great interest in the history of measurement. The earliest datable measuring rods hitherto known are two Egyptian masons' cubits of wood, of the reign of Hor-em-heb in the fifteenth century B.C.; but on these statues we find represented not merely a mason's rod, but a finely-divided plotting scale, and the date of these figures is placed before the fifteenth century B.C. Of course the accurate lengths of cubits can easily be recovered from the dimensions of buildings of the earliest periods; but no measures, or accurate representations of such, are preserved to us from the primitive times.

There are several of these diorite statues of King Goudea in the Louvre, some rather less and some rather more than life size; all finely executed in a style superior to anything of the later times from Mesopotamia, with which we were already familiar. They are wrought by means of tubular drills and graving tools, by which lengthy and delicate inscriptions are cut all over the surfaces; the tools employed seem to have been very similar to those used by the early Egyptians for their statuary in diorite, which I recently described at the Anthropological Institute.

The statues which now concern us are two seated figures of an architect (or perhaps the king, as founder); these each bear on the knees a drawing board, 6·3 × 11·3 and 7·4 × 12·7 inches respectively. One board is plain, the other has an elaborate outline of a fortified town, showing all the buttresses and turns of the wall. By the right hand of each figure lies a drawing stylus, and along the front of each board a plotting scale, subdivided along both outer and inner face.

These scales have a sloping face along each side, like modern scales, but meeting in a ridge at the top, like French plotting scales, without a level space. The breadth is ·90, and height ·33 inch, sloping therefore about 36°; the length is just over 10½ inches, or half a cubit, the terminals being lines, with a small surplus beyond them.

The subdivisions vary on the different sides; but the general arrangement is a uniform series of spaces, which we will call digits; these are each $\frac{1}{28}$ of the half cubit, or ·653 inch. Then along one side of each rod the *alternate* digits are subdivided; thus there can be no confusion between digit lines and subdivisions. The dividing lines run the whole width of the face; they are about $\frac{1}{20}$ inch wide, and scored out nearly as deep into the diorite. The subdivisions are of halves, thirds, fourths, fifths, and sixths of a digit; and two sixths are carried over to the other side of the scale, and there further divided into twelfths and eighteenths of a digit; this last fraction being only $\frac{1}{252}$ of an inch.

By calculating a normal scale from the various digit lines (as described in "Inductive Metrology," p. 31) the average error of division may then be computed. It is about the same for the digits and also the subdivisions, varying on different sides from ·009 to ·013 inch; the mean error of all the digit marks is ·011 inch, or about half the breadth of a cut. But it is not to be expected that mere decorative representations like these would be divided with the same care as actual working scales. The mean value of the cubit deduced from these scales is 20·89 ± ·07 inch, which is apparently a long variant of the old 20·63 cubit, and not the later Assyrian cubit of 21·4 or 21·6.

The actual values of the divisions of the two sides of each scale are as follows, stating the amounts as differences from the normal scale in thousandths of an inch, which enables the variations to be most plainly seen. The points measured were about one-third from the bottom edge toward the top ridge.

Normal scale.		Without the plan.				With the plan.			
Digits.	Subdivisions	Outer.		Inner.		Outer.		Inner.	
		+	−	+	−	+	−	+	−
0		(. . .)		12		(. . .)		(. . .)	
·653			15		2	(. . .)		(. . .)	
1·306		(. . .)			20	(. . .)		(. . .)	
1·959		(. . .)			8	(. . .)		(. . .)	
2·612		(. . .)			26	(. . .)		(. . .)	
	½ 2·938	28		. . .		(. . .)		(. . .)	
3·265			9	2		12		11	
3·917			3	2		. . .		25	
	½ 4·244	. . .			9	. . .		18	
4·570		(. . .)		. . .		. . .		7	
5·223		(. . .)			8	. . .			11?
	⅓ 5·441	. . .		2		. . .		(. . .)	
	⅓ 5·658	. . .		4		. . .			1
5·876		(. . .)		4		. . .			1
6·529		(. . .)			5	. . .		8	
	¼ 6·692	. . .		21		. . .		6	
	¼ 6·855	. . .		25		. . .		3	
	¼ 7·018	. . .		18		. . .			1
7·182		7		58			8		10
7·835		1		4		. . .		(. . .)	
	⅕ 7·966	. . .		3		. . .		8?	
	⅕ 8·096	. . .		2		. . .			7
	⅕ 8·227	. . .			3	. . .			13
	⅕ 8·357	. . .			5	. . .			22
8·488		11		0		. . .			7
	½ 8·814	. . .		. . .			25	. . .	
9·141			7		12		6		2
	⅙ 9·249	. . .			7	. . .			4
	⅙ 9·358	. . .			27	. . .			4
	⅙ 9·467		14		11	. . .			8
	1/18 9·503		13	. . .		. . .		. . .	
	1/18 9·539		11	. . .		. . .		. . .	
	1/18 9·576		6	0		. . .			19
	⅓ 9·685	4		20		. . .			12
	1/18 9·739	14		. . .		. . .		. . .	
9·793		19		20		(. . .)			21
10·446			5		24	(. . .)		(. . .)	

The plain dots show that there was no mark; the dots in brackets where a mark is defaced, or the whole surface destroyed. The great error of ·058 inch is due to a cut run askew, the line being as accurate as the others on the outer face of the rod.

I am indebted to M. Ledrain for kindly granting me permission to take the measurements from these statues.

Bromley, Kent W. M. FLINDERS PETRIE

A Result of our Testimonial System

A LITTLE incident has come under my notice of such a character that I think it ought to be made known to the readers of NATURE.

A candidate, whom I will call Mr. A. B., for a vacant scientific chair in this country writes to an eminent German professor for a "testimonial," and in his letter there occurs the following remarkable sentence:—

". . . 17 *July*, '83

"DEAR SIR,—I intend applying for the vacant chair of . . . at . . ., and would feel grateful if you could send me a testimonial saying a few favourable things of my contributions to the science of . . .

". . . I hope that you will not think me too bold in asking this request, and as I know your time is too valuable to be trespassed on by a stranger, *I beg that you will accept the inclosed.*"

The German professor, whom I will call Prof. C., thereupon writes to a distinguished English professor, who is a personal friend of his, the following letter, which has been placed in my hands with the request that I will add a few comments. The letter, which I give in its original language in order that none of its force may be lost, runs as follows:—

". . . 23 *Juli*, 1883

"Verehrter Herr College,—Ihre freundliche Gesinnung gegen mich, ermuthigt mich, Ihnen folgenden Fall vorzutragen, mit der Bitte möglichst viele Ihrer Herrn Collegen und, wenn Sie es für gut halten, auch die Presse davon in Kenntniss zu setzen.

"Ich hatte schon öfter aus England Briefe erhalten von Candidate für irgendwelche . . . Professur mit der Bitte ein Zeugniss ueber ihre Leistungen anzustellen. Ich habe, da mir diese Art der Bewerbung, wie sie in England leider gebräuchlich ist, im höchsten Grade zuwider, meist derartige Schreiben gar nicht beantwortet. Neulich erhielt ich nun aber einen Brief aus . . . von einem gewissen . . . der an Schamlosigkeit Alles uebersteigt, zum Mittel der Bestechung greift. Es klingt unglaublich, aber Herr . . . ist so schamlos, mir als Preis für ein Empfehlungschreiben *Geld anzubieten*. Damit Sie sich selbst davon ueberzeugen können, sende ich Ihnen das Original mit der ergebensten Bitte mir dasselbe nach gewonnener Einsicht bezw. Abschrift, wieder zurückzusenden. Eingelegt war eine Anweisung auf 1 guinea! Letztere sende ich heute ohne Brief recommandirt an . . . zurück. Ich habe Beider hier meinen Freunden gezeigt und werde auch vor Zeugen die Rücksendung der Anweisung auf 1 Guinea vornehmen.

"Ich glaube, verehrter Herr College, dieser Fall ist dazu angethan, weiteren Kreisen mitgetheilt zu werden, um zu verhindern dass ein solch erbärmlicher Mensch wie . . . etwas die Stelle in . . . erhalte. Ihnen im voraus für Ihre Mühe dankend mit vorzüglichste Hochachtung.

"Ihr Ergebenster, . . ."

I imagine that all Englishmen on reading the above will, like myself, be filled with shame that any one speaking our tongue should have laid himself open to such a rebuke.

At the same time it seems to me quite possible that Prof. C.'s view of the matter is unduly severe and indeed unjust. I do not know Mr. A. B. personally, and am quite ignorant of what character he bears; but I can conceive that he has fallen into this disgrace through a clumsy attempt to carry out to its logical conclusion our English system of testimonials. He can hardly have thought that so distinguished and successful a man as Prof. C. could be *bribed* to say something handsome by a post-office order for *one guinea*; and he cannot be so ignorant as not to be aware of the just pride which all Germans feel in the integrity and honour of their professoriate; it is quite open for us to suppose that he was really offering Prof. C. *a fee for a professional service*. And really when you come to think of it, this is a point of view for which something may be said. Only last week, in talking to a colleague about testimonials, I asked him how many testimonials he wrote on an average a week. He replied that he thought *not more than a dozen or fifteen*. In fact when a man, especially one who has spent some years in teaching, has acquired a certain reputation in science, the tax upon his time and energy for the skilful composition and writing of appropriate testimonials amounts during his lifetime to a something which, converted at the market value of his powers into pounds, shillings, and pence, would appear no mean sum.

Now—and this is the kernel of the matter—no one would grudge time spent in assisting a deserving man to get into a place for which he was fitted; but our testimonial system has nowadays reached such dimensions that only a few of the testimonials written have this end in view. I am writing freely, because this is a very serious matter, and one which I have much at heart; I therefore do not hesitate to say, what indeed is well known, that great skill has been reached by many in the art both of writing and reading testimonials. Many testimonials are framed after that well-known formula for acknowledging the receipt of pamphlets which runs as follows:—"Dear Sir,—I beg to thank you for the valuable pamphlet which you have so kindly sent me, and which I will lose no time in reading." And I heard the other day a testimonial praised because it showed the electors whom not to elect.

Surely the time has come to consider whether this plague of testimonials (for it is hardly less) cannot in some measure be stayed. At all events, cannot in higher places at least some steps be taken to mend matters? When such a post as a professorship is vacant, it is the duty of the electors to make themselves acquainted with the manner of man wanted and to find him; our present plan lays upon all persons connected with the subject of the chair the burden of trying to enlighten the electors as to the claims of this or that candidate. A passage in Prof. C.'s letter shows how degrading the Germans think our method; and it is not agreeable to Englishmen to read such passages. Yet every one who has had to struggle for a post with testimonials must feel that such criticisms are just, and that the process is one distasteful to a right-minded man. And it is also unnecessary. I, for one, would rejoice to see the German system of a "call" introduced into our professorial elections; but if we cannot obtain this, let us at least do away with testimonials. In the recent elections at the University of Cambridge, the following significant phrase occurred in the announcements of the vacancies: "testimonials, *if any*, to be addressed, &c." ; and as a matter of fact, in the cases of the four chairs recently filled up on the new system, the man chosen in each case had sent in no testimonials. Why cannot this be done in all elections to professorial chairs? Where, as may sometimes be the case, the candidates are previously not all thoroughly known, the electors, by reference, formal or otherwise, can easily make themselves acquainted with their relative merits; and indeed, as I just now said, it is their duty to make such inquiries, and not simply to collate, interpret, and form their decisions on the curious documents which we call testimonials.

Hence, though I venture to send this communication to NATURE for the purpose of making an example of Mr. A. B.'s post-office order for one guinea, I cannot help thinking that he, though sinning, is also sinned against, and that our system of testimonials is to be blamed as well as he. M. FOSTER

Birds and Cholera

YOU ask in one of your "Notes" (p. 329), what can be the cause of birds leaving a locality before the approach of cholera? The following anecdote may be of interest, but I of course cannot vouch for its having any real connection with the subject. It must have been in the summer of 1848 that I was invited to meet a party at my uncle's house in the Close at Salisbury, on the occasion of the visit of the Antiquarian Society. On arriving I found the cholera raging, and the party put off. There were in the house only the gardener and his wife, whom, having been previously servants to my father, I had known from my childhood. The gardener told me that, just before the outbreak of the disease, the man whose duty it was to oil the vane upon the spire had made his annual ascent (of 404 feet), and had perceived a foul scent, which, it seems, had not been noticed below. The inhabitants connected this with the appearance of the epidemic shortly afterwards. Birds might no doubt be affected by such a circumstance. O. FISHER

THIS has been remarked before. It is recorded of the great outbreak of cholera at Salisbury in 1849—can any of your correspondents say where?—that an officer recently from India, happening to make the ascent of the Cathedral, exclaimed suddenly, "I smell cholera!" Immediately afterwards the outbreak followed, when it was observed that the birds (swallows are especially in my remembrance) had fled the neighbourhood. If these two incidents are to be trusted, it can scarcely be doubtful that there is a connection between them. HENRY CECIL

Bregner, Bournemouth, August 6

YOU will find a very interesting but rather sceptical paper on the supposed connection of birds leaving towns with invasions of cholera (NATURE, vol. xxviii. p. 329), by Pfarrer Häckel of Windsheim, in the monthly journal, *Der zoologische Garten* (Bavaria), September, 1873 (vol. xiv. p. 328), published by the Zool. Gesellschaft of Frankfort-on-Main. D. WN.

Freiburg, Badenia, August 4

Animal Intelligence

SEVERAL remarkable instances of intelligence in animals have been given in recent numbers of NATURE. Possibly the following instance of reasoning power in an elephant may not be without interest:—Some years ago I was ascending the lower part of the Darjeeling Hill Road, in the Himalaya Mountains, from Terai. At a certain part of the road, where we met a string of bullock carts, the outer few feet was encumbered by a long flat-topped heap of small rounded boulders, piled there to be broken up for road metal; from the outer edge there was a steep, almost precipitous, slope. On the inner side of the road was a small drain, and then a few feet of comparatively level ground between the drain and the slope above. The carts just mentioned were of the usual kind, the body (constructed of bamboo) about

12 feet long and 3½ feet broad, with the wheels near the middle, each cart being drawn by a pair of bullocks. The *mahaut* (driver) of the elephant I was riding having halted the animal close up to the heap of boulders, there was just room left between the elephant and the chain for the carts to pass. These carts were the ordinary vehicles of the country, and under ordinary circumstances an elephant would no more think of "shying" at them than a London dray horse would think of shying at a cab. Yet as the carts went by one by one my elephant became more and more uneasy, and finally, in spite of the efforts of the *mahaut* to restrain her, mounted on the heap of boulders, at the risk (which, considering how cautious elephants are in treading on suspicious ground, I believe she must have seen quite as clearly as the *mahaut* or I) of rolling down the slope below the road, if the rounded boulders shifted and gave way beneath her weight. It was some time before I perceived the cause of her fear. Elephants, even in India, are uncommon, and bullocks, as well as other domestic animals, generally feel considerable dread of them from their unusual appearance as well as their size. The bullocks in question were greatly frightened at having to pass so close to the bulky brute, and several of them in passing tried to get away from her by jumping the drain. It required all the efforts of the drivers to prevent their doing it. The elephant evidently saw that the bullocks were frightened and that they were trying to jump the drain, and she further calculated that if they did so *the long tail of the cart would swing sharply round in the opposite direction* and strike her violently across the fore legs. Of the two risks she preferred that of mounting on the heap of boulders.

F. R. MALLET

Calcutta, July

AS NATURE frequently contains notices of intelligence in animals, I have ventured to send you the inclosed note from the Reading local paper, as containing a remarkable fact regarding intelligence in a blind horse. The writer, Mr. Gostage, is quite trustworthy, and I have taken pains to verify the truth of his statements.

JOSEPH STEVENS

128, Oxford Road, Reading, August 6

NOTE PUBLISHED IN THE *Reading Observer* OF AUGUST 4, 1883

Sagacity of the Horse

SIR,—A circumstance so fully illustrative of the sagacity of the horse was witnessed in the neighbourhood of Mortimer last Saturday, and reported to me through the owner, that I think it worth publicity. I can vouch for its truthfulness, and if any doubt arises I can introduce such doubter to the owner. The horse under notice, an old blind one, belonging to a small tradesman and farmer, was turned out to graze on the common near the owner's house. For some cause it wound its way through lanes to the blacksmith's, where he had often been before. The entrance to the forge is difficult of access on account of the ditches on either side, but the animal reached it safely, took its stand by the forge, and then neighed. The blacksmith, being at work in his garden, and hearing a horse neigh, looked for it, and not seeing it, returned to his gardening operations. In a short time he heard it again, but could not see a horse anywhere, until he went into his shop, when he found it standing very quietly by the forge as if waiting to be shod. Thinking some one must have brought it there, the blacksmith looked at its feet, and found one with the shoe pressing into the frog, causing great pain. He then put on another shoe, and sent the horse back to its owner.

This instance of sagacity is so clear and telling that I thought it desirable to ask you, Mr. Editor, to publish it.

Yours truly,

S. GOSTAGE

King's Street, Reading, August, 1883

ACCOUNTS are not rare of female cats having adopted the young of other creatures when deprived of their own, or while nursing their own young, but I have never met with a case like the following :—

My tom cat, Smut, whose eighteenth birthday was lately celebrated, has always been kind to kittens; and a long friendship with a tame rabbit was only terminated by the death of the rabbit in consequence of eating too much plum pudding one Christmas. But his benevolence to feathered creatures was first shown in 1881, when, having a solitary chick hatched out of a clutch, I bethought me of making him useful as nurse, and with some fear put the chick into his basket. The experiment answered admirably, except that Smut sometimes licked the feathers the wrong way; and when about a fortnight afterwards the chicken was accidentally killed, it was curious to see its foster-father's search for it during the following three or four days.

Since then Smut has taken charge of as many as fifteen young chickens at a time, but he has never evinced the same affection for them as for his first feathered foster-child.

J. DE B. F. P.

The Orphange, Wandsworth Road, August 7

Different Sources of Illumination

IN your issue of July 19 you give in the "Notes" (p. 281) some interesting data as to the products of combustion and heat produced by different sources of illumination, each being of 100 candle-power and giving off this light for one hour. This is valuable information, and I am sure that others besides myself would be glad if you could give a reference to the authority. I would also suggest that it would be interesting to have a comparative authoritative statement as to the carbonic acid and heat produced in the same time by an average human being. I was told the other day by a mining engineer that he finds that one oil-lamp contaminates the air to the same extent as one miner when at work. It is often stated that one gas-burner in a theatre is as deleterious as six members of the audience. If the true state of the case were published in your columns, it would be interesting to many.

GEORGE FORBES

34, Great George Street, Westminster, July 20

[The information is based on an article in *La Lumière Électrique* for June 16.—ED.].

A Remarkable Form of Cloud

AN account, which will I believe be found satisfactory, of the formation of the type of cloud described in NATURE (vol. xxviii. pp. 299, 320), will be found in a paper read by me before the Meteorological Society on June 20 last, and which will be published in the next *Quarterly Journal* of the Society. The paper is on "The Structure of Cirro-filum, or Ice-cloud disposed in Threads." A very valuable contribution to our knowledge on this subject will also be found in an article by Dr. Linn ("Ueber die Entstehung der Wolkenstreifen," *Zeitschrift für Meteorologie*, xviii. 52), to which I would refer those of your readers who are interested in the topic.

The cloud is very common, and regular reports of the direction both of movement and of "filature," elements of very considerable value in the prognosis of weather, have been, for some years past, sent to the Meteorological Office by a limited number of observers.

W. CLEMENT LEY

Disease of Potatoes

WHEN I read the note from *Naturen* in NATURE, vol. xxviii. p. 281, it appeared to me that Herr Anda was describing the same effects in the potato stalk as had been described by Berkeley in 1846. In his description of the usual potato disease Berkeley says:—"The stem now rapidly putrefies, the cuticle and its subjacent tissue become pulpy, and separate when touched from the woody parts beneath. The whole soon dries up, and in many instances exhibits in the centre the black, irregular fungoid masses which are known under the name of *Sclerotium varium*, and which are believed to be the mycelium of certain moulds in a high state of condensation."

Now the *Sclerotium varium* grows exactly as described by Herr Anda; but so far as it has appeared here, it does not seem to be truly parasitical, but only begins to be developed on the potato stalks when they are dying down of the common disease. Whether this *Sclerotium* is the same as that referred to by Mr. W. G. Smith (NATURE, vol. xxviii. p. 299) I do not know, but probably it is. He says he did not get his to germinate; while Herr Anda describes the fruit of the *Sclerotia* found at Stavanger.

From "pink eye" potato stalks of last year I threshed out a quarter of a pound of *Sclerotium varium*, and at the present time I have hundreds of specimens germinating in the way Herr Anda describes; one stalk only has yet come to what I regard as the perfect fructification, having developed at the apex a beautiful little cup; but about a score of others of those first

laid on wet cloth are beginning to give distinct evidence of the production of cups. The probability at present is that *S. varium* is the Sclerotium of a Peziza, nearly allied to *Peziza tuberosa*.

A. STEPHEN WILSON

North Kinmundy, Aberdeen, July 30

P.S.—Since the above was written I have discovered amongst growing potatoes great numbers of *S. varium* with the completed fungus attached to them. It is a yellowish-brown Peziza of various diameters up to half an inch. I send you a box of specimens.—A. S. W.

"Zoology at the Fisheries Exhibition"

IN NATURE, vol. xxviii. p. 289, is an article upon the zoology of the Fisheries Exhibition, in which the writer states that some of the corals exhibited by Lady Brassey belong to me and are not that lady's property. Will you permit me to emphatically assert that not a single coral in the case belongs or ever did belong to myself, and that every specimen was procured by Lady Brassey during her voyages in the *Sunbeam*.

What is meant by the words "gratuitous inventions" I cannot understand; the new species were carefully compared with those in the British Museum, also with those obtained during the *Challenger* expedition, and with the works of Lamarck, Dana, Milne-Edwards, Moseley, and others.

It is possible that the commissionaire in charge may have, in dusting the collection, shifted some of the labels, but the fact remains that Lady Brassey's collection of corals is the only one in the Exhibition which gives any information either upon the nomenclature or habitat of the specimens exhibited.

204, Regent Street, W., August 4 BRYCE-WRIGHT

"The Student's Mechanics"

I HAVE no wish to quarrel with the review you have printed of my book, "The Student's Mechanics;" and I have to thank the reviewer for drawing attention to one omission, namely, the failure to explain fully the second law of motion, as related to the two methods of measuring force. But I should be glad to be allowed a few words to explain my treatment of Accelerating and Moving force. One of my objects was to clear away, by full explanation, the confusion which no doubt sometimes exists as to those terms; and this I could not have done if I had omitted them altogether. It will be long before a reader of works on mechanics can safely remain ignorant of their meaning; and indeed the discussions of force as causing change of velocity simply (as in kinematics), and as causing change of momentum, are still kept so much apart that terms to indicate the distinction do not seem out of place. Nor do I see any confusion likely to arise between "acceleration" and "accelerating force": the one is the actual change of velocity in a given time, the other is the force which causes that change. The latter is measured by the former, but it is not the same thing. In Art. 422 the word "accelerating" is simply used in opposition to "retarding," in the sense of that which increases velocity instead of diminishing it: I know no other word in use for the same purpose. Lastly, the proof in Art. 359 was given precisely to supply the omission to which your reviewer calls attention, and which does exist in the ordinary proofs that no velocity is lost in passing round a smooth curve. I there show that the sum of such losses, in a given time, is indefinitely small compared with the sum of another set of quantities, which sum is itself finite; hence the first sum may properly be neglected. WALTER R. BROWNE

Sand

As explained in my note on p. 245, I had not the advantage of perusing Mr. Waller's paper on "Sand." Mr. Gardner, in his notice of it gave the first place to "distinguishing with certainty by the aid of the microscope sand that has been worn by the action of wind from sand that has been for long exposed to surf, and this again from sand brought down from torrents." I assumed this was its primary object. In this I am in error. Mr. Waller says his "paper was to show that chalk flints had scarcely any place in the formation of sand." Had I known this was the purpose of his writing I would not have troubled you with any remarks, as I entirely agree with Mr. Gardner when he says, as in p. 225: "The coast-line occupied by flint shingle is almost limited to portions of Western Europe, and is relatively insignificant."

I am glad to learn that Mr. Waller has a more comprehensive object in view, and that a large series of sands from modern and ancient formations are being examined microscopically, and shall be glad to supply portions of specimens of the soils and subsoils of Australia and New Zealand which contain sand, and were examined under the microscope ten years ago, to compare their form and appearance with similarly situated soils from Europe. JAMES MELVIN

Treble Primary Rainbow

ON Sunday, July 15, as a heavy thunderstorm was passing away from over this place, a brilliant rainbow appeared a little to the south of east about 5.45 p.m. There was a complete primary arch and a nearly perfect secondary one, and on being led to examine the former in consequence of its appearing unusually broad, it appeared to be made up of three bows, one directly below the other. The red of the spectrum being repeated three times was what drew my attention to this point. The two lower bows appeared smaller than the top primary arch. Thinking I must be suffering from some optical illusion, I got my wife, brother, and my little girl of nine, all to look carefully at the rainbow, and found that they all saw three distinct bows in the primary arch, in addition to the secondary arch. Is not this an unu ual occurrence? R.

Bexley, Kent, July 21

[This is merely the well-known phenomenon called *spurious bows*, which has not yet found its way into the "popular" class of text-books, though the principles of its explanation were long ago pointed out by Young. The full theory was given by Airy, and found to coincide with the very exact measurements of Hallowes Miller. When the raindrops are all of the same size, each wave-length in the rainbow has one principal maximum with an infinite number of subsidiary maxima of rapidly-decreasing brightness. These lie *inside* the chief maximum in the *primary* rainbow, and outside it in the secondary.—ED.]

FUEGIAN ETHNOLOGY

IN Guido Cora's *Cosmos* for May, 1883, Lieut. Bove, of the Italian Antarctic Expedition, supplies some interesting details on the little known inhabitants of Tierra del Fuego, amongst whom he spent some time in the spring of the present year. He speaks highly of the English missionaries stationed at Ushiwaya, in Beagle Channel, who have succeeded in introducing a few rudimentary notions of human culture amongst several tribes hitherto supposed to be quite irreclaimable. As had long been suspected, the archipelago is found to be occupied not by one but by three distinct races, the Alacalufs in the west, the Onas in the east, and the Yagans in the south. Of these the Yagans, who stretch from the north side of Beagle Channel southwards to Cape Horn, appear to be the true aborigines. They have been driven to the southernmost and most inhospitable islands by the Onas and Alacalufs, both intruding from the mainland. The Onas, who are clearly of Tehuelche origin, penetrated from Patagonia across the eastern arm of Magellan Strait, into the large island of King Charles South Land (Eastern Tierra del Fuego), which they now hold almost exclusively. In the same way the Alacalufs, of Araucanian stock, made their way from the Chilian Andes, across the western arm of Magellan Strait, into the western islands, which they now occupy from Cape Pillar to Stewart Island, at the Pacific entrance of Beagle Channel. They number scarcely more than 2000 altogether, while the Yagans and Alacalufs are estimated by the English missionaries at about 3000 each, giving 8000 for the whole archipelago.

Although now representing the most aboriginal element, the Yagans themselves would appear to belong originally to the same Chilian family as the Alacalufs, the points of difference being easily explained by their longer isolation from the parent stock and by the more unfavourable climatic conditions of their present homes. From numerous measurements taken by Bove, they seem to be much below the middle height, although still nearly as tall as the Araucanians of the mainland. Of these the

average stature, according to D'Orbigny, is 5 feet 3 inches, while the Yagans range from 4 feet 10 inches to 5 feet 4 inches, and the women from 4 feet 9 inches to 5 feet. But in other respects they present a more debased appearance than their continental congeners, being distinguished by low brows, prominent zygomatic arches, large pendent lips, flat nose, round face, loose, wrinkly skin ("pelle grinzosa e cadente"), thin extremities, the legs curved outwards. The black hair is of the usual American texture, coarse, lank, and long, but in one district chestnut and wavy, due, no doubt, to mixture with white blood.[1]

They neither tattoo nor paint the body, which is exposed almost naked to the inclemency of an excessively rigorous and stormy climate. In this respect the Fuegians present a striking contrast to the Eskimo at the opposite extremity of the continent, the general cut of whose warm and comfortable attire may, according to Mr. E. B. Tylor, be due to the influence of the old Norse settlements in Greenland. Although Bove gives us two distinct terms, *áccar* and *tuma-chi* for *house* and *hut* respectively, the dwellings themselves are all alike described as wretched hovels, made of branches stuck in the ground and loosely bound together in the Botocudo fashion. More skill and care is displayed in the construction of their beechwood canoes, which are generally from fifteen to twenty feet long and about two feet wide. In these frail craft they navigate the intricate channels of their storm-swept waters, and boldly pursue the whale and dolphin often far out on the high seas beyond sight of land ("spesso fuori dalla vista d'ogni terra"). Here, however, it may be well to remember that similar statements were constantly made of the Andaman islanders until Mr. Mann recently showed that in their light outriggers they never venture far from the shore.

Like the Araucanians the Yagans are polygamists, and, like the followers of the Prophet, they have generally four wives. But, while the Araucanians purchase their mates,[2] the Fuegian bride is provided with a dowry consisting usually of a canoe and a few harpoons. Nevertheless all the hard work, such as fishing, hutbuilding, the kindling and preservation of fire, falls to the share of the women, who in return meet with nothing but the most brutal treatment from their helpmates. "How often," writes Bove, "have I seen men seated cosily round a good fire, while the wretched women remained exposed to the snow, wind, water, fishing for their idle and unmannerly husbands!" Notwithstanding their hard lot the women are exceptionally fruitful; but, on the other hand, a small percentage only of the children resist the severity of the climate. They leave the paternal roof at a very early age, and begin to shift for themselves *before* reaching their teens. In fact family ties can scarcely be said to exist, and the only affection of which the Fuegian seems capable is "self love." "How often," again remarks the Italian explorer, "have I seen the father devouring a hunch of meat or bread, while round him stood wives and children, their eyes riveted on the food, with features distorted by hunger, rendered all the more painful at sight of others being sated, timidly gathering the scraps dropping from his lips, and falling rabidly on the remnants of the feast contemptuously thrown to them by the ferocious head of the household!"

Each family circle lives apart in absolute independence, combining only in small tribal groups for the purpose of mutual defence against some common enemy. Thus it is that the first germs of the community are sown by the necessity of self-preservation, just as the fully organised society is still kept together by the same overruling principle. But in the Fuegian community the idea of headship has not yet been evolved. No one claims the right to assume the chieftaincy, or to meddle in the concerns of his neighbour. Hunting or warlike excursions are arranged by common consent, and the spoils of war or the chase are equally distributed amongst the members of the expedition. Certainly the Fuegian social system seems to favour the views of those, rather, who hold that everywhere the commonwealth preceded oligarchy and the monarchy. As the monotheistic conception was arrived at through pantheism and polytheism, so in the social order the autocrat appears as the final outcome of a rude communism and *πολυκοιρανία*.

The Yagans, however, seem to have scarcely reached the pantheistic, or perhaps it would be more correct to say the pananthropomorphic, state. Religious notions, in the strict sense, cannot be said to exist where no clear distinction has yet been drawn between the natural and supernatural. Even with superstitious ideas they are but little troubled ("sono pochissimo superstiziosi"), while their indifference to the remains of the dead would seem to imply that they have no anticipations of an after life. To the naturalists of the Italian expedition they freely parted with the crania of fathers, friends, and relations, without the least outward symptoms of regret. In one instance, however, a good deal of sentiment was expressed by a young Yagan, who thus somewhat poetically addressed the skull of his father: "Farewell, dear father. You, who when alive never saw aught but our snows and our storms, are now going dead far far away!" This is the language of one, in whom at least dim visions of another existence seem to be dawning.

Considering the extremely low state of their culture, it requires a considerable degree of credulity to accept the statement that their agglutinative language possesses some 30,000 words, besides highly complex and elevated grammatical forms ("ha circa 30,000 vocaboli, e forme grammaticali molto complesse e elevate"). This is naturally regarded as a sure proof that the Yagans have had a much higher origin than might appear from their present debased condition. But it will be safer to await further proof before accepting the statement at all. Reserve is the more needed that we are told somewhat mysteriously that this linguistic phenomenon *was very little studied* by the explorers ("femoneno notato, quantunque pochissimo studiato, dei nostri exploratori.") It is also curious that, with such a copious vocabulary, of which a few specimens are given, the same word *yash* should have to do duty both for *hand* and *finger*, as well as for *head*, this last, however, doubtless as a homophone, or else through one of those mistakes which cannot always be avoided even by *careful* students of barbarous languages. The numerals do not seem to get beyond *five* (cu-pash-pa, an obvious compound), which is again somewhat inconsistent with a vocabulary of 30,000 words! But we may soon expect further light to be thrown upon this point by the English missionaries, who are doing such excellent work among the Yagans of Beagle Channel, and whose labours will doubtless soon be extended to the whole of the Fuegian Archipelago. A. H. KEANE

[1] With this description may be compared that of the fourteen Araucanians now encamped in the Jardin des Plantes, Paris, and figured in the *Illustration* of July 28, 1883. The low brow, high cheek-bone, flat nose, lank hair, and general flat features give to both races a common Mongoloid expression, such as is distinctly seen in the Guarani, Tupi, Botocudos, and so many other South American peoples. This expression seems in fact almost more pronounced in the southern than in the northern races of the New World, and it is certainly remarkable that the physical appearance of the Araucanians and Fuegians should be even more suggestive of an Asiatic origin than is that of the Eskimo and Athabascan groups.

[2] "L'Araucanien peut prendre autant de femmes qu'il en peut nourrir et payer aux parents, car les femmes s'achètent."—*L'Illustration*, July 28, 1883.

THE ISCHIAN EARTHQUAKE

THE report from the Central Observatory, by Prof. de Rossi of Rome, shows that signs of the coming catastrophe were not wanting at the different meteorological stations. What follows is, according to the *Daily News* correspondent, the most interesting part of Prof. de Rossi's report.

"Several days before the 25th and 28th July the micro-

cosmical instruments at Rocca di Papa and connected microphones in Rome showed a great increase in subterranean activity. The earthquake which took place at Cosenza and Catanzaro on July 25 seemed to be the one predicted by those movements; but their continuance and increasing force showed clearly the approach of a new dynamic effort. Science, however, cannot yet determine the topographical point menaced by such effort, because we have not a sufficient number of observatories, and they are especially wanting in the places where the manifestations of the subterranean forces are most to be feared. Thus we could only suspect the direction of the movement, and gather from the daily observations made here and there in Italy that the seismic activity has concentrated in the southern part of the peninsula. The earthquake of Saturday, July 28, was registered by the seismographs in Rome, Velletri, and Ceccano at 9.30 p.m., with slow waves from north to south and east to west. The other instruments, which register quick and abrupt movements of the ground, remained quiet. As far as can be gathered from the observations till now made, this earthquake was an exact but more extensive repetition of that of March 4, 1881, and those just preceding, confirming the previsions and data collected at that time. It is deplorable that my advice respecting the institution of regular observations in those parts was not followed, as such observations would certainly have given warning of the imminent catastrophe. I gave that advice not only immediately after the catastrophe of March 4, but also on my visit to Naples at the Meteorological Congress. In consequence of that visit I wrote in the name of the Observatory to the director of one of the chief baths in Ischia, begging him at least to undertake daily note of the temperature of the thermal waters and the state of the fumarole (natural apertures from which issue smoke and steam). Alteration in the temperature of thermal-mineral springs, when that alteration exceeds certain limits, is one of the surest signs of a subterranean storm, and such alteration has always been noticed at Casamicciola, even without regular scientific observations. This time, as often before, the drying up of wells, subterranean thunder, and slight oscillations of the earth, have preceded the catastrophe, which shows what valuable indications might have been afforded by the delicate seismic instruments, the microphones, and telephones now at our command. The reluctance shown to follow my advice arose purely from a selfish fear lest the establishment of a meteorological observatory at Casamicciola should give an appearance of danger, and frighten visitors away. This false idea is so prevalent in the minds of even educated persons in the place that notices of the occurrence of small phenomena during the last few years have often reached me with great reserve, and very late. Let us hope that such a prejudice will not long continue to the damage of science."

The actual moment of the explosion has, according to the correspondent of the *Standard*, been variously stated. The clock in the Sala Belliazzi stopped at twenty-two minutes past nine, but it is generally agreed that the real time was fifteen or twenty minutes later—a singular detail, which has not been generally noticed.

Shocks of earthquake are reported to have occurred daily in Ischia since the 28th ult.

Prof. Palmieri states that all the later shocks felt at Ischia have been registered instantaneously by the seismographic instruments at the Observatory on Mount Vesuvius. On Friday morning, according to the Naples correspondent of the *Standard*, the instruments showed signs of considerable subterranean disturbance. Vesuvius was rather active, but the fear that a fresh crater was about to open immediately above Torre del Greco appears to be unfounded. Neapolitan passengers returning from Ischia appeared delighted to see Vesuvius blazing away in the distance. "Oh," said they, "so much the better; that may, perhaps, be a safety valve." Rossi and other observers, who differ from Palmieri on this point, predict nothing less than the reopening of the old crater of Monte Epomeo or the opening of a new one.

In making the tour of the hospitals on Wednesday, in order to collect the narratives of the wounded, the *Standard* correspondent found strong confirmation of the fact that there were signs of danger two or three days beforehand, which cannot have escaped the observation of the inhabitants of the island; but they were, unfortunately, he states, suppressed, in order to avoid giving alarm to the visitors, and so spoiling an unusually prosperous season. The Advocate Jeremiah Tonti, of Antria, Bari, who lies badly hurt in the Church of the Pellegrini, adjoining the great hospital, related to the correspondent that he had gone there with his wife to take the baths for rheumatism. The spring used comes forth from the ground so hot that it is necessary to temper it for the bath with one-fourth of cold water, but two days before the disaster the temperature of the spring rose so suddenly that it was found impossible to enter the bath until the supply of cold water had been largely increased. Dr. Dominico Bucco, who lies at the Hospital of the Pellegrini, says that the shocks at Forio and Lacco Ameno were vertical as well as undulatory, so that the floors of the houses fell in one upon another from garret to cellar, sometimes still leaving the outer walls standing. He was also conscious of a momentary whirling motion, as if being drawn into the vortex of a whirlpool.

A telegram from Athens states that a strong shock was felt at Piræus on Saturday last.

WE have received the following communication from Dr. Johnston-Lavis, of Naples :—

The island of Ischia is but too well known from the earliest historic times for the prevalence of earthquakes and even volcanic eruptions. In 1827 a shock destroyed the greater part of Casamicciola, some portion of Lacco Ameno, and injured Fontana Serrara, besides shaking severely Barano and Forio. On March 4, 1881, a quite similar shock to the former brought down a large number of houses and severely injured the rest. The present one occurred at about 9.30 on Saturday, July 28, and resulted in the absolute and total destruction of the whole town, most of Lacco Ameno, and a large part of Forio, Fontana, and Barano.

One remarkable fact is that the exact detailed area has been similarly affected in each case, so that the description of the earthquake of 1827 by Covelli, that of 1881 by myself, and the present would be much the same; the only difference being in intensity. The earliest killed under 50 people, the second 127, and the present will carry the number near a thousand.[1] The large increase of the deaths of the present one is due to its occurrence at the culminant point of the bathing season, so that the hotels were crowded with visitors; and the hour also found many of the peasantry going to bed.

The earthquake of two years since only ruined the worse built houses, and fissured the better ones, which were replastered and patched, so that the present shock has reduced every one to a heap of stones and mortar.

The shock was estimated to have lasted fifteen seconds, but a number of inquiries I have made as to what different persons had done to escape, and how the time was occupied between the first and last sensation, and the distance traversed during the movement, makes me believe thirty seconds nearer the point; for instance, one man awoke, jumped out of bed, stumbled over some furniture, opened the door, descended a flight of twenty steps, and when in the courtyard below still felt the movement.

The sound is said to have resembled a report followed

[1] Later information makes it near 5000.—ED.

by boob, boob –, boob —, boob ——, boob ———, boob ————, and so on.

In the short notice of the earthquake of March 4, 1881, I pointed out that the centre of the mesoseismal area or seismic vertical was at Casamenella, which occupies the same relative position to Epomeo as do Montagnone, Mount Rotaro, Cremate, and many other lateral cones. Also that this earthquake belongs to that subterranean class of movements that precede the bursting forth of an eruption such as the Vesuvian shock of A.D. 63, and the series that gave warning for some years before of the appearance of Monte Nuovo.

Prof. Samuel Haughton and myself are still engaged on a memoir of the last earthquake, and so far as we have gone we have found the following interesting facts:—

1. That the area of injury is very small.
2. That the angle of emergence rapidly diminishes as we recede from the seismic vertical.
3. That the focus is therefore very near the surface.
4. That there is another seismic vertical at Fontana. This is probably explained by conduction along a column of trachyte which occupies the old vent of Epomeo, as Fontana lies in the very centre of the old crater.

Mallet pointed out that shallow foci must produce violent effects in limited areas, that transmission to a distance of the earth-wave diminishes rapidly—conditions we find well illustrated in the present case. This led Prof. Palmieri to believe that the shock of 1881 was the result of the tumbling in of the clay caves near Casamicciola, and he again proposes a similar explanation, as for this one he had not noticed any movement of the seismographs of Naples of Vesuvius. On the former occasion I pointed out in my letter at the time that such could not be the case, not even as the result of the imagined spaces excavated by the dissolving action of the mineral waters. The real truth seems to be the inelastic nature of the tufas, which vary much in density and dip in every imaginable direction, so that the earth-wave has two powerful retarding agencies at work—the absorption by an inelastic medium, and continual reflection and refraction from its irregular structure. If really a falling-in had occurred as the cause of the earthquake, we should expect some signs of it, but such is not the case; there is not a true fissure in the locality, and no apparent changes of level. Nor can we conceive that the houses of Forio, four miles distant, would be shaken about the ears of their inhabitants; besides in this one, unlike the preceding shock, Naples felt the movement quite distinctly.

In addition to the destruction of the houses by the shock, fires have burst forth amongst the ruins, and two large landslips have swept down from the flanks of Epomeo, and converted gardens and vineyards into utter ruin.

In conclusion I would remark, as was done on a former occasion, that we must expect other shocks more violent in character, and that, as one follows the other, the interval of tranquillity will be less, until the final eruption bursts forth. What time such an occurrence may be expected it is only possible to judge by the force, character, and frequency of future events. Only last week I advised Dr. Dohrn of the peril of living at Casamicciola; and another friend, who would not heed my warning as to the event and the dangerous position of certain rooms in his house with regard to the seismic vertical, has lost his son in the part of the building indicated.

Would this not be a remarkably favourable occasion to carry out a thorough investigation of the whole of the phenomena accompanying this type of earthquake? If, for instance, some scientific society would choose a committee, provide a number of suitable seismographs to be placed in different parts of the island, and any other means that might be proposed, so as to study the progress of the focus towards the surface, if such is really the case, the form of the focal cavity, and many other points of interest, it might be the means of preventing further catastrophes by showing the nearing approach of volcanic matter to the surface.

The horrors of the occasion I will not touch upon, as it is the province of other newspapers, not to speak of the hurry in which I send off this rough memorandum of my visit to the island. H. J. JOHNSTON-LAVIS

Naples, July 30

P.S.—Since writing the above, notices from Isernia in the Apennines announce a severe earthquake in that locality, besides others at Sorrento and in other parts of Italy. The three Ischian shocks were each accompanied by a period of seismic activity in Italy and other parts of Europe. Vesuvius is slightly more active.

August 1.—Another slight shock occurred at Casamicciola about 4 p.m., and another a little before 12 p.m.

August 2.—At 12.30 another shock took place.

THERE has not yet been time to collect data which may throw light on the origin of the terrible catastrophe that visited Ischia on the 28th of last month. As in the case of the previous earthquake on the island, one of the most striking features of this last calamity is its extremely local character. There does not appear to have been any simultaneous perceptible tremor at Naples, and Professor Palmieri's delicate seismometers on Vesuvius registered no sympathetic movement on that mountain. That the source of the shock at Ischia must have lain comparatively near the surface may be confidently inferred. Had it been more than a few hundred feet deep, the waves of such a shock would assuredly have been propagated to a considerable distance all round.

Various possible causes of earthquakes have been assigned, each of which may at different times and places be effective in the production of the phenomena. The sudden snap of large masses of rock under great strain may be the origin of the frequent earthquakes of mountain chains, such as those so constantly experienced along the line of the Alps. On a smaller scale similar results may arise on a line of dislocation, as is probably the case at Comrie in Scotland. In volcanic regions the earthquakes that usually precede and accompany volcanic eruptions have been plausibly attributed to the explosions of elastic vapours, and particularly of steam. Ischia lies in a volcanic district, and is itself of volcanic origin. But its earthquakes do not seem to be part of the active volcanic phenomena of the district. So far as information is yet available regarding the recent catastrophe, there appear to have been no concomitant volcanic manifestations, though there were active vents where they might certainly have been expected to show themselves. The only facts yet known that might indicate a connection between the Ischian earthquake and the vulcanicity of the Neapolitan district are the reported outflow of lava from Vesuvius on the 31st, and the alleged increase in volume and temperature of the Ischian hot springs. As regards the descent of lava towards Torre del Greco on Tuesday of last week, it did not take place until three days after the calamity of the 28th ult., and may have been entirely independent of it. Disturbance of the thermal springs of the locality could hardly fail to accompany so severe a shaking of the ground, from whatever source the concussion might arise.

So far as materials exist for forming a judgment on the subject, the recent earthquake at Ischia appears to have been caused by the sudden collapse of some subterranean cavern, situated not far below the surface in the Casamicciola district. Such caverns no doubt frequently exist underneath volcanic vents from which large masses of material have been emitted. It is well known to geologists that one of the final phases in the history of a volcano is the subsidence of the cone. This downward

movement probably continues during a long period of time. It may be on the whole gradual and imperceptible; but if, from time to time, the roofs of the huge vesicles, whence lava and steam have escaped, should give way, though there may be no perceptible change of level at the surface, such shocks will be generated as to convulse the area with earthquakes. We may infer that the Ischian earthquakes, though not directly connected with the present active volcanic phenomena of the district, are the result of the former extravasation of volcanic materials, and the consequent vesicular condition of the earth's crust at the locality. But we must await the careful collection of evidence before any positive conclusion on the subject can be embraced.

THE NORWEGIAN NORTH-SEA EXPEDITION

WITH the general work of the expedition sent out by the Norwegian Government in 1876-8 for the investigation of the physical and biological conditions of the North Atlantic, our readers have already been made familiar by communications from Dr. Mohn during the progress of the expedition. We have, moreover, already noticed one or two of the five volumes containing some of the results of the expedition. When the series of publications connected with the expedition is complete, it will form one of the most important contributions to a knowledge of the deep sea hitherto published. The present article is concerned with vols. iv. and v. of the series, containing a historical account of the expedition, a description of the apparatus used, the astronomical, magnetic, geographical, and natural history observations.

The historical account by Capt. Wille, who was in command of the vessel, the *Voringen*, tells us that so long ago as 1874 Professors Mohn and G. O. Sars memorialised the Norwegian Government on the importance of a thorough investigation of the North Atlantic. In the memorial we find an excellent summary of what had already been done by previous expeditions, and what might be accomplished by a new one. The Norwegian Government entered heartily into the proposal for an expedition, and after taking competent advice in the matter, resolved to agree to the prayer of the memorial, and appointed Capt. Wille to make the necessary preparations. Capt. Wille at once proceeded to England to confer with Sir George Nares, and to purchase apparatus. A suitable vessel, the *Voringen*, was purchased, and specially fitted and equipped for the work of the expedition; very brief and elastic instructions were issued for the general conduct of the expedition, while each member of the comprehensive scientific staff was furnished with special instructions for guidance in his work. The liberal scale on which the expedition was organised has guided the Norwegian Government in the publication of the results. These are contained in a series of large quarto volumes, beautifully printed (in Norwegian and English), and abounding with maps, coloured illustrations, and engravings. These volumes are liberally distributed among institutions and individuals in all countries, wherever indeed they are likely to be of service to science. Such liberality in a comparatively poor Government like that of Norway is in marked contrast to the conduct of the Government of the wealthiest country in the world in respect of the *Challenger* publications.

The general scope of the expedition was (1) to determine by soundings the contour of the sea-bed; (2) the rate and direction of currents; (3) the surface-temperature of the sea; (4) to investigate the physical conditions and chemical constituents of the sea-water; (5) zoological work; (6) botanical work; (7) meteorological observations; (8) magnetical observations; (9) whatever other observations time and place might render practical. Thus it will be seen the programme was comprehensive enough; and as the voluminous reports show, much valuable work was done in each department. Among the scientific staff on board were Prof. Mohn and G. O. Sars.

The *Voringen* prosecuted her work for about three months in the summers of the years 1876-7-8. During

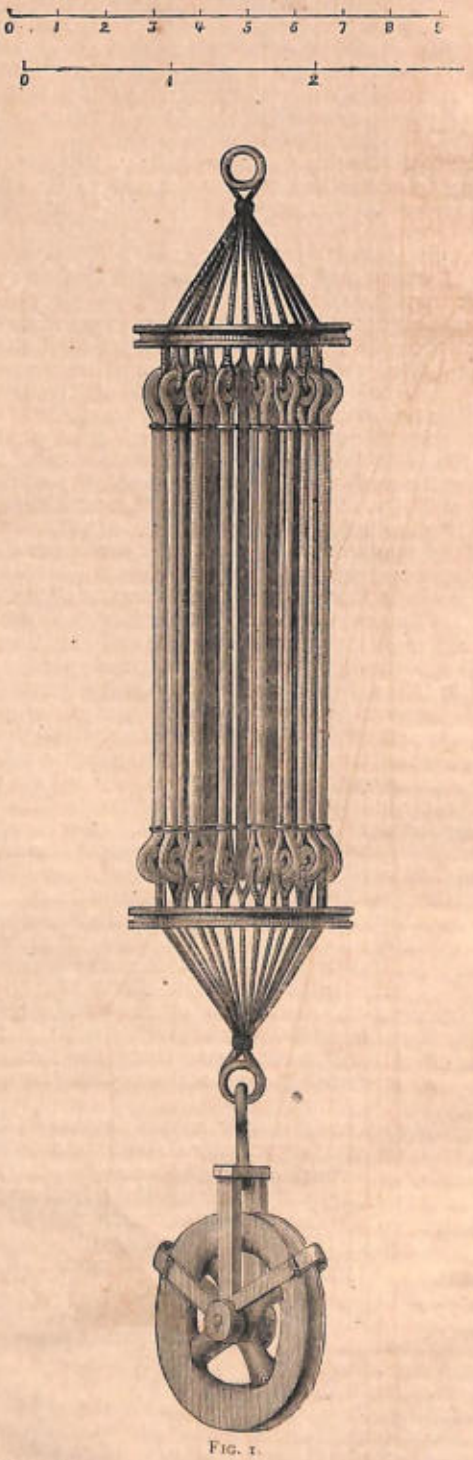


FIG. 1.

that time she made numerous sections over the region lying between the west coast of Norway and a line extending from Iceland to Spitzbergen on the one side, and between Faeroe and the north of Spitzbergen on the other; in 1878 moreover she made a circuit east and

north from Vardoe to Bear Island. On every section stations were established for observations at very frequent intervals; off the coast of Norway these

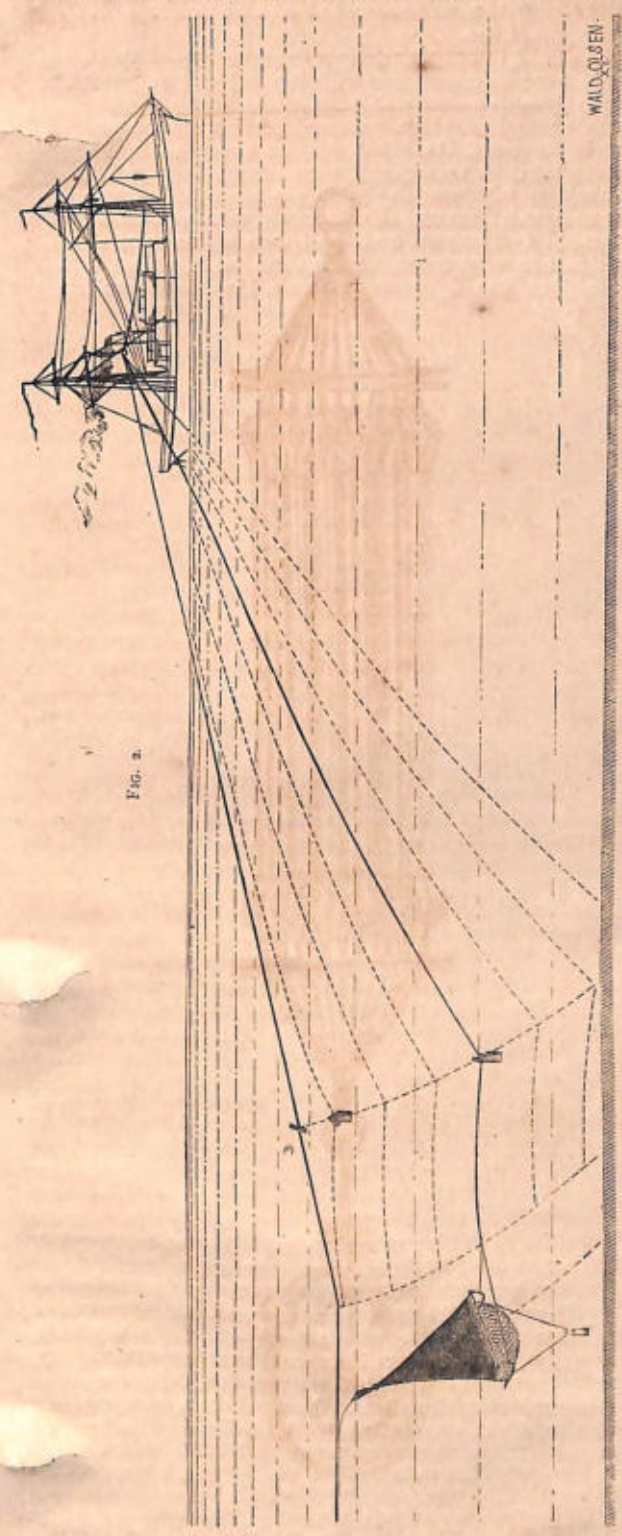


Fig. 2.

stations were as close as they could well be. The vessel itself, of 344 tons, was admirably arranged for the work, the best possible use having been made of the not too large space for disposal. The apparatus was abundant, and in its construction the experiences of previous expeditions were fully taken advantage of. We are all so familiar with the apparatus used in deep-sea work that it is unnecessary to describe it in detail. The experience of the first year led to some improvements in the arrangements of the work-room, which occupied the whole breadth of the ship; and the light and ventilation were much improved. As a specimen of the apparatus, we reproduce the illustration of the sounding accumulator (Fig. 1), composed of fifteen straps. To the lower thimble is hung the cast-iron sounding-block, provided with a swivel on artificial rollers, and two hinged arms to act as fair leaders for the line. When in use, the apparatus hangs suspended from the port mainyard-arm. Its most important function is to take off the suddenness of the strain on the line when the vessel is rolling or pitching. For collecting water both from the bottom and intermediate depths, Capt. Wille devised a very ingenious water-bottle, which could hold five litres. The sounding-line, 3000 fathoms, was wound on the port side of the after-deck on a large, strong reel, secured by screws to the deck. For dredging, especially, very careful preparations were made, and a variety of apparatus taken on board. Capt. Wille gives the following interesting description of their method of dredging:—

"We steamed full speed ahead, with the wind a little on our starboard bow. So soon as the vessel had got sufficient headway, the engine was stopped, the dredge lifted by hand over the railing, and dropped into the sea. At the foremast, a man with thick leather gloves stood ready to pay out the dredge-rope, which another kept clear with a handspike as it ran out from the coil in the locker. On the dredge entering the water, the word was immediately given to veer, when the paying out commenced, slowly, however, to make sure that all was right. So soon as the dredge was clear of the propeller, the vessel again went ahead, steaming at a uniform rate of 4 knots, which the engineer was enabled to keep up by frequent reference to the water-log (see below). Meanwhile, we kept steadily veering, while taking care, by frequent holding on to the rope, that the length run out should be properly taut, and steering the course given to the ship when the dredge was put over. After paying out, according to depth, 200, 300, or 400 fathoms, we again stopped, hauled in the rope to the taffrail by means of the lizard and thimble, and fastened, below the latter, with spun-yarn, a wooden toggle to the rope. Starting again (same course and speed), we next ran out the whole length of rope deemed necessary for the operation—not less than double the depth, nay for smaller depths even more.

"The engine was now stopped, after which we hauled in the dredge-rope, as before, to the taffrail, and kept it up in a bight of rope's end. With the lizard was then made fast to the wooden thimble a weight proportioned to the depth, consisting of 3 or 4, and for the deepest dredgings of as many as 6, of the sinkers of the Baillie sounding-machine, weighing each 55 pounds. We now, after letting go the rope, tilted the weight overboard, which spun down along it till stopped by the wooden toggle. The shock of its arrest was distinctly perceptible to a person who had his hand on the rope.

"The vessel was now kept stationary, while the weight and the dredge were sinking. After some experience, we calculated the time required for the dredge to sink 100 fathoms to be about 12 minutes. Fig. 2 will give an idea of the descent of the dredge, or rather of the trawl. The supposed depth in the diagram being 1300 fathoms, the vessel and the trawl are of course on a much larger scale. The dotted lines represent the lines of descent of the weight, the shackle, the dredge-rope, and the beam of the trawl—assuming the trawl to sink more slowly than the weight. When the weight strikes the bottom, the trawl has still some distance to travel, and the last part of its

line of descent will be well-nigh perpendicular. We found that, when worked in the manner described above, both trawl and dredge could as a rule without difficulty be made to reach the bottom in the right position. If the dredge or trawl descend much more slowly than the weight, it will fall vertically, with the heavy end foremost. If, on the other hand, its rate of descent be equal to or exceed that of the weights, it will, on reaching the bottom, have a horizontal component in its motion—which is pretty sure to keep it from clogging during the ensuing operation."

In vol. v. Dr. Mohn renders account of the astronomical observations, as well as the geography and natural history of the expedition, while Capt. Wille describes the magnetic observations. The vessel was well supplied with suitable instruments for determining latitude and longitude, and use was made of them whenever favourable opportunities presented themselves. Observations were thus made at nine important points. The various magnetic elements were determined at eight stations on land and seven at sea.

The most interesting geographical results of the expedition were in connection with Jan Mayen, to which Dr. Mohn devotes considerable space and many fine illustrations, several of them coloured. While the expedition was in progress, Dr. Mohn sent us some account of his observations in this island, with illustrations (vol. xviii. p. 222), but of course the subject is more fully treated in the volume before us. Evidences of volcanic action were observed everywhere, and the forms of some of the old craters are very beautiful. As the main object of the expedition was deep-sea research, Dr. Mohn could not

FIG 3.

give so much time to the observations of the island as he could have wished; nevertheless, by bringing together the observations of the various members of the expedition, and comparing them with the results obtained by Scoresby and other previous observers, Dr. Mohn is able to give a very full and interesting account of this curious island, which we here quote:—

"Cut off on all sides by extensive ocean tracts from the nearest land, the Island of Jan Mayen occupies an isolated position in the Greenland Sea. Between Norway and Jan Mayen the depth reaches 1760 fathoms, towards Spitzbergen upwards of 2000 fathoms, towards Greenland upwards of 1300 fathoms, and towards Iceland upwards of 1000 fathoms. The direction of the island is from N.E. by E. to S.W. by W.; it points towards Denmark Strait, and lies parallel to the volcanic line of Mount Hecla. As previously stated, Jan Mayen is built up of volcanic rocks, all of which would appear to belong to the modern group. Hence the island is probably a later formation than are the Faeroes and Iceland, where the old volcanic rocks prevail either exclusively or in greater part. Its length slightly exceeds 7½ geographical miles. It consists of two large parts or divisions, a northern and a southern, connected together by a lower and narrower tract. The greatest breadth of the northern part is a little more than 2 geographical miles, that of the southern 1½ geographical miles, and the connecting tract (including the lagoon) measures at the narrowest point 1½ English miles across (0·4 geographical mile). The area of the island is 7·32 geographical square miles."

Fig. 3 gives a view of the headland forming the north-east extremity of North or English Bay, the isolated rock in the distance being the Brielle Tower of the Dutch navigators.

(To be continued.)

THE SHOOTING STARS OF THE JULY METEORIC EPOCH

QUETELET pointed out, many years ago, the period July 26—30 as a meteoric epoch of considerable intensity, and recent observations have fully confirmed his opinion. There are two special showers contributing to this result, namely, the Aquariads and Perseids. The latter merely represents the oncoming of the great August display which culminates on the 10th and then rapidly dies out.

This year, on July 28th, the sky was very clear from clouds (though a little haze prevailed), and a fairly good opportunity was offered for witnessing these July meteors. It was important that this should be done, because the previous observations were not in satisfactory accordance. Professor Herschel in 1865, July 28th, had observed the chief radiant near the bright star *Fomalhaut*, and in 1881, July 25—30, M. Cruls of the Imperial Observatory at Rio Janeiro, found that the radiant point of more than 90 per cent. of the meteors observed during that period was situated five degrees north of *Fomalhaut*. In 1880, July 28—30, Mr. E. F. Sawyer, of Cambridgeport, Mass., found the major radiant to lie at α 330°, δ − 6°, with minor showers at 328° − 15°, and 341° − 10°. Colonel Tupman, who watched these meteors with considerable success and accuracy during the last few nights of July, 1870, determined the focus of divergence as at 340° − 14°, and the writer from observations at Bristol in 1878 and 1879, corroborated this position, and found that in addition to these Aquariads, there was a very rich contemporary shower, directed from a point near the star cluster χ Persei.

Comparing the various observations to which we have just briefly referred, it will be seen that considerable doubt exists as to the exact centre of radiation of these July meteors. Obviously the point is either in Aquarius or further south in *Piscis Australis*, and near the conspicuous star *Fomalhaut* of that constellation. The observations also suggest that there may be several streams in marked activity at this epoch, and it was with the object of obtaining further evidence towards the settlement of this question, that I reobserved these meteors on the night of July 28 last.

I began watching the eastern heavens at 10.30, and at 10.36 a very fine meteor, as brilliant as Jupiter, appeared near γ Andromedæ. It had a short path of only four degrees, and left a vivid streak. The meteor was evidently much foreshortened and close to its radiant point slightly west of χ Persei, so that it was an early forerunner of the Perseids. At 11.4 another fine meteor, of exactly similar type, was seen falling between α and β Andromedæ, and at 11.10 a third, considerably brighter and quite equal to Venus, traversed a path of nearly thirty degrees between Pegasus and Aquila, where it left a bright streak of some twenty degrees for a few seconds. Several other Perseids were observed later on, and the radiant point was found to lie at 27° + 55°, which conforms fairly well with the position I found for the same display in 1878 at 32° + 53° (63 meteors). As to the expected shower of Aquariads I was not disappointed, though during the earlier part of the night only small ones were seen, and I could not get the position of the radiant with the necessary exactness. Between 13h. and 14h. however, I saw eight Aquariads, and three of these were brilliant. At 13h. 13m. one appeared just below β Andromedæ. It was brighter than a first magnitude star. At 13h. 37m. a fine Aquariad, rivalling Jupiter, was seen in the west region of Pisces, and at 13h. 54m. another of the first magnitude appeared in nearly the same place. They moved slowly and left trains of sparks.

During the 3½ hours (10½h. to 14h.) that I continued to watch I saw eighteen of these Aquariads, and by the intersection of the paths, found the radiant very sharply defined at 337° − 11°, and close to the point I had determined in 1878 and 1879. This shower was far superior to the Perseids in the morning hours, and fully asserted its claim to be considered as the special display of the epoch. The meteors generally have long paths, as the radiant point is not far above the horizon. In all I saw 48 meteors during the night, and of these no less than 28 belonged either to the Perseids or Aquariads.

There can be no doubt that these July Perseids are identical with the celebrated shower of August 10, though the radiant point is some 8° west in July. I have watched these Perseids very carefully from July 25 up to August 16 in several years, and traced the gradual shifting of the radiant point. From my observations during the last week of July, 1878, I had supposed these July Perseids to form a distinct shower to the Perseids of August 10, but from observations obtained on intermediate dates, *i.e.* on August 3, 4, and 5, the connection of the two showers is most certainly established, and the displacement of the radiant point on each successive night can be clearly distinguished by those who will mark the tracks of such meteors as appear near this radiant from say July 25 to August 15.

As to the Aquariads, I believe the maximum takes place on July 27-28, when they are undoubtedly more numerous than the early Perseids. I feel certain that the radiant point is near δ Aquarii or at 339° − 13°. There is another shower near *Fomalhaut*, which appears to have developed remarkable energy in 1881 from M. Cruls' observations, and there are also other showers in Aquarius at this special period, which have led to the difficulty in determining the position of the major radiant. There is certainly a very fine shower of meteors at the end of July from a point a few degrees S.E. of β Aquarii, which has been observed as follows :—

	July 25-31	324° − 6°	Schmidt.
1870	July 28	326 − 13	Tupman.
1880	July 28-30	328 − 15	Sawyer.
	July 25-31	324 − 9	Denning.

I gave some details of this particular stream, which, it may be added, is one remarkable for its large meteors, in the *Monthly Notices of the Royal Astronomical Society* for November, 1881, p. 38.

It now becomes important to watch for the annual returns of these meteors of the July epoch at observatories in the southern hemisphere, where they may be more favourably observed than in high northern latitudes. Obviously, a shower near *Fomalhaut* will be in a great measure marred by the extremely low altitude of the radiant, as that star never attains an altitude even of 10° in this country. At stations further south, the shower of Aquariads appears to be one of great strength and to form a display of first-class importance. Observations made in 1879 show a wide disparity in the number of these meteors visible in different latitudes. Mr. D. W. Barker, during a voyage from London to Melbourne (*Monthly Notices*, Vol. XL., p. 364), in that year observed meteors falling at the rate of 180 per hour on July 28 and 120 per hour on July 29, between 0h. and 4h. a.m. on the dates referred to. Yet, at Bristol on July 28 of the same year, the hourly number was only 23, and on July 29, 11.

The further investigation of the July meteoric epoch offers an attractive field to observers. Apart from the rich shower of Aquariads there are the Perseids, equally interesting from the fact that these early members of the great shower prove it to be one of long duration, and to have a radiant point which shifts its position amongst the stars from night to night. These interesting details will no doubt come under frequent observation in future years.

W. F. DENNING

NOTES

THE meeting of the French Association for the Advancement of Science will take place this year at Rouen on the 16th inst.; extensive preparations are being made for the reception of the members. The electric light is to be a prominent feature of the meeting, owing to the project entertained by the municipality of lighting part of the city by the motive power of the Seine at Pont de l'Arche, as we mentioned in a recent note.

THE Lords of the Committee of Council on Education have sanctioned the addition of Hygiene to the list of sciences towards instruction in which aid is afforded by the Science and Art Department. The following is the syllabus of the subject:—Elementary stage: (1) food, diet, and cooking; (2) water and beverages; (3) air; (4) removal of waste and impurities; (5) shelter and warming; (6) local conditions; (7) personal hygiene; (8) treatment of slight wounds and accidents. Advanced stage: (1) food and adulterations; (2) water and beverages; (3) examination of air—chemical and microscopical; (4) removal of waste and impurities; (5) shelter and warming; (6) local conditions; (7) personal hygiene; (8) prevention of disease. Honours:—In addition to the topics enumerated under the elementary and advanced stages, questions will be set in the following subjects: trades nuisances, vital statistics, sanitary law.

THE new portion of the University of Indiana, at Bloomington, in that State, was set on fire by lightning during a thunderstorm on the night of July 12, the electricity travelling along a telephone wire which served the institution. The laboratory, museum, and library were completely destroyed. The museum contained a collection of fishes, made by Dr. Jordan, which was thought to be the largest and most valuable in the United States. There were 15,000 volumes in the library, besides the so-called Owen collection, the loss of which is believed to be irreparable. The general loss is estimated at $200,000, of which only $30,000 is covered by insurance.

THE U.S. bureau of education has, we learn from *Science*, just published a circular of information, containing the results of an inquiry into the effects of co-educating the sexes in 340 cities and large towns of the Union. Of these, 321 practise co-education throughout the public-school course, 17 co-educate for part of the course, and 2 separate the sexes entirely. A careful analysis of the reasons adduced for co-education enables the editor to formulate them as follows: co-education of the sexes is preferred where practised, because it is (1) *natural*, following the usual structure of the family and of society; (2) *customary*, or in harmony with the habits and sentiments of every-day life and law; (3) *impartial*, affording to both sexes equal opportunities for culture; (4) *economical*, using school funds to the best advantage; (5) *convenient* both to superintendent and teachers in assigning, grading, instruction, and discipline; and (6) *beneficial* to the minds, morals, habits, and development of the pupils. The pamphlet concludes by observing that "both the general instruction of girls, and the common employment of women as public-school teachers depend, to a very great degree, on the prevalence of co-education, and that a general discontinuance of it would entail either much increased expense for additional buildings and teachers, or a withdrawal of educational privileges from the future women and mothers of the nation."

IN an article entitled "Cholera and Our Water-Supply," in the current number of the *Nineteenth Century*, Dr. Percy F. Frankland draws attention to the vital connection between water-supply and the diffusion of zymotic disease. He points out how, in consequence of the terrible epidemics of Asiatic cholera to which the metropolis has been subjected in the past, the companies supplying London with water from the Thames have been obliged to remove their intakes to a distance which shall insure the freedom of their supply from contamination with the London sewage, and thus at any rate to put an end to their former practice of "rapidly restoring to the inhabitants of London the drainage matters which the sewers had discharged." But although the Thames at Hampton is free from this source of pollution, yet it is similarly fouled, although in a less degree, with the sewage of a population estimated at upwards of half a million which enters the river above the intakes of the water companies. In extenuation of this obviously revolting state of things, many theories have been started: of these the most popular and fallacious is that which, under the title of "the self-purification of river-water," announces that noxious organic matters present in river-water are rapidly destroyed in the course of a few miles' flow. This doctrine, unsupported as it is by any facts or accurate observations, is wholly dogmatic and in complete opposition to all previous knowledge concerning the properties of organic substances in general. The late Rivers Pollution Commissioners, moreover, conclusively proved that water once polluted with sewage is only very slowly purified, and more recent research shows the great tenacity of life possessed by the lower organisms which are believed to be allied to those capable of communicating zymotic disease. Chemical analysis further proves that the Thames water reaches the intakes of the London Water Companies with a but slightly diminished proportion of organic matters. In the face of the now well known fact that London possesses within easy reach water of the purest quality and abundant in quantity, it is inexcusable that such manifestly impure sources should still be resorted to. Hitherto only one of the eight metropolitan water companies has entirely abandoned the polluted rivers and substituted them by the pure water obtained from deep wells sunk into the chalk. London should follow the example of other large towns in Great Britain; thus Glasgow now drinks the waters of Loch Katrine, Manchester is bringing a supply from Cumberland, whilst London, with water of the best quality much nearer at hand, is still compelled to drink the waters of the Thames and Lea.

THREE addresses will be delivered at Annonay by members of the Academy of Sciences on the occasion of the forthcoming inauguration of the Montgolfier statue. M. Dupuis de Lome will speak on the general history of ballooning; M. Tisserand, in the name of the Paris Observatory, on the scientific prospects of ballooning; and Col. Perrier, the representative of the President of the Republic, on the results of ballooning in warfare. M. Laussedat, the director of the Conservatoire des Arts, who was the first director of Meudon Châlet Aëronautical Establishment, will speak on the career of the brothers Montgolfier. The aëronautical ascents will be made with a Montgolfier by Eugène Godard, and with a gas balloon by M. Brissonet, *fils*, of Paris. We believe that M. Tisserand will recommend the use of balloons for certain astronomical observations.

THE Trustees of the Australian Museum (Sydney) have issued their twenty-ninth Annual Report for 1882. The increasing importance of the Australian Museum, and the growing interest of the public in it, are shown by the remarkable increase of 18,446 visitors during the past year; the attendance being 81,596 on weekdays as against 73,995 in 1881, and 52,505 on Sundays as against 41,660 in 1881, the increase on weekdays being upwards of 14 per cent., and on Sundays upwards of 26 per cent. Application has been made to the Government to consider the necessity of enlarging the Museum buildings. More room is urgently required, not only for purposes of exhibition, but for the office staff and workmen. A catalogue of Australian stalk- and sessile-eyed Crustacea, prepared by Mr. Wm. A. Haswell, M.A., B.Sc., has been printed and distributed extensively among various museums and natural history societies; and the work of

cataloguing the whole of the Museum collections is being pushed forward as rapidly as possible. The most serious loss ever sustained by the Museum has occurred through the recent destruction of the Garden Palace—the large and varied collection of technological and ethnological specimens sent there for exhibition having been totally destroyed by the fire which consumed the building. The Technological Committee lost no time in commencing a new collection; and, having already obtained many ethnological specimens of great interest, they are taking steps to secure as many others as possible. This is a work which admits of no delay, as genuine ethnological examples from the islands are becoming scarcer every day, in consequence of the general spread of trade and civilisation through the whole of Polynesia. Suitable accommodation for the display of the technological and ethnological specimens already in hand should at once, if possible, be provided. The most important work carried on by the Trustees during the year has been the exploration of the caves and rivers of Australia. It was continued until the close of December at the Wellington Caves, where the bones of an immense Echidna and of a large Struthian bird allied to the Emu, as well as some smaller animals of less note, hitherto unknown to science, have been discovered and added to the Museum. Numerous other fossil bones valuable for exchanges with foreign museums have been obtained. The exploration of rivers was conducted by the assistant taxidermist in Queensland, where strong hopes of discovering some new Ganoid fishes were entertained. A special report of this work, with a list of the specimens procured, is given in appendices.

THE Clothworkers' Company have agreed to give a donation of 10,000*l.* for the enlargement of the Textile and Industrial Department of the Yorkshire College at Leeds. Altogether the Clothworkers' Company have given upwards of 25,000*l.* towards this institution.

THE Ornithological Society of Vienna wishes to call the attention of English ornithologists to the International Congress of Ornithologists which will be held next spring at Vienna in connection with the annual exhibition of the Ornithological Society of Vienna, under the protection of H.I.H. the Crown Prince Archduke Rudolf of Austria. The chief business of the Congress will be to pass preliminary resolutions for international legislation regarding the protection of birds. The Austrian Government will send out invitations to the different foreign Governments, and will grant a free passage to Vienna to the representative of each foreign Government. All those interested in the above subject should apply for further information to Dr. Gustavus von Hayek, Hon. First Secretary of the Ornithological Society of Vienna, 3, Marokkaner Gasse, Vienna.

THE following list of candidates successful in the competition for the Whitworth Scholarships, 1883, has been issued by the Science and Art Department:—James Hamilton, Engineer, 200*l.*; William E. Dalby, Engineer Apprentice, 150*l.*; John L. Barnes, Engineer Apprentice, 150*l.*; Thomas K. Mackenzie, Student, formerly Mechanical Engineer, 150*l.*; William Sumner, Fitter, 150*l.*; Frank W. Dodd, Engineer Apprentice, 150*l.*; Charles N. Pickworth, Mechanical Engineer, 150*l.*; Henry E. Kitton, Mechanical Engineer, 150*l.*; James Layzell, Engineer Apprentice, 150*l.*; Horace W. Meteyard, Engineer, 100*l.*; Alfred S. Ormsby, Mechanic, 100*l.*; William P. Abell, Mechanical Engineer, 100*l.*; Alfred W. Bevis, Tutor, formerly Engineer Apprentice, 100*l.*; John W. Aston, Engineer Apprentice, 100*l.*; Alfred E. Mackett, Marine Engine Fitter, 100*l.*; Victor F. Whitehead, Engineer, 100*l.*; Charles Lang, Pattern Maker, 100*l.*; James Bradshaw, Mechanical Engineer, 100*l.*; Alfred J. Joshua, Fitter, 100*l.*; William A. Rogerson, Fitter, 100*l.*; William E. Donohue, Draughtsman (Marine), 100*l.*; Albert H. Case, Engineer, 100*l.*; Alexander Shannon, Engineer, 100*l.*; Mark R. Bullimore, Fitter, 100*l.*; John S. Bean, Engineering Draughtsman, 100*l.*

THE biennial marine excursion of the Birmingham Natural History and Microscopical Society, which took place at Oban in July last, and lasted for ten days, was on the whole most successful. It was attended by twenty-three members of the Society. A superior screw steam yacht, the *Aërolite*, was chartered for the occasion, and the weather being very fine, dredging was carried on daily at various stations which were all recorded on a chart at depths which varied from fifteen to one hundred fathoms. The principal object of this excursion was to secure further specimens of the *Pennatulida*, a few only of which were taken in the dredgings at the same place during 1881. These formed the subject of a special report made to the Society last year by Prof. Marshall, D.Sc., and Mr. W. P. Marshall, M.I.C.E., and for which the Darwin Gold Medal, given by the Midland Union of Natural History Societies was awarded at the Tamworth meeting held in June last. Some special instruments made of galvanised iron and armed with hooks were devised by Mr. W. P. Marshall for the occasion, called the "plough" and the "harrow." These, together with the dredges and trawl, were for the first time on these excursions worked by means of steam gear. A small dredge measuring a few inches was used by hand for testing the nature of the bottom of the sea, and all these various appliances worked admirably. A large number of specimens of *Funiculina quadrangularis* and *Pennatula phosphorea* in various stages of growth were secured in fine condition and unbroken. A number of specimens of Sponges, Zoophytes (including a rare free form of *Zoanthus conchii*, var. *liber*, Gosse), Echinoderms, Crustaceans, Annelids, Tunicates, Mollusca, &c., were also secured. These were exhibited and described to the members during the days and in the evenings by Mr. W. R. Hughes, F.L.S., chairman of the excursion, Mr. W. P. Marshall and Mr. J. F. Goode, Hon. Sec. of the Biological Section, who have also made a preliminary report thereon to a recent meeting of the Society. During the excursion phosphorescence was for the first time observed in *Funiculina*, the characteristic pale blue light coruscating over the whole series of polypes, the length of the specimen being between three and four feet, and presenting a very beautiful effect when viewed in the dark. In addition to the dredging, some attention was paid to the botany and geology of the district by several of the members. During a walk on July 1 fifty species of plants were gathered in flower. A collection of specimens of the rocks of Oban and the vicinity, including Staffa, Iona, Mull, Glencoe, Easdale, &c., was also made for future examination.

THE city of Geneva intends to utilise the current of the Rhone for lighting the whole of the city. A report on the question is being drawn up, which will be submitted to the Council of State.

A PRELIMINARY meeting of the members of the future Société des Électriciens took place at the Ministry of Posts and Telegraphs. M. Cochéry was present, but he declined to preside over the proceedings, and the honour was bestowed upon M. Berger.

AN electrical omnibus was recently tried on the Cour de Carrousel, Paris, before M. Cochéry to prove the facility with which this sort of carriage is handled in spite of its immense weight. The trial, which took place in the busiest hours of the day, attracted much notice from the passers-by, and was generally deemed satisfactory.

THE *Italia del Popolo*, in one of its latest numbers, gives the names of a number of localities from which birds and insects have disappeared just before invasions of cholera.

THE death is announced, at the age of 83, of Linant Pasha (Linant de Bellefinds), one of the leading personages connected

with the existing Suez Canal. Under Said Pasha he was appointed head of the Ponts et Chaussées department, and chief engineer of the Suez Canal project. In early life he travelled much in Abyssinia, Kordofan, and Darfur.

SIR CLAUDE DE CRESPIGNY, in company with Mr. Simmons, made a successful balloon voyage from Maldon in Essex across the North Sea to Flushing on Wednesday last week. The start was made at 11 a.m., and Flushing was reached about 8 p.m. The highest altitude reached was 17,000 feet.

WAUSCHAFF of Berlin has lately made a piece of apparatus for registering earth currents. It consists of a very delicate galvanometer inclosed in a case with a clockwork arrangement for moving a photographic plate steadily downwards. A fine ray of light is reflected on to the galvanometer mirror by a total reflection prism and is focused on the photographic plate. The speed of the movement of the plate is 80 mm. per hour, thus allowing variations from minute to minute to be observed.

MM. LELANDE AND CHAPERON have brought out a new battery of very remarkable properties. The battery is a single liquid cell and has a depolarising electrode of oxide of copper, the liquid used is caustic potash, and the other pole is zinc. The battery is made in various forms, its E.M.F. is nearly 1 volt, whilst it is said to give a steady current through even a low resistance for many hours. Finally it is claimed for this battery that when exhausted it can be restored by driving a current from an accumulator through it.

A NEW edition (the fifth) is announced of the "Dictionnaire des Arts et Manufactures et de l'Agriculture," edited by M. Ch. Laboulaye.

MR. BROWNE asks us to say that in his recent article on Glacier Motion, p. 235, by a slip of the pen he stated that the sides of a glacier move faster than the middle, whereas, as every one knows, the reverse is the case.

THE additions to the Zoological Society's Gardens during the past week include a Grivet Monkey (*Cercopithecus griseo-viridis* ♂) from West Africa, presented by Lord Hastings; two Black-backed Jackals (*Canis mesomelas*), two Triangular Pigeons (*Columba guinea*) from South Africa, presented by Mr. R. Southey; two Indian Brush-tailed Porcupines (*Atherura fasciculata*) from Ceylon, presented by Mr. A. Dent; three Puffins (*Fratercula arctica*), British, presented by Mr. H. Becher; a Common Cormorant (*Phalacrocorax carbo*), British, presented by Mr. W. R. Temple; a Common Barn Owl (*Strix flammea*), British, presented by Mr. H. Hanaeur; a Common Wombat (*Phascolomys wombat* ♂) from Tasmania, a Common Cormorant (*Phalacrocorax carbo*), British, a Common Boa (*Boa constrictor*) from West Indies, deposited; a White Stork (*Ciconia alba*), two Common Spoonbills (*Platalea leucorodia*), two Purple Herons (*Ardea purpurea*), European, purchased; a Musk Deer (*Moschus moschiferus* ♂) from Central Asia, received on approval; a Collared Fruit Bat (*Cynonycteris collaris*), two Amherst's Pheasants (*Thaumalea amherstiæ*), two Summer Ducks (*Aix sponsa*), bred in the Gardens.

A CONTRIBUTION TO THE STUDY OF THE TRANSMISSION EASTWARDS ROUND THE GLOBE OF BAROMETRIC ABNORMAL MOVEMENTS

IN his paper on "Abnormal Variations of Barometric Pressure in the Tropics, and their Relation to Sun-spots, Rainfall, and Famines," published in NATURE (vol. xxiii. pp. 88 and 107), Mr. Fred. Chambers pointed out, when treating of the barometric records of the stations, St. Helena, Mauritius, Bombay, Madras, Calcutta, Batavia, and Zi-ka-wei, that abnormal movements which had occurred at a westward station—*e.g.* Mauritius—reappeared at an eastern station—*e.g.* Bombay—some time later, and then again at a further eastern station, Madras, still later, and so on, until they finally reached the most distant station eastwards. It appeared therefore that there were abnormal movements of the atmospheric pressure which travelled from west to east; the rate of travel seemed to vary at different times; and Mr. Chambers summed up his results in the following words:—"It appears then that these atmospheric waves (if such they may be called) travel at a very slow and variable rate round the earth from west to east like the cyclones of extra-tropical latitudes."

In his "Brief Sketch of the Meteorology of the Bombay Presidency in 1880," Mr. Chambers proceeded to test the validity of his conclusions by applying them to an examination of the barometric records of Zanzibar for that year and a portion of the next as compared with the records of Belgaum for the same period; and he again noticed that "there was much similarity in the abnormal movements of barometric pressure at Zanzibar and Belgaum, although these stations are about 2500 miles apart, but that the Belgaum curve lagged decidedly from two to three months behind the Zanzibar curve."

This discovery, if substantiated, would obviously prove of great practical value, inasmuch as it would make it possible to obtain a forecast of the barometric movements about to occur at any particular station by watching the movements already taking place at a point westward of that station. And as definite variations in the atmospheric pressure may be, and in some cases are known to be, accompanied by definite variations in the other meteorological elements, a method of weather prediction would thus be furnished.

It has fallen to my lot to receive and discuss the Zanzibar observations succeeding those last discussed by Mr. Chambers; and the results obtained by my examination of them seem to involve matters of some practical and theoretical interest.

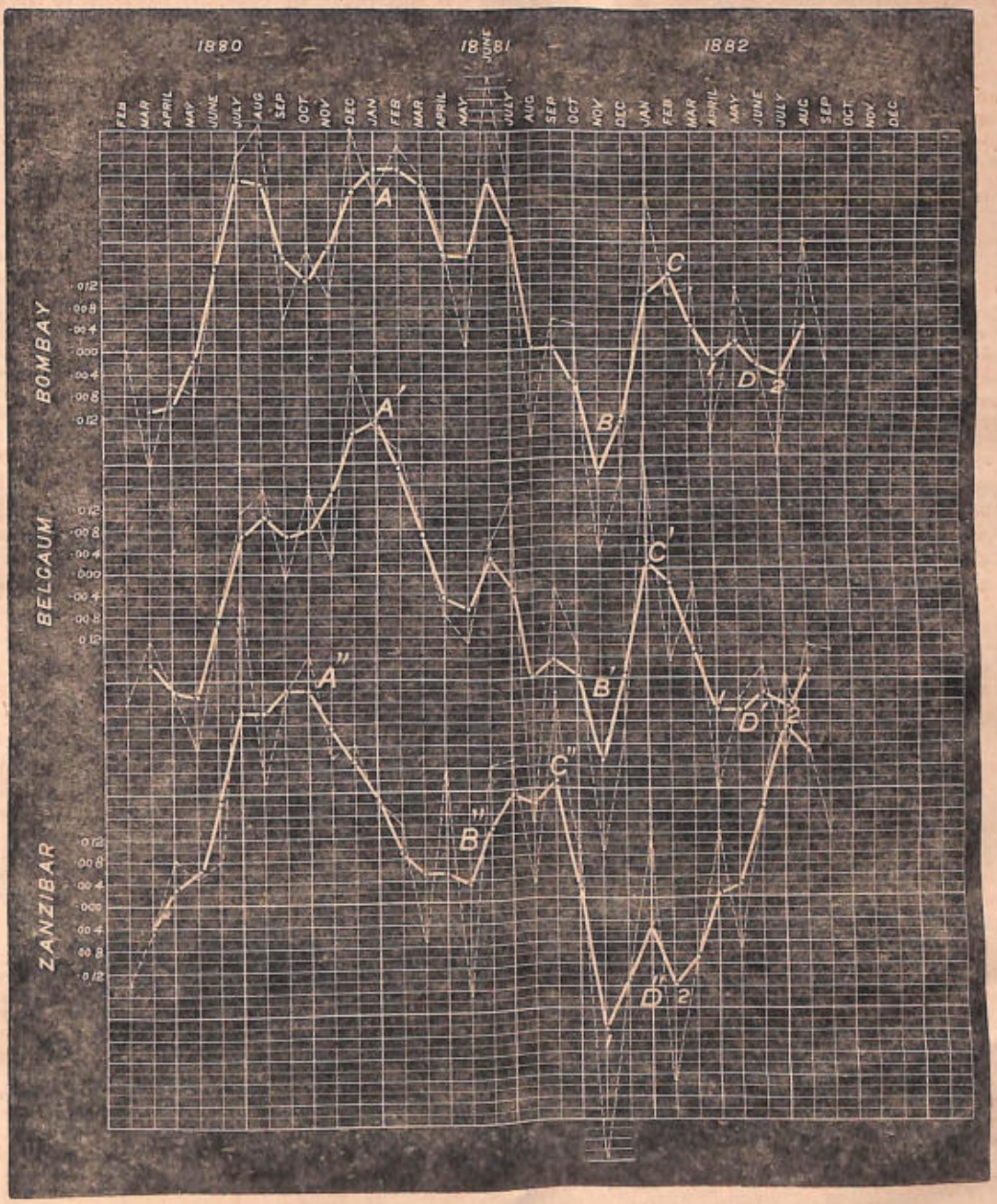
TABLE I.—*Monthly Abnormal Barometric Pressure at Zanzibar, Belgaum, and Bombay*

Months.	Monthly Abnormals (unsmoothed).			Monthly Abnormals (smoothed).		
	Zanzibar	Belgaum	Bombay	Zanzibar	Belgaum	Bombay
February 1880	−·014	−·024	·000	—	—	—
March ,,	−·005	−·013	−·020	−·004	−·017	−·011
April ,,	+·008	−·022	−·006	+·003	−·022	−·010
May ,,	+·005	−·032	−·008	+·006	−·023	−·002
June ,,	+·008	−·008	+·015	+·018	−·009	+·014
July ,,	+·054	+·011	+·035	+·034	+·007	+·031
August ,,	+·022	+·015	+·041	+·034	+·010	+·030
September ,,	+·038	−·001	+·006	+·035	+·007	+·017
October ,,	+·044	+·015	+·019	+·038	+·008	+·013
November ,,	+·026	+·003	+·010	+·031	+·014	+·019
December ,,	+·028	+·037	+·040	+·025	+·015	+·029
January 1881	+·018	+·026	+·029	+·019	+·027	+·033
February ,,	+·014	+·022	+·037	+·009	+·019	+·033
March ,,	−·007	+·008	+·032	+·005	+·007	+·030
April ,,	+·023	−·008	+·020	+·005	−·005	+·018
May ,,	−·017	−·013	+·001	+·003	−·007	+·017
June ,,	+·024	+·005	+·049	+·013	+·002	+·031
July ,,	+·025	+·013	+·028	+·019	−·003	+·022
August ,,	+·003	−·046	−·016	+·017	−·020	·000
September ,,	+·037	−·004	+·005	+·021	−·017	·000
October ,,	+·009	−·014	+·004	+·002	−·020	−·006
November ,,	−·047	−·051	−·037	−·024	−·035	−·023
December ,,	−·014	−·028	−·024	−·015	−·020	−·010
January 1882	+·012	+·026	+·029	−·005	+·001	+·014
February ,,	−·033	−·017	+·010	−·016	−·003	+·014
March ,,	−·012	−·003	+·011	−·011	−·015	+·004
April ,,	+·012	−·040	−·016	·000	−·026	−·002
May ,,	−·009	−·024	+·011	+·002	−·026	+·001
June ,,	+·017	−·018	−·002	+·016	−·023	−·005
July ,,	+·040	−·034	−·019	+·031	−·025	−·005
August ,,	+·029	−·014	+·020	+·027	−·019	+·004
September ,,	+·012	−·015	−·002	—	—	—

From these observations the variations from the normal monthly barometric movements have been obtained. They are tabulated in Table I., and are represented graphically by the

thin dotted line of the lowest curve in the accompanying plate. Alongside of them are arranged, both in the table and the plate, the barometric abnormal movement of the meteorological stations, Belgaum and Bombay. In order to facilitate comparisons between the curves of these three stations the actual normal movements, which are represented in the plate by thin dotted lines, have been put through a double process of smoothing; the results are tabulated under the heading of "Monthly Abnormals (smoothed)," and are represented on the plate by the thick continuous lines. The observations not previously discussed are those taken from June, 1881, to September, 1882, of all the stations, together with the Bombay record from February, 1880, to June, 1881.

The addition of this series to the Zanzibar record seems to confirm the result of previous observations, viz. that there are abnormal movements of the atmospheric pressure which affect



a very wide area, and which are not simultaneous in all parts of that area, but travel from west to east. An inspection of the smoothed curve will show what amount of truth there is in this statement. Thus the Zanzibar curve shows an upward bend at A″ and a downward bend at B″, a second upward bend at C″, and a second downward bend at D″. The Bombay and Belgaum curves both show a similar general form, having upward bends at A and A′ corresponding with the upward bend A″ of the Zanzibar curve, downward bends B and B′ corresponding with the downward bend B″ of the Zanzibar curve, and similarly C, C′ and D, D′ corresponding with C″ and D″ of Zanzibar. And it is at once seen that the movements at Zanzibar are in advance of those of Bombay and Belgaum. Thus the Zanzibar maximum A″ took place in October, 1880, whilst the corresponding movements did not appear at Belgaum until the month of January, 1881, and at Bombay until between January and February,

1881; that is to say, at periods of three and three and a half months later. Then again the minimum movement B, B′, and B″ which occurred at Zanzibar in the month of May, 1881, did not appear at Bombay and Belgaum until the month of November of the same year; that is to say, after an interval of six months. Again, the maximum movement C, C′, and C″ occurred at Zanzibar in the month of September, 1881, but not at Belgaum until January, 1882, and at Bombay until February, 1882; that is to say, until after intervals of four and five months respectively. Again, on examining the minimum D, D′, and D″, which is divisible into two minor minima, the first of these minor movements appears at Zanzibar in the month of November, 1881, but at Belgaum between the month of April and May, and at Bombay in the month of April, 1882; that is to say, after intervals of five and a half and five months respectively. Lastly, the second minor movement of the minimum D, D′, and D″ occurred at Zanzibar in the month of February, 1882, and at Belgaum and Bombay in July of the same year; that is, after an interval of five months.

These facts may be presented briefly and concisely thus :—

TABLE II.

	An interval of		An interval of
From A″ to A′ ...	3 months	From A″ to A ...	3·5 months
,, B″ to B′ ...	6 ,,	,, B″ to B ...	6 ,,
,, C″ to C′ ...	4 ,,	,, C″ to C ...	5 ,,
,, D''_1 to D'_1 ...	5·5 ,,	,, D''_1 to D_1 ...	5 ,,
,, D''_2 to D'_2 ...	5 ,,	,, D''_2 to D_2 ...	5 ,,
Average from Zanzibar to Belgaum	4·7 ,,	From Zanzibar to Bombay	4·9 ,,

In the case before us, then, it does appear to be matter of fact that there are movements taking place at the two stations, Belgaum and Bombay, similar in character to movements which have taken place at Zanzibar on an average about five months previously. And assuming that the same course of events will occur in the future, it may be expected that from the month of August to the month of December, 1882, the abnormal variations of the barometer at Bombay and Belgaum will in a general way follow the same course as was taken by the variations at Zanzibar during the months of April, May, June, and July; that is to say, an upward movement.

This prediction might be considered fairly reliable to within about a month one way or the other, were there no modifying conditions. But the curves are seen at a glance to present most decided departures from absolute parallelism; there are movements at Zanzibar which do not reappear at the eastern stations, whilst the eastern stations experience movements which do not appear to have been previously experienced at Zanzibar. Moreover, the rate of transmission of movements from Zanzibar to the west of India has been shown to vary from three to six months. And further, the movements at the eastern stations are sometimes much less or much greater than those which took place at the western station. Evidently, then, there is some influence which tends to produce irregularities in the eastward transmission of the abnormal movements; and this influence must be discovered and its occurrence foreseen and allowed for before the Zanzibar curve could be used for the purpose of predicting the nature of the movements at Belgaum and Bombay, and, as a consequence, the nature of the seasons in Western India.

A second inspection of the curves seems to indicate that not only are there abnormal movements which travel from the western station to the eastern ones, but there are also variations which are felt at all the three stations simultaneously. Thus in the months of July, 1880, June, 1881, and January, 1882, there are simultaneous upward bends of the curves at all the three stations. And again in the months of May, August, and November, 1881, there are simultaneous downward movements at all the three stations. These simultaneous movements are especially observable if the unsmoothed monthly abnormals (the thin dotted lines) be referred to instead of the smoothed curve (the thick continuous line). They are then seen to be exceedingly numerous—so numerous, indeed, that they may well be supposed to frequently mask the non-simultaneous or travelling movements, and cause those movements apparently to present many irregularities. The following table shows concisely the times when upward and downward movements have taken place at all the three stations simultaneously :—

TABLE III.—*At Zanzibar, Belgaum, and Bombay simultaneous Barometric Abnormal Movements*

Occurred in an upward direction in	Occurred in a downward direction in	Cannot be easily traced in
June 1880	May 1880	February 1880
[1] July ,,	November ,,	March ,,
October ,,	January 1881	April ,,
December ,,	March ,,	August ,,
February 1881	[1] May ,,	September ,,
[1] June ,,	[1] August ,,	April 1881
[1] September ,,	October ,,	July ,,
December ,,	[1] November ,,	March 1882
[1] January 1882	[1] February 1882	April ,,
	September ,,	May ,,
		June ,,
		July ,,
		August ,,

Thus out of thirty-two months there were nineteen in which it can be seen that simultaneous movements occurred at the three stations; and out of these nineteen months there were eight in which the movements were very distinct. In the remaining eleven months out of the nineteen the movements were not so prominent or well marked, but were always distinct enough to be readily recognised, and it does not seem unreasonable to suppose that the influence of such movements may have been felt in some if not all of those months in which they cannot be easily traced; that in fact the simultaneous movements may have been so small as to show themselves only in an excessive or deficient movement, upward or downward as the case may have been, of the curve which represents the non-simultaneous or travelling movements. In any case eight of these movements appear to be sufficiently distinct to disallow of doubt; and considering that Zanzibar is about 2500 miles distant from Belgaum, the fact seems to be interesting.

A. N. PEARSON,
Acg. Meteorological Reporter for Western India

Bombay, January 10

(*To be continued.*)

THE INSTITUTION OF MECHANICAL ENGINEERS IN BELGIUM

THE Institution of Mechanical Engineers has this year held its summer meeting in Belgium—the first time that it has crossed the Channel, except on the two occasions of the exhibitions in Paris. The reception was organised by the Association of Engineers from Liége University (Honorary Secretary, M. Édouard de Laveleye), and was of the most cordial character. The great works of Belgium were thrown open without reserve, and numerous excursions were organised to visit them. Amongst those specially to be noticed are the colossal establishment of the Cockerill Society at Seraing, the great iron and steel works at Ougrée and Sclessin, the vast zinc works of the Vieille Montagne Company, the cloth factories at Verviers, and the splendid collieries of Mariemont, probably the finest examples of colliery plant in the world. Space forbids our entering into a description of these works, and we shall confine ourselves to the papers read, so far as these possess more than a technical interest.

The proceedings opened on Monday evening, July 23, with a reception by the Mayor of Liége, after which the president, Mr. Percy Westmacott, delivered an interesting and suggestive address. After speaking of the great modern extension of Belgian industries, and of the debt which the world owes to the inventive skill of the engineer for providing those processes on which all trades are dependent for cheap and rapid production, he went on to develop his special theme, namely, the advantage of High Speed and its connection with high workmanship. The following extracts are well worth quoting :—

"The keen and continual attention bestowed upon the work to be done, and the means of doing it, has led engineers in general to regard speed of production as one of the first elements of success. There is indeed a proverb, 'more haste, less speed;' but this, though true of human labour, which ceases to

[1] In these months the movements are very distinct.

be accurate when forced beyond a certain rate, does not hold good of mechanical processes. Generally it may be said that rapidity of working not only reduces cost but improves the result, and also confers great benefits from the way in which it brings out and perfects the highest qualities of the engineer. To be able to do a thing leisurely and quietly simply requires the rudest materials and the rudest workmanship; but if work is to be done quickly, or the appliances made to move quickly, the case alters. Mechanical energy increases as the square of the speed; and so it may be said that the mental energy and skill required to carry on work increase also at something like the square of the speed with which that work is performed. The materials used must be far stronger and far finer; everything must be well proportioned and balanced; there must be the most perfect arrangement in each structure and in every part of a structure, and the most perfect workmanship in the fitting of those parts together; and thus we may almost reverse the proverb, and say of mechanical processes, 'The higher the speed, the better the work.'

"The torpedo boat is an excellent example of the advance towards high speeds, and shows what can be accomplished by studying lightness and strength in combination. In running at 22½ knots an hour, an engine with cylinders of 16-inch stroke will make 480 revolutions per minute, which gives 1280 feet per minute for piston speed; and it is remarked that engines running at that high rate work much more smoothly than at slower speeds, and that the difficulty of lubrication diminishes as the speed increases: doubtless the experiments on friction which are now being conducted by this Institution will throw light upon this subject.

"An important experiment on high speed in light vessels, which will doubtless be watched with much interest, is now being carried out. Mr. Loftus Perkins is building a steel vessel with a screw at each end: she is 150 feet long; her boiler pressure will be about 800 lbs. per square inch, and she has a four-cylinder compound condensing engine of 800 h.p. working on to a single crank, and making from 400 to 500 revolutions per minute. When this vessel is laden with 300 passengers, her total weight will not much exceed 150 tons. Should this experiment be successful, it will materially advance the solution of the problem, how to put the largest possible amount of propelling power into a vessel, and so to drive her at the highest possible speed.

"Again, in touching upon speeds, the mind naturally reverts to railway travelling. Here, however, it would seem as if for the present we had reached a maximum. It is surprising how soon the speed of the locomotive was brought up to something approaching its present limit. George Stephenson was laughed at in 1825 for maintaining that trains would be drawn by a locomotive at twelve miles an hour, but the 'Rocket' herself attained a speed of twenty-nine miles an hour at the Rainhill competition in 1829, and long afterwards ran four miles in four and a half minutes. In 1834 the average speed of trains on the Liverpool and Manchester Railway was twenty miles an hour; in 1838 it was twenty-five miles an hour. But by 1840 there were engines on the Great Western Railway capable of running fifty miles an hour with a train and eighty miles an hour without. In 1841 we find Stephenson himself ranged on the side of caution, and suggesting that forty miles an hour should be the highest regular speed for trains. In 1851 Mr. Crampton, who had already in 1849 inaugurated the express service of the Continent on the Northern Railway of France, conveyed a train twenty miles in nineteen minutes, four miles in the journey being at the rate of seventy-five miles an hour. Thus, it is a remarkable fact that the highest speed at which locomotives run in ordinary practice scarcely seems to have been raised during the last thirty years; on the other hand, the weight of the trains has been perhaps doubled.

"What are the causes which have tended to prevent any improvement in this particular? In the first place it may be said that the permanent way would suffer seriously by further increase in speed; but this could surely be overcome in time by improving the permanent way itself, which also remains very much in the same condition and of the same construction as it was twenty-five years ago. Again, it may be said that the running at a higher speed would require more powerful engines, and hence that trains now worked by a single engine would require two, or would have to be split up into two trains at a great increase in running expenses. This, however, assumes that it is not possible so to improve the engine that it shall be able to exert a considerably higher power without an inadmissible increase in weight. By utilising a larger part of the total weight of the engine as adhesion weight it would be easy to obtain the amount of adhesion required for the increased tractive force; and for this purpose Mr. Webb's compound locomotive (to be described by the author in a paper he has prepared for this meeting) which enables the number of driving wheels to be increased without the use of coupling-rods, appears to merit particular attention.

"Another point in which improvement may possibly arise in the future should be noticed. On the Russian railways, where both coal and wood are dear, the burning of petroleum has now taken a practical form. Our member, Mr. Thomas Urquhart, has been very successful in this direction, and is now running locomotives regularly which use only petroleum refuse, and which show a marked economy over coal or wood. To test the point he prepared three locomotives of exactly the same type, and started them on successive days under exactly similar conditions of weather, train, and section of road. The trips were made both ways, and the results per verst, including fuel required in lighting up, were as follows:—

	Copecks.
Anthracite, 52·9 Russian lbs., cost	26·35
Wood, 0·0107 cubic sashin, cost	23·54
Petroleum refuse, 27·36 Russian lbs., cost ...	11·64

"There is thus in this instance an economy of at least 50 per cent. on the side of petroleum, the boiler pressure being from 120 lbs. to 130 lbs. and the gross load over 400 tons. At the same time the weight of fuel used, as against coal, is diminished by about 50 per cent., which is a most important item.

"Although petroleum is scarcely a product of Western Europe, we have to notice on the other hand the progress which has lately been made in the extraction of oil as a waste product from coal, &c. Mr. Jameson has extracted as much as nine gallons per ton from mere shale. It is suggested that markets for such oil will be difficult to find; but it seems allowable to hazard the idea that we may hereafter see our locomotives, even in England, running with oil fuel, which would be at once much lighter and much more easily renewed than the coal which is used at present, and get rid of the intolerable nuisance of smoke and dirt. There might in fact be an oil tank and a water tank side by side at every stopping station, and the engine would replenish her store of fuel at the same time as her store of water.

"Another point in which speed and perfection of workmanship have gone hand in hand is the important industry connected with textile fabrics. When Arkwright first brought his inventive mind and mechanical skill to bear upon this subject, the tools he had to work with were rude compared with the tools of the present day, and could not produce the accurate work now attainable; and therefore the speed at which he was able to drive his spindles was not remarkable. But our member, Mr. John Dodd, of Messrs. Platt Bros., informs me that the average speed of mule spindles at Oldham, in new mills with new machinery, and spinning No. 32 yarn from American cotton, is about 8500 revolutions per minute; whilst speeds as high as 9500 or even 10,000 revolutions have been attained. When we consider the delicate nature of the material under treatment, the disastrous result of the slightest hitch or unevenness in working, and the perfection of mechanism required to bring up a multitude of spindles to such a speed from that of the comparatively slow main shaft of the mill, we may give every credit to the constructive skill which has achieved such a result. In woollen mills (of which we hope to see some excellent examples at Verviers on Thursday next) the speed is 4000 revolutions per minute. The progress made here has not been so great, mainly, in Mr. Dodd's opinion, from wood being still adhered to as the material for the bobbins. Here therefore is a case where improved material may yet produce improved speeds; but with cotton Mr. Dodd considers that the extreme possibilities as to speed have been very nearly attained. The limit however is imposed by the feebleness of the material, not by any lack of skill or enterprise on the part of the engineer. 'If higher speeds were required,' says Mr. Dodd, and I fully believe him, 'we could make spindles which would be equal to the demand.'

"The construction of modern artillery, and with still greater justice the methods of employing it, may properly be brought under the scope of this address. I doubt whether of late years any mechanical appliances or arrangements have given greater impetus to skilful work and to the improvement of materials, especially of steel. Twenty-five years ago the largest piece of ordnance in use was a gun weighing 4¼ tons, firing with a maximum charge

of about 15½ lbs. of powder a ball of 66 lbs., and made of cast-iron, a treacherous material for such purposes. We have now guns built up on well understood mechanical principles, of the most trustworthy and suitable material known, weighing 100 tons and firing with charges of 772 lbs. of powder shells of 2000 lbs. Already considerable experience has been obtained with guns of this weight. No fewer than fourteen have been issued from the Elswick Works, and several more are in the course of construction.

"Perhaps the most interesting feature in these formidable pieces of ordnance is the ease, rapidity, and noiselessness with which they are worked. It is of course impossible that such ponderous pieces could be brought into practical use without the aid of some mechanical appliances; but it is scarcely an exaggeration to say that nothing can work with greater precision and ease and be better under control than the hydraulic machinery employed for opening and closing the breech of the gun, ramming home the charge, elevating or depressing, running in or out, and training with accuracy on a given object. Two men working levers perform all these operations, and they, together with the machinery, are under complete protection from an enemy's fire.

"The projectile when fired has an energy imparted to it equal to nearly 48,450 foot tons, yet the gun is under such entire control that its recoil, due to this enormous force, is completely absorbed in a distance little exceeding three feet, without undue strain to any part of the mechanism. When it is remembered that the internal dimensions of the costly turrets in which guns of this size are ordinarily mounted depend mainly upon the space allowed for recoil, it is clear that it is of very great importance to reduce this space to a minimum.

"The fact which lies at the basis of these results is of course this, that the attainment of a high speed requires a more perfect machine, and with a more perfect machine more perfect work is turned out.

"In conclusion, it should be remembered that high speed, especially the speed of rotation, is almost necessary to give perfect accuracy and steadiness to motion, as in the case of an ordinary spinning top, of a gyroscope, and again of the ingenious centrifugal machines now in use for separating cream, &c. The speeds which we find in Nature are beyond all conception high, and her operations under those speeds are absolutely true and perfect. We cannot hope to vie with Nature even to an infinitesimal fraction of her powers of speed and accuracy; but in this, as in many other great lessons taught by her, we see the direction in which we must travel in our efforts towards the perfection of work.

"Finally, it is unfortunately a necessity that nations should still provide themselves with materials for war; and engineers have to devote their minds to the perfecting of such materials. It does not seem impossible that projectiles may be gradually developed, of such precision and devastating power as to make the existence of life within a certain range well nigh impossible. Were this accomplished, it is clear that nations would hesitate more and more before rushing into a war so destructive; and even if they did so, its rapid termination would unquestionably go far to diminish the various miseries which war always brings in its train. Hence it may not unfairly be said that the attention and skill given to the arts of war is really our best warrant for the continuance of peace."

On the next morning the papers read were on the "History of the Coal and Iron Industries in the Liége District," by M. Edouard de Laveleye, and on the "Manufacture of Zinc in Belgium," by M. St. Paul de Sinçay. The first of these was generally of an historical character, giving many interesting details as to the development of collieries and ironworks in Belgium. A claim was put in on behalf of Belgium for two most important discoveries in the metallurgy of iron, namely, the blast furnace and the cementation process. With regard to the present position of coal-working in this district, it was observed that all the difficulties which generally beset the mining of coal have to be encountered in their severest form. The chief of them—fire-damp—is nowhere so destructive, though its effects have been to a great extent obviated by the introduction of the Davy lamp and afterwards the improved safety-lamp of Mueseler. This lamp will resist a current of air of 15 feet per second, and has also the great property of self-extinguishment. In the recent disaster at L'Agrappe, which cost the lives of more than 100 miners, a sudden escape of gas issued from the shaft and burnt for several hours like an enormous gas-burner; but there was no explosion inside the mine, the 220 Mueseler lamps which were underground at the time having all been extinguished. Similar escapes of gas have taken place on other occasions and in enormous volume, without having previously given any indication of their appearance. Science appears to be powerless to prevent these disasters.

The second paper gave a sketch of the manufacture of zinc, which is a special trade in Belgium. Little was said as to the details of metallurgy, but it appears that the Belgian process, invented by Dony, of Liége, in 1810, is superseding all others, even in England. The difficulty and loss in reduction are, however, very great, and the labour is described as harder even than that of the puddler.

The third paper, by M. Mélin, was on "The Manufacture of Sugar from Beetroot," and formed a complete and exhaustive monograph on a manufacture of which but little is known in England. We regret that we can only give the briefest possible sketch of the processes. The beetroot, of which the cultivation was fully described, contains about 95 per cent. of juice in weight, and 5 per cent. of cellulose. These 95 parts of juice contain 10 parts of sugar, 2 of solid matter, and 83 of water. In manufacturing, the special point to be considered is the percentage of sugar, together with the purity of the juice. The manufacture is carried on in the winter only, and the beetroots are piled in silos until they are required for use. They are then washed, and are now ready for the extraction of the juice. For this purpose two systems are employed. On the first or hydraulic system, the roots are immersed in powerful rasping machines, and so reduced to pulp. This pulp is collected in sacks, which are piled up one upon the other between the table and the pressure head of a hydraulic press. The press is started, and acts with a pressure of about 450 lbs. per square inch on the pile of sacks, squeezing the juice through them. The dry pulp is used for feeding cattle, and is of considerable value. On the second or diffusion system the beetroots are cut up by a cutting machine into small slices called *cossettes*. These are placed in cylindrical vessels with an opening at the top for charging, and another at the bottom for emptying. These vessels are filled with water, and the result is that a current of endosmosis takes place from the water towards the juice in the cells, and a current of exosmosis from the juice towards the water. These currents go on until equilibrium is produced; and if fresh water is substituted they begin afresh. In this way the whole of the sugar contained in the cells is gradually drawn out. On the other hand, the water passes from the more exhausted to the less exhausted cells, and thus gradually increases in richness. A number of such vessels are used, forming what is called a diffusion battery; but in each of them the process going on is the enriching of the juice on the one hand and the impoverishing of the slices on the other. The slices are finally pressed in order to remove the residue of juice, but this is never effected so completely as by the hydraulic method.

The next process is that of defecation, which consists in adding milk of lime to the juice, in order to neutralise the organic acids which are precipitated, and also to decompose the salts of potassium, sodium, and ammonia. The result is that the dark brown juice becomes perfectly clear and of an amber colour. The scum which floats on the top, and which contains much juice, is passed through filtering presses, and the dried cake is sold as manure. After defecation the juice is filtered, twice at least, through animal charcoal under a sufficient pressure. It is then evaporated and transformed into syrup in a series of three vertical vessels, of which the first communicates with the second, the second with the third, and the third with a condenser. Steam is admitted to the first, and passes through to the last; and, owing to the partial vacuum produced by means of the condenser, causes an evaporation of the juice in all three. The next process is that of boiling this group, so as to allow the sugar to crystallise. This goes on within cast-iron vessels under a high vacuum, and heated by steam at high pressure circulating through worms. After a certain amount of evaporation, crystallisation begins in the form of an immense number of small grains of sugar. To develop these grains syrup is pumped in at regular intervals and with great care, so that the crystals may grow steadily and may be large, regular, and hard. Finally the crystals are dried by ceasing to supply syrup and introducing a current of steam. After eight to ten hours the sugar is removed from the boilers, and placed in vertical turbines running at 1000 revolutions per minute. Under the action of centrifugal force the boiled mass is spread upon the outsides of

these turbines, which are perforated, and the syrup passes through the holes, while the sugar remains behind. This sugar is cooled, and is called sugar No. 1. The syrup is boiled over again so as to obtain a second sugar called No. 2, and by a similar process a sugar No. 3 is obtained. The time of crystallisation, however, increases greatly, and for syrup No. 3 it is as much as six months. The final residue is molasses, which contains a large proportion of sugar that cannot be reduced by boiling. It is sold to make alcohol, or subjected to osmosis, by which the salts contained are drawn off and replaced by water; the sugar is then revivified and rendered capable of being crystallised. The paper concluded by giving careful analyses of the juice and of the products in all the stages of manufacture.

The next paper read was "On the Application of Electricity to the Working of Coal-Mines," by Mr. A. C. Bagot. The writer described a system of electric signals replacing the old system of signalling from the bottom to the top of the shaft by a gong worked by means of a wire. Galvanised iron telegraph wire was found to form the best communication, and the most suitable batteries to be 12-cell Leclanché. The system used for signalling in underground haulage planes, which are frequently the scene of accidents, was also described. Electricity had also been applied to signal the indications of an anemometer placed in the return air-way up to the engine-room at the surface. By an arrangement of clockwork and revolving tape, the engineer obtains an automatic and continuous record of the speed of the main air current at any part of the mine. Lastly the telephone might be applied with advantage for hearing the action of the pump-valves in the pumping shaft, without having to send the sinkers down.

Electricity may, however, be brought to bear for other purposes in mines, such as illumination and transmission of power. For lighting the pit bank, powerful arc lamps are found very serviceable, and the ordinary staff of a colliery, after a week's instruction, is capable of maintaining the appliances in operation. Alternating high-tension machines are very unadvisable on account of the likelihood of accident, and the Edison low-tension machine is said to be the best that can be used. At Risca Colliery a cable is taken down the pit from a dynamo at the surface, and is connected with a series of Crompton incandescent lamps at the bottom. These give an excellent light, and greatly facilitate the work of the men about the bottom of the shaft. But Mr. Bagot's opinion is strongly against the use of electric lamps in the working stalls and faces; partly because such lamps do not, like safety-lamps, indicate the approach of gas, partly because the line-wires may easily be broken, and partly because the hewer requires to be constantly shifting his light. With regard to the transmission of power by an electric tramway, as now in use at Zankerode, the writer holds that small locomotives worked by steam or compressed air are at present far more economical; so that the question of electric haulage need not in his opinion be considered at present.

These latter opinions did not pass without challenge. M. Tresca, who was present, pointed out that there was another form of electric transmission, viz. by a fixed cable with a dynamo at each end. Where work had to be done at some special part of a colliery, especially on an emergency, he believed that this would be found a handy and economical system. At the mines of La Perronière power was thus conveyed to a distance of 500 metres, and with a useful effect of about 30 per cent. This, in spite of over-bold statements to the contrary, was about the utmost which at present could be obtained in practice. The various sources of loss in such transmission were enumerated as follows:—First getting up the speed from that of the motor engine to that of the generator; secondly, loss within the generator itself; thirdly, loss in transmission along the cable; fourthly, loss within the receiver; fifthly, loss in slowing down the speed of the receiver to that of the main shaft. These defects were all now fully recognised, and might gradually, he hoped, be overcome. With regard to the amount of power which could thus be transmitted, the well-known experiments of M. Deprez showed 5 to 6 h.p. But within the last week he had succeeded in transmitting 31 h.p. from a Gramme machine to a great distance. The facility of installation was a great advantage in this system of transmission. It was far superior to that by an electric locomotive, as to which at present he had little to say; but on the whole he was more firm than ever in the view that a negative conclusion with regard to the electrical transmission of power was at any rate premature.

The next paper was by Mr. Webb, of Crewe, upon "Compound Locomotive Engines." It described the system devised by him, and now carried out in several engines running upon the London and North-Western Railway.

The last paper read at Liége was on the St. Gothard Railway, by Herr Wendelstein of Lucerne. This paper gave an interesting description of the works of the railway, and of the Brandt hydraulic drill, which was used with great success for one of the spiral tunnels. It then passed on to the question of ventilation, which was very fully gone into. Tables were given of the temperature in the great tunnel during and after construction, together with an account of the observations made on the ventilation both of that tunnel and of the spiral tunnels. The subject is as interesting from a scientific as it is important from a practical point of view, the result being that artificial measures of ventilation, the necessity for which was fully discussed, are found to be wholly needless. We regret that space does not allow us to reproduce this part of the paper.

During a subsequent visit of the Institution to Antwerp, a paper was read by M. Royers, describing the great harbour works which are now being constructed at that city, especially the long quay wall which is being built far out in the river by a special system of floating cofferdam designed by Mr. Hersent. In addition to these papers a large number of notices of the various works to be visited, &c., had been prepared and were distributed at the meeting. We understand that copies of any of these, or of the papers above mentioned, may be obtained on application to the Secretary, 10, Victoria Chambers, Westminster, S.W.

GEOGRAPHICAL NOTES

In the *Transactions of the Berlin Geographical Society* (May-June) is an interesting paper by Herr Arthur Krause on South-eastern Alaska, or that strip of coast stretching from Mount Elias to Fort Simpson, comprehending about 120 miles breadth of continent, and the numerous islands lying alongside of it. Herr A. Krause passed the winter of 1882 with his brother at a factory to the north of the Lynn Canal, making short tours the following spring into the interior, as far as the Yukon district, and Herr Krause's paper is the result of his observations. The lower course of the Yukon River, as far as Fort Yukon, has been traced and astronomically observed by Raymond in his "Reconnaissance of the Yukon River, 1871." Its upper course and sources, on the other hand, have only seldom been visited by people of the Hudson's Bay Company and by gold seekers. The most important head stream is the Polly River, which springs from France's Lake on the west of the Rocky Mountains. From the south the Polly receives a powerful current, figuring in certain maps as the Lewis River. A northern offshoot of the Lynn channel cuts so deeply into the interior that in two short days' marches you can pass thence to the Yukon river. To the north of the Lynn Channel is the varied district of Chileat, forming the watershed between the coast and the Yukon river, and parting two distinct zones of flora and fauna. The Chileat district, like the whole of the west coast, is mountainous, and its peaks condensing the vapour driven by western winds from the warmer region of the sea, the whole western tract is distinguished by its violent falls of rain in summer and snow in winter, as also by its abundance of glaciers. Glacier Bay, to the west of the entrance of the Lynn Channel, is quite filled with ice in consequence of vast glaciers falling into it. All the valleys, too, along the coast abound in glaciers. As soon, however, as the watershed and the slope towards Yukon river are reached, the glaciers disappear. With this change also appears a corresponding change in vegetable and animal forms. The low banks and islands along the coast are covered with poplars, alders, willows, and thickets. Higher up on the slopes you meet a thick belt of pine. A few green trees of diminutive size, birch, maple, and mountain ash, may be observed, but these are mostly interwoven in the enormous thick underwoods of the pine forests. In some lower-lying spots an almost tropical luxuriance of vegetation surprises the traveller. On the inland side of the watershed the whole physiognomy of vegetation is in striking contrast with that on the sea side—is barer, drier, and lighter. Instructive particulars are also given by Herr Krause regarding the fur and fishing trades of this region.

In the *Bulletin of the Italian Geographical Society* for July is a paper giving a historic survey of the Harar district, Somaliland, by the Rev. P. Taurin Cahague. Great interest attaches to this place since Frederick Müller has shown that it forms a distinct ethnologic enclave allied to

the Semitic group of Abyssinia in the midst of the Hamitic populations of Somaliland. The town of Harar itself was never the capital of an independent kingdom, as has been wrongly stated by many writers, but simply a large emporium and station of great importance between the old Abyssinian empire and Massawa on the Gulf of Aden. Some years ago it was attached to the possessions of the Khedive, but on the withdrawal of the Egyptian troops the district was overrun by the fierce Oromo (Galla) people, who exterminated most of the old Amharic (Abyssinian) population.—In the same number is an editorial note, with illustration, on a human foot incised by the Bushmen of South Africa on a stone, which has been presented by Dr. Holub to the Society, and is now deposited in the Royal Prehistoric Museum, Rome.

THE general census of Japan, taken on the first day of the present year, gives the total population of the country at 36,700,110, made up of 18,598,998 males, and 18,101,112 females. The population of the larger towns is given as follows:—Osaka, 1,772,333; Hiogo, 1,418,521; Nagasaki, 1,204,629; Tokio, 987,887; Kioto, 835,215. To avoid erroneous conclusions it may be well to state that the figures here given are not the populations of the towns and cities mentioned, but of the administrative districts, locally known as *fu* or *ken*, bearing these names. In some instances, *e.g.* Hiogo and Nagasaki, these districts are as large as a medium-sized English county, and in all cases they include the towns and villages for several (from ten to thirty) miles around. Thus these statistics can by no means be accepted as data for the respective sizes of the towns. These would run, we believe, as follows: Tokio, Osaka, Kioto, Nagasaki, Hiogo; the two latter being smaller than probably a dozen other Japanese towns which might be mentioned—Nagoya, Sendai, Niigata, Kagoshima, Shimonoseki, &c. Statisticians should therefore receive these figures with the explanation here given.

AMONG the papers in parts 3 and 4 of the *Verhandlungen der Gesellschaft für Erdkunde zu Berlin* for the current year, we find one by Dr. Schwarz on Montenegro, the land and people; another by Dr. Uhle of Dresden on the divinity *Batara Guru* of the Malays; and also some geographical sketches of Portugal by Herr Müller-Beeck.

SOCIETIES AND ACADEMIES

PARIS

Academy of Sciences, July 30.—M. Blanchard, president, in the chair.—Active or dynamic resistance of solids. Graphic representation of the laws of longitudinal thrust applied to one end of a prismatic rod, the other end of which is fixed (continued), by MM. de Saint-Venant and Flamant.—Experiments on the reproduction of albite (white shorl) in an aqueous medium, by MM. C. Freidel and Ed. Sarasin. From a composition of silicate of soda and albite (Na_2O, Al_2O_3, $6SiO_2$) in a temperature ranging from 432° to 517° C., abundant precipitates of albite were obtained in the form of minute particles, which appeared as fine needle-points and short thick crystals with facets distinctly visible under the microscope. Steel and platinum vessels strong enough to resist this high temperature were specially constructed by MM. Golaz, père et fils.—Separation of gallium (continued). Separation from vanadium, by M. Lecoq de Boisbaudran.—Experimental researches on the action of a liquid introduced by a special process into the tissues of the vine for the purpose of destroying phylloxera (continued), by M. P. de Lafitte.—Capacity of various soils for retaining water under conditions suitable for viticulture, by M. P. Pichard. Appended is a comparative table showing the various degrees of resistance offered to the infiltration of water by siliceous, argillaceous, calcareous, and other soils in the south-east of France.—On the integration of a certain class of partial differential equations of the second order with two independent variants, by M. A. Picart.—On the critical temperature and critical pressure of oxygen, by M. S. Wroblewsky. The critical point is approximately determined at −113° C.—A determination of the inward inert resistance of any electric system, independently of the disturbing action of its interior electromotor forces, whose number, seat, and size remain unknown quantities, by M. G. Cabanellas.—On the visibility of the ultra-violet rays, by M. J. L. Soret.—A silicophosphate of crystallised lime obtained by liberating phosphorus in the process of iron-smelting, by MM. Ad. Carnot and Richard.—On the artificial production of rhodonite (silicate of manganese) and tephroite, by M. Alex. Gorgeu. A new and easy method is explained for producing these two natural crystallised silicates of manganese based on the reciprocal action of silicium and the red chloride of manganese in aqueous vapour.—On the "chloride of menthylum" obtained by Oppenheim from menthol by the action of a concentrated solution of chlorhydric acid, by M. G. Arth.—Experiments on poisoning by the oxide of carbon, with a view to ascertain whether this gas passes from the mother to the fœtus, by MM. Gréhant and Quinquaud. The authors, who experimented on bitches, arrived at an opposite conclusion from Andreas Hogyes of Klausenburg, who experimented on rabbits, and who concluded that the fœtus remained unaffected by the poison which was fatal to the mother.—On the open epithelium ("cellule epithéliale fenêtrée") of the closed follicules of the intestine of the rabbit, and its temporary stomata, by M. J. Renaut.—Researches on the structure of the constituent parts of the vent in Cephalopods, by M. P. Girod.—Observations and experiments on the circulation of the sap in plants under the tropics, by M. V. Marcano. From the experiments carried on at Caracas, Venezuela (10° 30′ 50″ N. lat.), the author considers that in intertropical vegetation the cycle of circulation is completed within a period of twenty-four hours, presenting two *maxima* of relative fixity, and that the inner pressure of the sap is inferior to that of the atmosphere during the dry but far greater during the rainy season, a phenomenon attributed mainly to the water directly absorbed by the leaves.—On the differentiation and anatomic variations of the branches of forest and fruit-bearing trees, and some other plants, by M. Laborie.—On the action of silica on the growth of maize, by M. V. Jodin.—On the alterations produced by age on wheat-flour preserved in bins and sacks, by M. Balland.—Experiments on evaporation made at Arles during the years 1876-82, by M. A. Salles. In his remarks on this paper, M. Lalanne dwells on the great importance of the subject in connection with the projected inland sea towards the southern frontier of Tunis.—Observations on Part IV. of M. de Koninck's work on the carboniferous fauna of Belgium, by M. Hébert.

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THURSDAY, AUGUST 16, 1883

RECENT TRAVEL IN EASTERN ASIA

The Golden Chersonese. By Isabella L. Bird. (London: John Murray, 1883.)

Across Chrysê; being the Narrative of a Journey of Exploration through the South China Border Lands from Canton to Mandalay. By Archibald R. Colquhoun. Two Vols. (London: Sampson Low, 1883.)

Among the Mongols. By the Rev. James Gilmour. (London: Religious Tract Society, 1883.)

Eight Years in Japan, 1873–1881. Work, Travel, and Recreation. By E. G. Holtham, M.Inst.C.E. (London: Kegan Paul, Trench, and Co., 1883.)

WHEN Miss Bird last took leave of her readers, steaming away from the coasts of Japan, her labours and wanderings were by no means over. In this volume she takes up the thread of her narrative exactly where she dropped it in her last book, and we find ourselves with her again just where we parted before, and pay visits first to Hong Kong and then to Canton before starting for the newer ground. If this volume at all falls short in the interest and, we may say, importance of the last, it is owing alone to the Malayan peninsula falling so far short of Japan in both its interesting ancient and marvellous modern history. It is as fresh ground as Japan: for of the eastern half of the peninsula nothing is known but the coast line. Yet commerce promises to open it up; for the export and import trade of the Straits Settlements amounted together in 1880 to £32,353,000. Ironstone, containing 60 per cent. of metal, is said to be used for macadamising the roads at Singapore; and the vastest tin fields in the world are found in the western Malay States.

Miss Bird sailed from a leaden stormy sky on the Pacific into the sunny harbour of Hong Kong to find the town on fire, an incident giving early employment to her graphic pen. Her remarks that, whenever the rocks are quarried there, fever breaks out, is one on which further observations would be valuable. Miss Bird reports also that the Hong Kong hospital doctors have drugs which throw patients into a profound sleep, during which the most severe operations can be painlessly performed, and from which the patients awake without even a headache.

From Hong Kong she makes an excursion to Canton, where her "admiration and amazement never cease." We must remark that the simple exercise of the faculty of seeing seems to give an unusually intense pleasure to Miss Bird. Further on she describes the rough life she led as "very enchanting," even where she owns that the redundancy of insect and reptile life certainly was oppressive! The river population, though looked down upon by the land-dwellers, seem as usual to have been sharpened and improved by the struggle for existence; at any rate Miss Bird seems to prefer their women. Miss Bird stops in the neighbourhood of a Cochin Chinese village where river boats are more crowded than at Canton. Among other low characteristics of the "hideous" inhabitants she notes a wide separation of the great toe from the rest.

In the seas about Singapore there is "nothing scanty, feeble, or pale," while on land she finds a perpetual struggle between man and the jungle, and a power of vegetation which must be a source of wealth to the former when he has numbers and energy to control it. The average temperature there is 80° F., with no greater range in any part than 24°: moist and uniform. This moisture adds greatly to the oppressiveness of the heat—nowhere else did Miss Bird feel it so overpowering as in a canoe on a river at night—but our traveller is one who can feel mere living to be a luxury with the thermometer at 88°, and her powers of endurance are shown by the early collapse of one of the only two companions she made in any part of her journey, although the daughter of the Resident at Malacca. This town is now out of the line of traffic, and Miss Bird describes in equal wealth of words its monotonous silence and sleepiness, and the impression and fascination it produced upon her. It is only 2° north of the equator, and the journeyings which commence from here are in small territories on the west coast of the Malayan peninsula, only 3° further north.

The jungle there is not an entanglement of profuse and matted scrub but a noble forest of majestic trees, many of them supported at their roots by three buttresses, behind which thirty men could find shelter. On many of the top branches of these other trees have taken root from seeds deposited by birds, and have attained considerable size. Under these giants stand the lesser trees grouped in glorious confusion. A long list of such is given, all of which are bound together by the rattan with its tough strands from 100 to 1200 feet in length. An enthusiastic description of magnificent tropical flowers follows here; but elsewhere she reconciles her description with the different one which Mr. Wallace gives by remarking that "a traveller through a tropical jungle may see very few flowers, and be inclined to disparage it. It is necessary to go on adjacent rising ground and look down where trees and trailers are exhibiting their gorgeousness," "where indeed one has to look for most of the flowers." The silence and colourlessness of the heart of the forest, she tells us, and the colour, light, vivacity, and movement among the tree tops contrast most curiously. Even with the latter our masses of flowers, buttercups and daisies, gorse or heather, are compared favourably among very few things of home which are compared favourably with what she finds abroad.

Of the mangrove she notes that the seeds germinate while still attached to the branch—a long root pierces the covering and grows rapidly downwards from the heavy end of the fruit—which arrangement secures that when the fruit falls off the root shall become at once embedded in the mud; of the cocoanut palm, that in loose sandy soil near the salt water it needs neither manure nor care of any kind, but if planted more than two hundred yards from the sea it requires manure or human habitation, and that its fruit takes fourteen months from the appearance of the blossom till the ripe fruit falls; of the nutmeg that it grows like a nectarine on a tree forty or fifty feet high, with shining foliage. A ripe one open revealed the nutmeg, with its dark brown shell showing through its crimson reticulated envelope of mace, the whole lying in a bed of pure white, a beautiful object.

"The sensitive plant with its tripartite leaves, green

above and brown below, is a fascinating plant, and at first one feels guilty of cruelty if one wounds its sensibilities. Touch any part of a leaf ever so lightly, and as quick as thought it rolls up. Touch the centre leaf of the three ever so lightly, and leaf and stalk fall smitten. Touch a branch and every leaf closes, and every stalk falls as if weighted with lead. Walk over it and you seem to have blasted the earth with a fiery tread, leaving desolation behind. Every trailing plant falls—the leaves closing show only their red-brown backs, and all the beauty has vanished; but the burned and withered-looking earth is as fair as ever the next morning."

It is satisfactory to read that the elephant, so near extermination in Africa through the pursuit of the ivory trade, is still plentiful in these forest-covered interiors, though novelty seemed its only recommendation to Miss Bird as a beast of burden. Half a ton is considered a sufficient load for one if it be of metal, but if more bulky, from four to six hundredweight. In passing through the forest an elephant always puts his foot into the hole that another elephant's foot has made. They have the greatest horror of anything that looks like a fence; and a slight one made of reeds usually keeps them out of padi, cane, and maize plantations. The insect which can draw blood from the wrinkled hide of an elephant is curiously small. The boiled or stewed trunk of the latter, we are told, tastes much like beef.

A most tender account is given of the living and dying of a tame monkey, which Miss Bird believes to be an "agile gibbon—a creature so delicate that it has never yet survived a voyage to England"; and curiously human are the differences in disposition between different species of monkeys which she observes. When tamed by living with Europeans these apes acquire a great aversion to Malays.

Some small bright-eyed lizards which ran about her room went up the walls in search of flies. They dart upon the fly with very great speed, but just as you think they are about to swallow him, they pause for a second or two and then make the spring. "I have never seen a fly escape during this pause, which looks as if the lizard charmed or petrified his victim." The Malays have a proverb based upon this fact: "Even the lizard gives the fly time to pray." One evening Miss Bird found seventeen lizards in her room and two in her slippers!

A snake about 8 feet long has gained its name of a "two-headed snake" because after the proper head is dead the tail will stand up and move forwards.

An interesting account is given of a column of ants, officered by larger ones, making their way to the stump of a tree from which the outer layer of bark had been removed, leaving an under layer apparently permeated with a rich sweet secretion, which a quantity of reddish ants of much larger size and with large mandibles were engaged in stripping off. The large pieces which they dropped were broken up and carried away by the smaller ants round the base. Other proceedings which she describes seemed inscrutable to Miss Bird.

Among the gorgeous butterflies, Miss Bird describes one with the upper part of its wings of jet black velvet, and the lower half of its body and the under side of its wings of peacock-blue velvet, spotted; another of the same "make" but with gold instead of blue; and a third with the upper part of the body and wings white with cerise spots. All these measured full five inches across their expanded wings. In one opening of the forest only she counted thirty-seven varieties of these brilliant creatures, not in hundreds, but in thousands, mixed up with the blue and crimson dragon-flies, and iridescent flies all joyous in the sunshine. Many birds rival them in beauty of plumage, though some resemble less brilliant European species.

The Malays are fond of animal pets; their low voices and gentle supple movements never shock the timid sensitiveness of brutes. A bird called a mina articulated so plainly that Miss Bird did not know whether a bird or a Malay spoke. Monkeys gather cocoanuts to order for their masters.

The Malays have an elaborate civilisation, laws, and even a literature of their own. They are a decently clothed, comfortably housed, settled, agricultural people, skilful in some arts, especially the working of gold, and they are rigid monotheists. Their houses show good work in lattice and bamboo, carved doorways, and portières of red silk, pillows and cushions of gold embroidery laid over exquisitely fine matting on the floors. Yet Miss Bird says that with no visible reason they have been dwindling away for several generations, and if they were swept away to-morrow not a trace of them except their metal work would be found. But nothing impresses itself so often or so strongly upon Miss Bird as the energy, enterprise, and large emigration of the Chinese. Most of her remarks about them might be thought to apply to the English; and indeed, so far from wishing to correct such an impression, she asserts that "to say that the Chinese make as good emigrants as the British is barely to give them their due. They have equal stamina and are more industrious and thrifty." Though the old hatred of foreigners in their native country does not pass away from them, and Miss Bird heard them mutter the phrase of "foreign devils" as she passed along the streets of Canton, yet the Chinese who are born in the Straits glory in being British-born subjects, and despise the immigrant Chinese. The principal result of British rule seems likely to be, from Miss Bird's account, that the Chinaman, striving, thriving, and oblivious of everything but his own interests, will soon overspread the whole of the Far East. Singapore is to all appearance a Chinese town, with 86,766 Chinese against 1287 European residents.

We think no one can help enjoying this happy traveller's book; though few would be led to think they would enjoy the same journey as thoroughly as she describes doing. One adjective fairly describes all her descriptions of what she meets with—they are superlative!

Mr. Colquhoun's object in undertaking the journey which he records in these two portly volumes, was to find a trade route from Rangoon through Burmah and the Shan States into South-western China. His attention was attracted to this subject by a previous journey to Zimmé or Kiang-mai on the Me Ping, and he accordingly decided to devote his first leave of absence from his official duties in India to attacking his task from the Chinese side. Briefly, then, he went up the Si Kiang, or Canton River, from its mouth to Pêsê, near the borders of Yunnan, and travelled through the southern districts of this province, passing the great towns Kaihua, Linan, and Puerh to Ssumao, immediately on the border of the independent

Shan States, the real goal of his journey. Here, where the most interesting part of his work was to commence, and when he had overcome many obstacles, he found himself compelled to abandon his plan by the refusal of his interpreter to proceed into these strange regions. It is not difficult to understand the bitter disappointment with which he turned northwards, when only a few weeks' journey from Zimmé, and passing almost across Yunnan to Tali, he took the usual route of Gill, Margary, and others through Manwyne and Bhamo, and thence by the Irrawaddy to Mandalay and British Burmah. It is to be hoped, not less in the interests of geography than of commerce, that Mr. Colquhoun may shortly be able to undertake the journey again, aided by the great commercial bodies of England; for we are bound to say that he exhibited throughout the journey many of the highest and most valuable qualities that a traveller can exhibit among strange peoples—patience in overcoming obstacles, unfailing good temper, tact in dealing with officials and with his own followers; and at the same time energy, industry, and skill in making and recording scientific observations. These volumes appear to have been written from day to day as the journey progressed, and this accounts for much repetition, and for an absence of arrangement which is none the less occasionally irritating. But how are we to account for the presence of illustrations in this important and scientific work of such hackneyed subjects as "Chinese Children," "Modes of Dressing the Hair," "Boats at Futshan," &c., such as may be found in any popular volume published on China during the last fifty years? They swell the size of the book, without in any degree adding to its interest or value. In fact, there was ample room for judicious pruning, and a single moderate-sized volume would have been sufficient to contain a full record of the journey, including the excellent maps, and the amusing sketches of the aboriginal tribes of Southern Yunnan. But we must not look our gift-horse too much in the mouth; and the faults to which we have adverted do not prevent Mr. Colquhoun's journey from being one of the most valuable contributions to our knowledge of the geography of China and its southern border-lands that we have had since Lagrée's adventurous journey up the Meikong and through Yunnan to the Yang-tsze about ten years ago. He appears to have settled the hydrography of many of the numerous rivers that flow from Yunnan through the Indo-Chinese peninsula, and his accounts of the various tribes inhabiting the southern borders of that province add much to ethnological knowledge. One fact, of great importance at the present time, which Mr. Colquhoun places beyond doubt is that the Songkoi River, which flows through Tonkin, and which the French regard as the future trade-route into South-western China, can never be used for that purpose with success. Its highest navigable point is cut off from the province by a range of lofty mountains, and when these are crossed, the district reached is a barren one. The real wealth of these regions appears to lie farther to the westward, about Puerh, Ssumao, and in the Independent Shan States, where the traveller found a busy and thriving trade. In the new journey which Mr. Colquhoun is about to undertake with more funds, and with other advantages which he did not possess last year, we are sure he will meet with the success which unfortunate circumstances then snatched from him at the last moment.

Mr. Gilmour's volume is one of the most charming books about a strange people that we have read for many a day. There is much deficiency in the matter of dates, but we gather that he commenced his missionary labours in Mongolia about 1870, and that he is still connected with the Peking mission. He lived amongst this nomad people as one of themselves. He learned the language in a manner that would have approved itself to the late Prof. Palmer, and then he travelled over the vast tract of country lying between the great wall of China on the south and the Amour on the north, sometimes joining caravans, sometimes alone, now staying in Mongol tents, now pitching his own tent on the confines of an encampment, from which the people came out to visit and hear him, or to get from him foreign medicines, which they expected to work extraordinary cures. In addition Mr. Gilmour has lived in towns such as Kalgan, on the southern frontier of Mongolia, Urga and Kiachta, and appears even to have once gone as far as Irkutsk. As a result he knows the Mongols from the inside; he has penetrated into their superstitions, their religion and habits of life, and he therefore is never compelled to hammer out a little substance to cover a large space. Indeed his wealth of material would in some hands have easily been extended to two portly volumes. Of geographical information there is very little, except an account of a journey across Mongolia from Kalgan to Kiachta, on the Siberian frontier; but the customs, religion, superstitions, &c., of the inhabitants of Mongolia are fully described, and the volume may thus be of much value to the ethnologist and student of comparative culture. It is in addition written in a simple and most amusing way.

The complaint that our books on Japan for the general reader are written by "globe-trotters" and travellers who have spent but a short time in the country is in a fair way of being removed. Mr. Holtham's is the second volume published during the past two years in which a resident on his return home has given the public the benefit of his experiences. Mr. Holtham was employed as an engineer on the Japanese railways. For the first two years survey work took him up country, but when the Japanese Government found they were exceeding their funds in various directions, the projected railways were abandoned for the time being, and Mr. Holtham was called in to administer one or other of the two small railways then in actual running order. One of these he extended slowly till it reached Kioto; the other he succeeded in relaying. The nature of the experiences of an engineer surveying for railways may be guessed with tolerable accuracy, but Mr. Holtham tells his story in a quaint and humorous fashion which, if a little strained now and again, is as a rule very taking. In addition to what may be called the professional section of the volume, there are also records of various journeys in the interior, but none of these are on unbeaten tracks; and interspersed everywhere we find interesting and amusing comments on what was going on under the author's eye in society and politics in Japan. It may be commended especially to readers who desire, from whatever motive, to know the conditions under which the scientific and professional

man works under the Japanese Government. Many of these are exceedingly irritating, among them being the incompetence and presumption of native colleagues, who are fond of proceeding in what Mr. Holtham styles "the rough and ready heaven-born-genius-and-see-it-with-half-an-eye kind of way" in cases where his old-fashioned education led him to seek first carefully for facts. The author passes over unpleasantnesses such as these in a very kindly way, but there can, we believe, be no question that many most important elements of the true scientific spirit are sadly lacking in young Japan. Energy, thirst for knowledge, and ingenuity exist in abundance, but we are not so assured of the patience, and caution in research, and respect for the opinions of older and more experienced heads, which are also necessary. Hence, doubtless, we find so many promising schemes come to nought. It is more satisfactory to find that, in Mr. Holtham's opinion, the students who have been so carefully trained under excellent foreign teachers in the Imperial College of Engineering give great promise of subsequent practical usefulness. The foreign staff of the Japanese Railway Department has now been almost wholly replaced by natives, and it will be very interesting to watch the Japanese walking alone. A few years will show how far they were justified in getting rid of the men to whom they owe their substantial public works. However this may be, we can cordially recommend "Eight Years in Japan" as a very interesting and amusing book.

ELEMENTARY APPLIED MECHANICS

Elementary Applied Mechanics. Part II. By Thos. Alexander, C.E., and Arthur Watson Thomson, C.E., B.Sc. (London: Macmillan and Co., 1883.)

IN this volume the authors have pursued the same course as that followed by Prof. Alexander in the first volume of his "Elementary Applied Mechanics," in giving an abundant commentary, illustrated by a large number of practical examples, of those parts of Rankine's "Applied Mechanics" which deal with transverse stresses and the shearing forces and bending moments on beams and cantilevers.

They have thus supplied a want which has long been felt both by teachers and students of a text-book which should treat applied mechanics in a way similar to that pursued in mathematical works.

The work before us is accurate and clearly written, and the explanations given are so full that it may be easily understood by any one whose mental powers are not so hopelessly deficient that he would be liable to incur responsibility for culpable homicide if he were to undertake to design or construct a bridge, or any sort of structure in which defects might be attended with risk to human life.

Thoroughly penetrated with the scientific spirit of Rankine's work, though happily with a more perfect acquaintance with the limits of average human intelligence, the authors have given at length the proofs of the formulæ belonging to this part of applied mechanics, and they have also examined carefully the various cases which occur owing to the different modes of loading a beam.

The results arrived at and the methods employed, many of which are new, have, in each case, been rendered more easy of apprehension by the addition of a solution of the same question by simple graphical methods, nearly all of which depend, by a proper change in the scale on which vertical ordinates are measured, on the use of an invariable parabolic segment which is to be carefully constructed beforehand in wood or cardboard, and employed throughout.

By this means complicated questions on beams with both a dead and travelling load, can be easily dealt with, and the curves of bending moment and maximum bending moment readily drawn.

The mathematics employed are of the simplest character, not extending, except in one or two instances, beyond elementary algebra, whilst those properties of the parabola which are employed are previously proved in the form of lemmas.

But excellent as is the theoretical exposition of principles in the book, we are disposed to attach even greater importance to the large collection of examples scattered through it, in which the facts and formulæ of the text are applied to well chosen practical examples.

It has been a great misfortune, which all teachers of the subject have deplored, that the writers of books on it have spared themselves the labour of compiling a set of numerical examples, which would enable students to obtain that grasp of it which examples alone can give, and at the same time afford them the assurance that the formulæ they have been studying have some practical significance.

Those which are scattered through this work are judiciously selected, and they are accompanied, when necessary, by hints for their solution. We set a high value on this feature of the book, and we believe that a student, even though otherwise unassisted, who should carefully read it and conscientiously work through the examples, would acquire a knowledge, theoretically sound and practically useful, of this part of applied mechanics which he could not gain with the same labour and in the same time from the study of any other book which has been published on the subject. J. F. M.

OUR BOOK SHELF

Text-Book of Physics. By J. D. Everett, M.A., D.C.L., F.R.S. Illustrated. (Glasgow: Blackie and Son, 1883.)

THIS book of 300 pages well fulfils the author's intention of providing an elementary text-book which may especially serve as an introduction to the well-known work of Deschanel with which his name is associated. It is full of matter, which is presented to the reader in a thoroughly systematised and acceptable condition.

The definitions, we need hardly say, are excellent and well worthy of the reputation of one who has taken a prominent part in scientific definition and terminology. Indeed we have rarely seen the chief points of scientific interest so clearly explained as they are in this volume.

We give the following as a good illustration (p. 119):—

"Fuel is a reservoir of potential energy, inasmuch as its elements are ready, whenever opportunity is given, to unite with the oxygen of the air and develop a large amount of heat. The words 'whenever opportunity is given' require some explanation. . . . If we have a large stone lying near the edge of a precipice 1000 feet deep, the stone will not move over of itself, but is ready to fall when opportunity is given, and a trifling expenditure of work in moving the stone to the edge will enable it to descend to the foot with terrific violence. . . . In the firing of a gun there is a combination of illustrations of

the kind of action we are considering. First, a little work spent in pulling the trigger releases a strong spring in the lock, and brings about a smart blow with the hammer. This blow liberates the explosive energy of the percussion cap, which in its turn fires the powder. Thus we have a series of processes in which the running down of a small quantity of energy gives opportunity for the running down of a larger."

This is only one illustration out of many which might be given. In fine the student of physics will find in this volume an accurate and clearly cut map of the various districts for the more minute details of which he must of course be referred to other guides. B. S.

Formulaire Pratique de L'Électricien. Par E. Hospitalier, Première Année, 1883. (Paris: G. Masson.)

In his "Formulaire Pratique de l'Électricien" M. Hospitalier has supplied us with a work which cannot fail to be of value as a convenient book of reference. It is divided into five parts. In the first are stated as briefly as possible those general principles with which every one who is in any way connected with electrical matters should be familiar. In the second is given the derivation of the electrical and magnetic units, with which are tabulated all the arbitrary units that have been or are at all generally used. In the third chapter almost every instrument and method that may be employed for making any measurement which an electrician is likely to require is mentioned, and when necessary explained by a figure. Though it must have been difficult to decide what to include and what to omit, surely considering the growing importance of "diagrams" so very useful an instrument as Amsler's planimeter might have been mentioned.

The fourth chapter, which in quantity is equal to all the rest of the book put together, contains a large amount of miscellaneous information. After giving the usual mathematical tables and formulæ, and several tables of the physical properties of bodies, the author treats in succession of batteries, accumulators, electro-metallurgy, thermo-electricity, dynamo-machines, and motors, electric lighting, the telegraph, and telephone.

The fifth chapter consists of a few pages, in which the composition of various alloys, cements, and varnishes, and a few manipulative processes are described. This part might and no doubt will be improved. For instance, a troublesome process of amalgamating iron is given, but no mention is made of the well known property that sodium possesses of making mercury wet iron or platinum.

There can be no doubt that both in the laboratory and in the workshop this will be found one of the most handy and complete books of reference existing. C. V. B.

LETTERS TO THE EDITOR

[*The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, or to correspond with the writers of, rejected manuscripts. No notice is taken of anonymous communications.*

[*The Editor urgently requests correspondents to keep their letters as short as possible. The pressure on his space is so great that it is impossible otherwise to insure the appearance even of communications containing interesting and novel facts.*]

"Elevation and Subsidence"

In an article in last week's Nature on "Elevation and Subsidence" (p. 323), Darwin's theory on the formation of coral islands is contrasted with mine, and it is apparently assumed that my theory is opposed to subsidence in those regions of the ocean where atolls and barrier reefs are situated.

I am not aware I have ever contended for this, but as several writers have lately attributed this opinion to me it may be as well to restate the position. My view is that the characteristic form of barrier reefs and atolls is in no way dependent on subsidence; that subsidence is not the cause of their peculiar features; that these reefs may be met with indifferently in stationary areas, in areas of subsidence, and in areas of elevation; and that elevation and subsidence only modify in a minor way the appearance of these islands.

All naturalists will be willing to acknowledge that Darwin's theory is "simple and admirable," but I do not think it will be generally admitted by those who have carefully examined coral reefs in recent years that it "accounts satisfactorily for all the observed phenomena of coral growth."

According to the explanation given by Darwin, the foundations of the coral reef sink gradually, and the corals, as gradually, build up the reef to the level of the waves. In this way these interesting coral islands are slowly developed.

It appears to me that the chief phenomena of barrier reefs and atolls are more satisfactorily accounted for in another way:—

1. By a physiological fact—the very vigorous growth of the reef-forming species on the outer or seaward face of the reef where there is abundance of food, and the much less vigorous growth and even death of these species on the inner parts of the reefs and in the lagoons, where there is much less food, and where there are other conditions inimical to growth.

2. By a physical and chemical fact—the removal of lime in suspension and in solution from the inner portions of the reefs and from the lagoons, where much dead coral is exposed to the action of sea water containing carbonic acid—the result being the formation, the deepening, and the widening of lagoons and lagoon channels.

My theory is represented as demanding "290 volcanic peaks at the sea level in the Pacific coral area alone."

What I have endeavoured to show is that the sum of all the agencies at work above the sea tends to reduce volcanic cones down to twenty or thirty fathoms beneath the waves, and the sum of all the agencies at work under the sea level tends to build up volcanic cones to within twenty or thirty fathoms of the surface.

In both cases banks are formed on which reef-building corals grow and eventually develop into atolls. The nearer the summit of the cone is to the sea level, whether above or below it, the more rapid is the formation of the bank.

Atolls, as we now see them, should, according to Darwin's theory, be situated on the summits of gigantic pillars of coral, which are probably higher (or deeper) the greater the diameter of the atoll. These pillars should rest on volcanic cones or peaks of continental land; and in the "Pacific coral area alone" should mark the spots where "290 peaks" have subsided. Where are the soundings which corroborate this part of Darwin's theory?

John Murray

Challenger Office, 32, Queen Street, Edinburgh, August 6

In his article on "Elevation and Subsidence" (Nature, vol. xxviii. p. 323) Mr. Starkie Gardner has given some very interesting new illustrations, drawn from observations of his own upon lava-fields in Iceland, where it is his belief that tracts have sunk owing to the mere weight of lava poured over them. But there are several places in his reasoning upon the general question of the condition of the earth's interior where he appears to argue upon the supposition that pressure by itself can be the cause of heat, and consequently of an increase of temperature among deeply buried rocks. This, however, as those who are acquainted with the science of energy will know, is clearly a mistake. It is only where pressure has produced motion, and that motion has been destroyed as visible motion in a mass of matter, and transformed into motion among the molecules of the matter, that the mass can be heated thereby.

Supposing that rocks at a considerable depth, and therefore under great pressure, are hot enough to be melted, it does not follow that the pressure is the cause either of the high temperature or of the fusion. We must look for some other cause for that high temperature and fusion, and this can only be guessed at. But it probably arises from the earth having once been an incandescent body—a little sun—which is now gradually cooling.

I have been led to make these remarks because Mr. Starkie Gardner has referred to a publication of my own with greater approbation than it perhaps deserves; but at the same time he says that the views he has put forward in his article present some important differences from mine. I wish therefore to be allowed to say that what I have now mentioned, and the consequences which he has deduced from it, are the only important points in which I should disagree with him. O. Fisher

Harlton, Cambridge, August 13

THE canal which it is proposed to make, connecting the Mediterranean and Red Sea *viâ* the Dead Sea and Gulf of Akaba, will, if carried out, throw considerable light upon the theory discussed by Mr. J. Starkie Gardner in your issue of August 2 (p. 323). The low-lying area which this scheme would submerge occupies the greater part of the Jordan Valley, and extends some distance to the south of the Red Sea, where the depression is at least 1300 feet. If there is any truth in the theory which ascribes elevation and depression to the denudation of rock from one area and its accumulation upon another, the introduction of such an immense weight of water from the Gulf of Akaba into the Jordan Valley will cause considerable subsidence in its vicinity. To what extent this would be the case it is difficult to say, but even a slight subsidence would much facilitate the cutting of the Mediterranean end of the canal.

Derby, Mill Hill, August 4 R. MOUNTFORD DEELEY

"The Speke and Grant Zebra"

ABOUT four months ago I wrote Mr. Joseph Thomson, the explorer who was selected by the Royal Geographical Society to examine the snow-clad mountains in Eastern Africa, and I requested him to look out for the "Speke and Grant" zebra mentioned in NATURE of April 26 last by Sir Joseph Fayrer, and I have had the following reply from Mr. Thomson, dated Mombassa, June 6, 1883:—

"With regard to your two questions I am happy to say that I can give you satisfactory answers.

"Within the last month I have seen hundreds of zebras, and I have shot three—one female and two males. The ground colour is *white* and the legs are striped to the hoofs. Of these facts I am certain, but to make quite sure I shall take care to note their characteristics in detail on my return. I did not know it was a subject of dispute."

The subject of dispute referred to is that the French zoologist, M. Milne-Edwards named a zebra after the President of the Republic, *E. Grevyi*, which appears to be no other than the animal which we shot twelve of in 1860-63. J. A. GRANT

19, Upper Grosvenor Street, W., August 10

The Fisheries Exhibition

THE allusion that you made to the marine invertebrates in our department led one of your scientific readers immediately to examine them. He was surprised to find them properly arranged, classified, and named, with a few exceptions. All the alcoholic specimens were looking bright and beautiful. The specimens of the marvellous Alcyonarian of British Columbia, *Ostocella*, Gray, or *Verrillia Blakeii*, as it is called by those who have sent it, are in a state of perfect preservation. They are not so well accommodated as I could wish, owing to their great length, 6 or 7 feet; still they are to be seen very distinctly, doubled up in a glass jar, 3 feet 5 inches in height, filled with strong alcohol clear as water. The fine specimen of *Cryptochiton stelleri*, collected and contributed by His Excellency the Marquis of Lorne, was also found by your reader to be properly exhibited in a convenient glass jar, and labelled inside and out. The large and interesting collection of marine invertebrates exhibited by the Government of the Dominion of Canada is formed of collections contributed by the Museum of McGill College, Montreal, Laval University, Quebec, and from the Nova Scotia Provincial Museum. The collection of Edible Mollusca was made by the late John R. Willis, of Halifax, N.S.

Canadian Department, I.F.E., August 7 D. HONEYMAN Canadian Commissioner

Birds and Cholera

ALLOW me to relate an anecdote in point. I was with a regiment, to which at the time I belonged, in Mauritius, when that bright and beautiful isle was desolated by Asiatic cholera in the year 1854. It was the subject of common remark that during the prevalence of the epidemic the Indian Minah-bird or starlings—"martins" they used to be called in the island—abandoned, or seemed to abandon, the main barrack square and other open spaces they were wont to frequent in the neighbourhood of Port Louis, and were nowhere to be seen. These birds had been imported from India many years before, and were protected as destroyers of certain insect pests in the sugar-canes. They were correspondingly tame in their habits. Presently they betook themselves to the forest or Grand Bois, remaining in the centre of the little island; they could not have left by sea. They reappeared, or seemed to us to reappear, when the sickness passed away. Mauritius was then one of the stations where meteorological observations were systematically recorded. I rather think that the disappearance of the birds from the haunts of men during the epidemic and their reappearance when it ceased were duly noted by the Colonial Meteorologist, the late Col., then Lieut., A. B. Fyers, Royal Engineers, in his report. At any rate, I distinctly remember his noting another circumstance, viz. that the decline of the cholera mortality in the island, which was sudden and marked, was coincident with a marked change in the electric condition of the atmosphere at Port Louis, as indicated by the pith-ball electroscope.

I venture to suggest that the collection and investigation of trustworthy meteorological data during the prevalence of epidemics and of collateral information bearing thereupon has not yet received as much attention as it deserves from observers outside the medical profession. H. M. C.

August 10

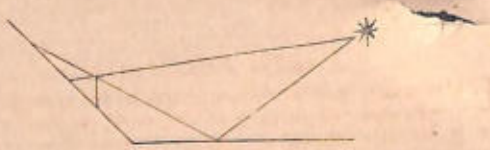
M. Wolf's New Apparatus

THE short abstract given in NATURE (p. 336) of the *Comptes rendus* for July 23, contains a mistake in respect to M. Wolf's paper "Sur un appareil à l'étude des mouvements du sol." It is stated that M. Wolf's apparatus involves the same principle as that by which my brother and I magnified the displacements of the vertical. This is not the case, since he uses an ingenious arrangement of reading by reflection from mercury. In the abstract in NATURE "sol" has been translated "sun" instead of "soil." G. H. DARWIN

Trinity College, Cambridge, August 9

Double Shadows

ONE cloudless evening lately, while walking on a hillside near the southern shore of Loch Etive, Argyllshire, facing the setting sun, I observed each member of our little company cast a double shadow on the upward slope of the hill; first, the usual complete, well defined shadow cast in clear sunshine; and second, a longer fainter shadow of the upper part of the figure, extending for some distance in the same line beyond the first. The explanation was not far to seek. The loch beneath us was perfectly calm, and reflected the sun's disk with dazzling brilliancy. The second shadow was evidently produced by the reflected rays, thus:—



The phenomenon must be of frequent occurrence, but I do not remember seeing it noticed. I should add it was only observable for a few yards at a particular part of the hillside; a little higher or a little lower it ceased to be visible—doubtless because in the one case the reflected rays fell short, and in the other passed overhead. D. B.

Glasgow, August 2

Regnard's Incandescent Lamp

HERR VON PETERSEN, the engineer of the Zoological Station in this town, recently having occasion to use a powerful light, took advantage of the apparatus described in NATURE (vol. xxvi. p. 108) under the name of Regnard's Incandescent Lamp. He used the apparatus figured and described in NATURE, but neither with air forced through petroleum or benzine, nor even with gas forced through the same liquids, could he raise the platinum wire cage to more than a dull red heat, and the flame was never more brilliant than an ordinary Bunsen burner. The experiments were repeated several times with slight variations, but always with the same result.

I have written this letter at the request of Herr von Petersen, as you do not generally publish communications in a foreign language. ARTHUR E. SHIPLEY

Stazione Zoologica Napoli, July 26

Disease of Potatoes

THE *Sclerotia* referred to by Mr. Worthington G. Smith (in NATURE, vol. xxviii. p. 299) as having destroyed the potatoes in Norway have been sent to me from two different places on our western coast. As I usually travel every summer, I had no opportunity of cultivating them myself; so I sent them to Prof. De Bary of Strasburg, who kindly informs me that he has cultivated them with success. They belong to *Peziza sclerotiorum* (Lib.). The spores of our Norwegian Peziza will produce *Sclerotia*, as he has proved by experiment, also in *Daucus carota*, and very likely in *Phaseolus* and some other plants.

Christiania, August 6 A. BLYTT

Determination of "*H*"

SINCE the publication of a method for the determination of the value of the horizontal component of the earth's magnetism by Mr. A. Gray in NATURE, vol. xxvii. p. 32, I have worked out the value of "*H*" for my laboratory here, and from six sets of experiments carried out during the month of March in a small building constructed free from iron near the laboratory, I find "*H*" to equal 0·18365. The method proposed by Mr. Gray was closely adhered to throughout the experiments.

Taunton, August 8 FREDERIC JOHN SMITH

Fireball

ABOUT 8.25 p.m. on the 11th inst. my attention was suddenly attracted in the direction of the window of my dining-room, which looks south, by a brilliant ball of fire of a deep amethyst colour. It was travelling across the clear blue sky at the rate of about twenty miles an hour in an easterly direction and at an angle of 45°. Before disappearing behind a cloud it seemed to throw a few particles of itself forwards at a greater speed than that at which it was travelling. I trust others saw it under more favourable circumstances, and that they will communicate their experience of its course to you. CHARLES F. CASELLA

The Lawns, Highgate, August 14

Palæolithic Implements at Stratford

ALLOW me to say that a few weeks ago I found an abraded ochreous *oval* Palæolithic implement at *Stratford* (*in situ* two feet from surface). I have shown it to Mr. W. G. Smith, who says it is very interesting, as implements are rare in that locality, and especially oval ones, and he thought it as well for me to communicate with you, as it may interest some of your readers.

49, Beech Street, E.C. G. F. LAWRENCE

EARTH PULSATIONS

FOR many years philosophers have speculated as to whether the surface of the earth is really so stable as it usually appears. With the sudden and violent motions of our soil which we call earthquakes man has been familiar since the earliest times, and the origin of these disturbances has always formed a fruitful source of speculation. With the help of properly constructed instruments, our knowledge of the nature of these movements has during the last few years been greatly extended, and we are brought to the conclusion that these natural vibrations are propagated through the surface of our earth in a manner very different to that which we should have anticipated from our knowledge of elastic solids. Another order of earth movements which, in the hands of Timoteo Bertelli of Florence, M. S. di Rossi of Rome, and other Italian investigators, have recently received considerable attention, are *Earth Tremors*. From observations carried on during the past ten years it would appear that the soil of Italy is practically in a perpetual state of vibration, even in districts far removed from volcanic centres. On account of the smallness in the amplitude of these motions they are only to be observed with the aid of specially constructed instruments. Messrs. George and Horace Darwin, in connection with their experiments on the disturbance of gravity caused by lunar attraction, have shown that these movements are common to the soil of Britain. Like observations have been made in Japan, and it does not seem improbable that after further experiments have been carried out we shall be brought to the conclusion that the surface of the whole globe is affected with similar microseismical disturbances.

In addition to these minute movements, which escape the attention of the ordinary observer on account of the smallness of their amplitude, theoretical investigation has shown that there may be existing in the soil on which we live movements which have escaped our attention on account of the slowness of their period. These motions for want of a better term I call *Earth Pulsations*. Mr. George Darwin in his last report to the British Association has shown that movements of that nature may be produced by barometrical variation. A rise of the barometer over an area is equivalent to loading that area with a weight, in consequence of which it is depressed. When the barometer falls, the load is removed from the area, which in virtue of its elasticity rises to its original position. This fall and rise of the ground completes a single pulsation.

On the assumption that the earth is extremely rigid, Mr. Darwin calculates that if the barometer rises an inch over an area like Australia, the load is sufficient to sink that continent two or three inches.

The tides which twice a day load our shores cause the land to rise and fall in a similar manner. On the shores of the Atlantic, Mr. Darwin has calculated that this rise and fall of the land may be as much as five inches. By these risings and fallings of the land the inclination of the surface is so altered that the stile of a plummet suspended from a rigid support ought not always to hang over the same spot. There would be a deflection of the vertical.

In short, calculation respecting the effects of loads of various descriptions which we know are by natural operations continually being placed upon and removed from the surface of various areas of the earth's surface, indicate that slow pulsatory movements of the earth's surface must be taking place, causing variations in inclination of one portion of the earth's crust relatively to another. That pulsatory motions of this description have repeatedly been observed it may be shown that there is but little doubt. The magnitude of these disturbances however is so great that we can hardly attribute their origin solely to the causes which have just been indicated. Rather than seeking an explanation from agencies exogenous to our earth we might perhaps with advantage appeal to the endogenous phenomena of our planet. When the barometer falls, which we have shown corresponds to an upward motion of the earth's crust, we know from the results of experiment that microseismic motions are particularly noticeable.

As a pictorial illustration of what this really means, we may imagine ourselves to be residing on the loosely fitting lid of a large cauldron, the relief of the external pressure over which increases the activity of its internal ebullition; the jars attendant on this ebullition are gradually propagated from their endogenous source to the exterior of our planet. This travelling outwards would take place much in the same way that the vibrations consequent to the rattle and jar of a large factory slowly spread themselves farther and farther from the point where they were produced.

Admitting an action of this description to take place, it would then follow that this extra liberation of gaseous material beneath the earth's crust would result in an increased upward pressure from within, and a tendency on the part of the earth's crust to elevation. If we accept this as an explanation of the increased activity of a tremor indicator, then such an instrument may be regarded as a barometer, measuring by its motions the variations in the internal pressure of our planet.

The relief of external pressure and the increase of the

internal pressure it will be observed both tend in the same direction, namely, to an elevation of the earth's crust.

This explanation of the increased activity of earth tremors which is I believe due to M. di Rossi, is here only advanced as a speculation—more probable perhaps than many others. We know how a mass of sulphur which has been fused in the presence of water, in a closed boiler, gives up in the form of steam the occluded moisture upon the relief of pressure. In a similar manner we see steam escaping from volcanic vents and cooling streams of lava. We also know how gas escapes from the pores and cavities in a seam of coal on the fall of the barometrical column. We also know that certain wells increase the height of their column under like conditions. The latter of these phenomena may be added to that which we have already mentioned, as a result consequent on diminution of atmospheric pressure, which, by its tendency to render an area of less weight, facilitates its rise.

The next question is as to whether we have any direct evidence of such heavings and sinkings in our earth's crust.

Although some of the proofs which are brought forward to show that slow pulsations like these are phenomena which have been repeatedly observed are unsatisfactory, taking them one with another they indicate that these pulsatory phenomena have a real existence.

Pendulums for instance which have been suspended for the purposes of seismometrical observations, have, both by observers in Italy and Japan, been seen to have moved a short distance out from and then back to their normal position.

This motion has simply taken place on one side of their central position, and is not due to a swing. The character of these records is such that we might imagine the soil on which the support of the pendulum had rested to have been slowly tilted and slowly lowered. They are the most marked on those pendulums provided with an index writing a record of its motions on a smoked glass plate, which index is so arranged that it gives a multiplied representation of the relative motion between it and the earth. As motions of this sort might be possibly due to the action of moisture in the soil tilting the support of the pendulum, and to a variety of other accidental causes, we cannot insist on them as being certain indications that there are slow tips in the soil, but for the present allow them to remain as possible proofs of such phenomena.

Evidences of displacements of the vertical which are more definite than the above are those made by Bertelli, Rossi, Count Malvasi, and other Italian observers, who, whilst recording earth tremors, have spent so much time in watching the vibrations of stiles of delicate pendulums by means of microscopes. As a result of these observations we are told that the point about which the stile of a pendulum oscillates is variable. These displacements take place in various azimuths, and they appear to be connected with changes of the barometer.

From this and from the fact that it is found that a number of different pendulums differently situated on the same area give similar evidence of these movements, it would hardly seem that this phenomena could be attributed to changes in temperature, moisture, and the like. M. S. di Rossi lays stress on this point, especially in connection with his microseismograph, where there are a number of pendulums of unequal length which give indications of a like character. The directions in which these tips of the soil take place, which phenomena are noticeable in seismic as well as microseismic motions, Rossi states are related to the direction of certain lines of faulting.

Bubbles of delicate levels when examined by a microscope change their position with meteorological variations, but Rossi also tells us that they change their position, sometimes not to return for a long time during a microseismic storm. Here again we have another phenomena pointing to the fact that microseismic disturbances are the companions of slow alterations in level.[1]

The more definite kinds of information which we have to bring forward, tending to prove the existence of earth pulsations too slow in period to be felt, are those which appear to be resultant phenomena of great earthquakes.

The phenomena that we are certain of in connection with earth vibrations, whether these vibrations are produced artificially by explosions of dynamite in bore holes, or whether they are produced naturally by earthquakes, are, firstly, that a disturbance as it dies out at a given point often shows in the diagrams obtained by seismographs a decrease in period; and secondly, a similar decrease in the period of the disturbance takes place as the disturbance spreads.

As examples of these actions I will refer to the diagrams which I have given in a paper on the "Systematic Observation of Earthquakes" in vol. iv. of the *Transactions of the Seismological Society of Japan*.

In a diagram of the disturbance of March 1, 1882, it seems that the vibrations at the commencement of the disturbance had a period of about 3 per second, near the middle of the disturbance the period is about 1·1, whilst near the end the period has decreased to ·46. That is to say, the back and forth motion of the ground at the commencement of the earthquake was six times as great as it was near the end, when to make one complete oscillation it took between two and three seconds. Probably the period became still less, but was not recorded owing to the insensibility of the instruments to such slow motions.

We have not yet the means of comparing together diagrams of two or more earthquakes, one having been taken near to the origin and the other at a distance. The only comparisons which I have been enabled to make have been those of diagrams taken of the same earthquake—one in Tokio and the other in Yokohama. As this base is only sixteen miles, and the earthquake may have originated at a distance of several hundreds of miles, comparisons like these can be of but little value.

The best diagrams to illustrate the point I wish to bring forward are those at the end of the paper just referred to. These are the results obtained at three stations in a straight line, but at different distances from the origin, of a disturbance produced by exploding a charge of dynamite in a bore hole. A simple inspection of the diagrams shows that at the near station the disturbance consisted of back and forth motions which, compared with the same disturbance as recorded at a more distant station, were very rapid. Further, by examining the diagram of the motions, say at the near station, it is clearly evident that the period of the back and forth motion rapidly decreased as the motion died out.

Then illustrations are given, as examples out of a large series of other records, all showing like results.

Although we must draw a distinction between earth waves and water waves, we yet see that in these points they present a striking likeness. Let us take, for example, any of the large earthquake waves which have originated off the coast of South America, and then radiated outwards, until they spread across the Pacific, to be recorded in Japan and other countries perhaps twenty-five hours afterwards, at a distance of nearly 9000 miles from their origin. Near this origin they appeared as walls of water, which were seen rapidly advancing towards the coast. These have been from 20 to 200 feet in height, and they succeeded each other at rapid intervals, until finally they died out as gentle waves. By the time these walls of water traversed the Pacific to, let us say, Japan, they

[1] Since my return to Japan in January, 1883, I may mention that I have commenced series of observations on earth tremors and earth pulsations, and on several occasions have observed very marked coincidences between barometrical depressions and these movements. Not only are these atmospheric changes accompanied with microseismic storms, but there are deflections in the stile of a pendulum, and changes in the position of the bulbs of delicate levels, which at such times can be seen with the naked eye to SURGE back and forth through a small range.

broadened out to a swell so flat that it could not be detected on the smoothest water excepting along shore lines, where the water rose and fell like the tide. Instead of a wall of water 60 feet in height we have long flat undulations perhaps 8 feet in height, but with a distance from crest to crest of more than 120 miles.

If we turn to the effects of large earthquakes as exhibited on the land, I think that we shall find records of phenomena which are only to be explained on the assumption of an action having taken place analogous to that which takes place so often in the ocean, or an action similar to that exhibited by small earthquakes and artificially produced disturbances if greatly exaggerated.

As a remarkable instance of such phenomena we may take the great earthquake of Lisbon on November 1, 1755. In Spain, Northern Italy, the South of France and Germany, Northern Africa, Madeira and other Atlantic Islands, the effects of the disturbance which created so much devastation in Portugal were also more or less severely felt as violent movements of the soil.

In other countries further distant, as, for instance, Great Britain, Holland, Norway and Sweden, and North America, although the records are numerous, the only phenomena which were particularly observed were the slow oscillations of the waters in lakes, ponds, canals, &c. In some instances the observers especially remarked that *there was no motion in the soil.*

Pebbly Dam in Derbyshire, which is a large body of water covering some 30 acres, commenced to oscillate as a strong current from the south.

A canal near Godalming flowed 8 feet over the walk on the north side.

Coniston Water in Cumberland, which is about five miles long, oscillated for about five minutes, rising a yard up its shores. Near Durham a pond 40 yards long and 10 yards broad rose and fell about 1 foot for six or seven minutes. There were four or five ebbs and flows per minute.

Loch Lomond rose and fell through about 2½ feet every five minutes, and all other lochs in Scotland seem to have been similarly agitated.

At Shirbrun Castle in Oxfordshire, where the water in some moats and ponds was very carefully observed, it was noticed that the floods began gently, the velocity then increased, till at last with great impetuosity they reached their full height. Here the water remained for a little while, until the ebb commenced, at first gently but finally with great rapidity. At two extremities of a moat about 100 yards long it was found that the sinkings and risings were almost simultaneous. The motions in a pond a short distance from the moat were also observed, and it was found that the risings and sinkings of the two did not agree.

During these motions there were several maxima.

These few examples of the motions of waters without any record of the motions of the ground at the time of the Lisbon earthquake must be taken as examples of a very large number of similar observations of which we have detailed accounts.

Like agitations it must also be remembered were perceived in North America and in Scandinavia, and if the lakes of other distant countries had been provided with sufficiently delicate apparatus, it is not unlikely that like disturbances would have been recorded.

The only explanation for these phenomena appears to be that the short quick vibrations which had ruined so many cities in Portugal had by the time that they had radiated to distant countries gradually become changed into long flat waves having a period of perhaps several minutes, and in countries like England these pulse-like movements were too gentle to be perceived excepting in the effects produced by tipping up the beds of lakes and ponds.

The phenomenon was not unlike that of a swell produced by a distant storm.

At Amsterdam and other towns chandeliers in churches were observed to swing. At Haarlem floods rose over the sides of tubs, and it is expressly mentioned that no motion was perceived in the ground.

At the Hague a tallow chandler was surprised at the clashing noise made by his candles, and this the more so because no motion was felt under foot.

At Toplitz the pulsation of the ground appears to have manifested itself in effects upon the springs. The flow of the principal spring was greatly increased. Before this increase it became turbid, and at one time stopped. Subsequently it became clear, and flowed as usual, but the water was hotter and more strongly mineralised.

At one or two places, as, for instance, in Britain, slight earthquakes were experienced. These, however, were local, and in every probability were secondary disturbances produced by the pulsations causing ground in a critical state to give way.

In this earthquake I think, then, that we have a clear case of the production of pulsations in the soil that were too slow to be felt by ordinary observers.

Motions like these might be called slow earthquakes, and it does not seem unlikely that they are the resultants of all large disturbances. When they accompany a large earthquake like that of Lisbon, their cause is evident. But when we see the waters of lakes and ponds oscillating, the bulbs of levels disturbed, and the plummet line of pendulums displaced, the reason of these phenomena are not so apparent. It would seem possible that in some cases pulsations producing these phenomena might have their origin beneath the oceans, or deep down beneath the earth's crust. Perhaps, instead of commencing with the snap and jar of an earthquake, they may commence as a heaving or sinking of a considerable area, which may be regarded as an uncompleted effort in the establishment of an earthquake or a volcano. The very fact that we know that volcanoes rising from deep oceans have in the first instance forced their way against a pressure of at least three or four tons to the square inch, indicates to us the existence of internal pressures tending to raise the crust of the earth, which pressures are infinitely greater than any of the pressures which we have upon the surface of our earth produced by tides and variations in the barometrical column. If we follow the views of Mr. Mallet in considering that the pressures exerted on the crust of our earth may in volcanic regions be roughly estimated by the height of a column of lava in the volcanoes of such districts, we see that in the neighbourhood of a volcano like Cotopaxi the upward pressures must have been many times greater than the pressures already mentioned—sea level being taken as the line of hydrostatic equilibrium. The chief point, however, is that beneath the crust of our earth enormous pressures exist tending to cause eruption; and farther, that these are variable. Before a volcano bursts forth we should expect that there would be in its vicinity an upward bulging of the crust, and after its formation a fall. Farther, it is not difficult to conjecture other possible means by which such pressures may obtain relief.

Should these pressures then find relief without rupturing the surface, it is not difficult to imagine them as the originators of vast pulsations which may be recorded on the surface of the earth as wave like motions of slow period similar to the motions in the outer area of a tract disturbed by a destructive earthquake.

That slow, undulatory motions or changes in the vertical do occur in the crust of the earth, whatever may be their origin, we have numerous phenomena which certainly admit of explanation on such an assumption.

In Switzerland from time to time we hear of oscillations in the waters of lakes known under the name of *Rhussen* and *Seiches*. These, it may be remarked, are common to the lakes and inland seas of many countries.

Other examples of what may have been a slow oscil-

lating motion of the earth's crust are referred to by Mr. George Darwin in his Report to the British Association in 1882. One of them was made by M. Magnus Nyrén at Pulkova, who, when engaged in levelling the axis of a telescope, observed spontaneous oscillations in the bulb of the level.

This was on May 10 (April 28), 1877. The complete period was about twenty seconds, the amplitude being 1".5 and 2". One hour and fourteen minutes before this he observes that there had been a severe earthquake at Iquique, the distance to which in a straight line was 10,600 kilometres, and on an arc of a great circle 12,500 kilometres.

On September 20 (8) in 1867 Mr. Wagner had observed at Pulkova oscillations of 3", seven minutes before which there had been an earthquake at Malta.

On April 4 (March 23), 1868, an agitation of the level had been observed by M. Gromadzki, five minutes before which there had been an earthquake in Turkestan.

Similar observations had been made twice before. These, however, had not been connected with any earthquakes, at least—Mr. Darwin remarks—with certainty.

Like phenomena are mentioned by M. S. di Rossi, in his "Meteorologica Endogena."

Thus on March 20, 1881, at 9 p.m., a watchmaker in Buenos Ayres observed that all his clocks oscillating north and south suddenly began to increase their amplitude, until some of them became twice as great as before. Similar observations were made in all the other shops. No motion of the earth was detected. Subsequently it was learnt that this corresponded with an earthquake in Santiago and Mendoza.

Another remarkable example illustrating the like phenomena are the observations which were made on December 21, 1860, by means of a barometer in San Francisco, which oscillated, with periods of rest, for half an hour. No shock was felt, nor is it likely that it was a local accident, as it could not be produced artificially. On the following day, however, a violent earthquake was experienced at Santiago.

This brings me to the end of the few important illustrations of the phenomena of earth pulsations which I have at my disposal. With a little trouble I have no doubt that these might be greatly multiplied. As they stand, however, I think that they are quite sufficient to convince us of the existence of phenomena which hitherto have been almost entirely overlooked. That disturbances of the vertical are from time to time produced by long pulse-like waves can, with these examples before us, hardly be doubted. It must, however, be noted that they are of a different order to those phenomena which were so carefully sought for by the Darwins at Cambridge.

JOHN MILNE

Tokio, Japan

ON THE SUPPOSED HUMAN FOOTPRINTS RECENTLY FOUND IN NEVADA[1]

DURING the past summer various accounts have been published of the discovery of human footprints in sandstone near Carson, Nevada. The locality is in the yard of the State prison, and the tracks were uncovered in quarrying stone for building purposes. Many different kinds of tracks were found, some of which were made by an animal allied to the elephant; some resembled those of the horse and the deer; others were apparently made by a wolf. There were also tracks made by large birds.

The footprints occur in series, and are all nearly in the same horizon. Some of the smaller tracks are sharp and distinct, but most of the impressions are indefinite in outline, owing apparently to the fact that the exact surface on which they were made is not usually exposed.

[1] Abstract of a paper read before the National Academy of Sciences, at New York, November 17, 1882.

The supposed human footprints are in six series, each with alternate right and left tracks. The stride is from two and a half to over three feet in extent. The individual footprints are from eighteen to twenty inches in length, and about eight inches wide. The distance between the line of right-hand and left-hand tracks, or the straddle, is eighteen to nineteen inches.

The form and general appearance of the supposed human tracks is shown in Fig. 2, which is a reduced copy of one of the impressions represented by Dr. W. H. Harkness, in his paper before the California Academy of Sciences, August 7, 1882. The shaded portion was restored by him from other footprints of the series. A

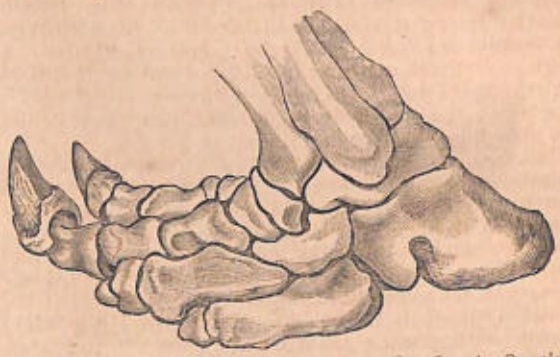


FIG. 1.—Left hind foot of *Mylodon robustus* (after Owen). One-sixth natural size.

copy of this impression was given also by Prof. Joseph Le Conte, in his paper before the same Society, August 27, 1882.

The size of these footprints, and especially the width between the right and left series, are strong evidence that they were not made by men, as has been so generally supposed.

A more probable explanation is that the impressions are the tracks of a large sloth, either *Mylodon* or *Morotherium*, remains of which have been found in essentially the same horizon. In support of this view it may be said that the footprints are almost exactly what these animals would make if the hind feet covered the impressions of

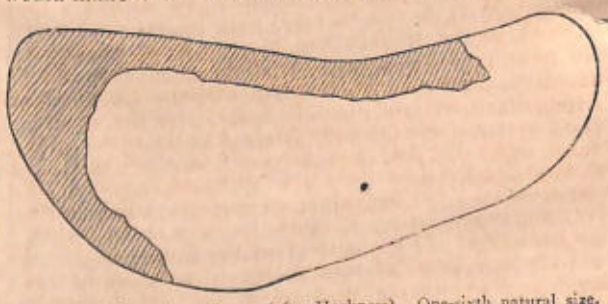


FIG. 2.—Left footprint at Carson (after Harkness). One-sixth natural size.

those in front. In size, in stride, and in width between the right and left series of impressions, the footprints agree closely with what we should expect *Mylodon* or *Morotherium* to make. In Fig. 1 the bones of the left hind foot of a species of *Mylodon* are represented, the figure being reduced to the same scale as the accompanying cut, Fig. 2, of one of the supposed human footprints.

The geological horizon of these interesting footprints is near the junction of the Pliocene and Quaternary. The evidence, at present, appears to point to the Equus beds of the upper Pliocene as the nearest equivalent.

Since the above communication was read, the writer has had an opportunity of examining photographs and casts of the Carson footprints, and is confirmed in his opinion that the supposed human tracks were made by large

Edentates. The important fact has recently been determined that some of these tracks show impressions of the fore feet. The latter are somewhat outside of the large footprints, as would naturally be the case if the animal changed its course. O. C. MARSH

WINTER LIFE AT FORT RAE

It was not until the beginning of December that our winter really set in, but when it did so there was no mistake about it, as the 1st of the month began with the thermometer at −34°, and except for some mild weather at Christmas, the cold continued through that month. January was colder still, the thermometer once or twice approaching −50°, but in the early part of February a violent storm was accompanied by a remarkable rise of temperature (to +20°), and followed by some mild weather, since which the thermometer has again fallen, reaching −39° a couple of days ago.

This, however, I am informed by the inhabitants, is the mildest winter that has been known for many years, and I have no doubt that a temperature of −60° is not uncommon in severe winters.

It is strange how much less one feels this extreme cold than might be imagined. For the first day or two it was unpleasant, but after that the system seemed to accommodate itself to it, so that a day when the temperature was anywhere above −15° felt quite warm and pleasant. To-day, for instance, I am writing with my window open, although the thermometer is several degrees below zero, and there is a light breeze. There have been days, it is true, when—with the thermometer near −30°, and a strong breeze blowing, filling the air with snowdrift like a dense fog—outdoor exercise was most unpleasant, probably resulting in a frozen face, but such days were not very numerous, a strong wind, even from the cold quarter (the north-west), sending the temperature up in a way that I cannot quite account for.

Now the climate reminds me of Davos Platz, the sun having considerable power; there is, however, more wind. Yesterday the black bulb *in vacuo* read 82°. The only drawback is the intense glare from the snow, which makes coloured spectacles a necessity.

During the first part of the winter we were a little anxious about food, not that we were in any danger of starvation, as the Indians had brought in quantities of dried meat in the autumn, but dried meat is a most unpalatable article of diet, and requires strong teeth and a strong digestion; and then the fishery was not as productive as usual, and the daily produce of the nets (which are set under the ice) was gradually diminishing. At last, however, the deer made their appearance some forty miles from this, and since then our supplies of fresh meat have come in regularly. Rabbits, too, have lately become most numerous. These animals are the great resource of the Indians in times of scarcity, but they are not always plentiful. They are said to attain their maximum once in ten years, when they seem to suffer from a disease which shows itself in lumps on their heads; the following year there is hardly a rabbit to be seen, and then they gradually increase for another ten years.

The winter has passed very uneventfully. On November 17 and two or three following days there were magnetic disturbances of great violence, due, no doubt, to the large sunspot. The displays of aurora at that time, however, were not of any remarkable brilliancy; we have had far brighter ones since, with far less magnetic disturbance. But as a rule the auroras have not been remarkable, though a night seldom or never passes without more or less—the brilliant coloured ones one reads about are conspicuous by their absence. For the most part they are all of the same yellowish colour, showing the single characteristic bright line in the spectroscope, but a bright aurora usually shows more or less prismatic colouring along the lower edge, with a spectrum sometimes of one or two additional bright lines, as a rule towards the violet end of the spectrum, though on one occasion I observed a bright band in the red.

Aurora is very rarely seen until night has quite set in, but on three occasions we have seen it shortly after sunset, and on these occasions it was of a reddish or copper colour, as though partly coloured by the sun's light; it must, I think, have been associated with thin cloud. Its motion and shape showed it to be aurora.

The terrestrial radiation thermometer placed on the snow generally showed a depression of from 10° to 20° on every calm, clear day throughout the winter, even by day when sheltered from the sun. The lowest readings were, as might be expected, with the dry north-west wind. Sometimes the first warning of an impending change of wind to the south-east was given by a rise of this thermometer before the barometer was affected.

A thermometer suspended on the outer wall of the observatory at times read 9° or 10° lower than one in the screen, owing to radiation, and I think that the common practice of exposing unsheltered thermometers may explain some of the low temperatures sometimes reported from this country.

Our daily routine of observations goes on very regularly. Lately wolves have taken to prowling about the neighbourhood, and the observer on duty goes to visit the thermometers armed with a huge club; of course a gun or axe cannot be allowed near the observatory on account of the magnetic instruments.

A remarkable epidemic of influenza made its appearance here in January. We first heard of it among the Indians far to the north-west of this. When it arrived here it attacked every soul in the place—Indians and whites—fortunately in a very mild form, and we hear that Fort Simpson, on the Mackenzie, suffered in the same way. Such an occurrence is most unusual in this country. With this exception we have all enjoyed good health.

We expect the ice to break up about the middle of June, and then will come the reign of the mosquitoes, which make the summer the most disagreeable season of the year in this country. Fortunately they do not last long in this latitude, and by the end of August, when we set out on our homeward journey, they will be over.

Fort Rae, March 25 HENRY P. DAWSON

THE NORWEGIAN NORTH-SEA EXPEDITION[1]

II.

DR. MOHN continues his description of Jan Mayen Island as follows:—

"The northern part of Jan Mayen is larger and more elevated than the southern. From its central tract towers the monarch of the island, Mount Beerenberg, an extinct volcano, rising in regal majesty to the height of 6400 feet. The crater measures 4360 feet in diameter. The upper cone, which shelves at an angle of 42° and attains an altitude of about 2000 feet, would, to judge from the black spots so conspicuous on its western declivity, appear to be composed of ashes. The base supporting the cone slopes out in every direction at an angle of from 8 to 10 degrees, and this incline is retained towards the north and east to a depth of at least 1000 fathoms beneath the sea-level. The edge of the crater has a jagged appearance, and the loftiest peak lies on the west side of the mountain. Towards the north the wall of the crater has partially given way down to a height of from 600 to 700 feet. The depression thus formed extends northwards towards the north coast of the island, bounded on either side by diverging mountain ridges, that here and there project ledge-like one above the other. This is Beeren-

[1] Concluded from p. 350

berg's *val del bove*, which constitutes the snow-field for the largest of its glaciers, that jut out from the north side of the mountain. On the east side, too, are seen prominent ribs, all of which intersect the nevés of the east side; towards the south and west, however, the surface of the outer cone would appear to be remarkably smooth, at the edge of the crater only being furrowed with shallow depressions between the jags. The base of Mount Beerenberg shelves towards the west, south-west, and north-east, with a comparatively gentle incline, either to the water's edge or the low-lying shore; towards the north and east, however, the descent at the coast is very abrupt, exhibiting precipices 1000 feet high. In several places the base of the mountain is intersected by deep ravines, through which the glaciers find a passage to the sea.

"The height of the southern part of the island cannot be compared to that of the northern. The southern land constitutes a wide plateau, which, in a south-easterly and southerly direction, exhibits numerous precipices along the coast, but, towards the north-west, has extending before it a low-lying foreland, less than 300 feet above the sea. The height of the plateau I estimated at 1000 feet. Rising above this tableland are seen several summits; the loftiest, which has apparently a conical form, and may therefore be of eruptive origin, can hardly attain an altitude of 1600 feet above the sea-level.

"The low middle tract of the island, which is built up of compact masses of lava, and bears numerous eruptive craters, has at its lowest point an elevation of only 200 feet, or perhaps even less, whereas the crater summits reach a height of 400 to 600 feet. The altitude of Fugleberg we found by observation to be 490 feet; that of Egg Island was estimated at 400 to 500 feet.

FIG. 4.

"As shown by Carl Vogt, the base of Mount Beerenberg is composed partly of layers of lava, and partly of layers of tuff, that would appear to have flowed or been discharged from the great central crater previous to the formation of the upper cone of ashes. The middle tract of the island exhibits a similar structure, and, to judge from its appearance, also the southern part. Above this stupendous mass of lava rise a number of small parasitic craters, the greater part of which have retained a conical form. Such, for instance, are Sars's crater, the crater east of the southern glacier, the Esk and Vogt craters, Danielssen's and Blytt's craters, and the craters in the vicinity of Guinea Bay. Fugleberg on the west coast, and Egg Island on the east, are no longer conical, the outer edge of the crater having given way and fallen into the sea. Some of the parasitic craters are built up of lava, and would appear to have sent forth considerable currents, as the Vogt and Esk craters; the summit of others consists of loose erupted masses, cinders, and ashes (rapilli), as the craters in the vicinity of Mary Muss Bay and Guinea Bay; others are composed of layers of tuff, tuff-conglomerate, and compact masses of lava, as the Fugleberg, and others again of ashes alone, as Egg Island and the Berna crater.

"The chief volcanic fissure in which Jan Mayen Island is built must obviously extend in the longitudinal direction of the land, parallel to the volcanic line of Mount Hecla. Meanwhile, the grouping of the parasitic craters would seem to intimate the existence of transverse fissures running from W.N.W. to E.S.E.; for in that direction there are, apparently, several rows of parasitic craters, as the Esk, Vogt, Berna, the Fugleberg, and Egg Island, Hoyberg, and the crater in the vicinity of the 'pilot-boat' (?). Must we regard it as mere accident that each of the terminal craters towards the south-east in the two first rows should have discharged ashes alone?

"Jan Mayen has no valleys of considerable extent; the

large ravines in the northern part of the island are filled with glaciers, and the southern land would appear to be but little intersected by vales or ravines. Of brooks or rivulets very few have been observed. A characteristic feature, distinguishing the coast of Jan Mayen, are the fantastic-shaped rocks that in many places rise abruptly from the sea, of which we have mentioned several. They are no doubt in greater part fragments of lava detached from currents that had flowed into the sea.

"The coasts of Jan Mayen are, as previously stated, in many places lofty and precipitous. In some localities, however, there is a low expanse of foreshore consisting of lava, partially covered with sand. This foreshore, which is separately marked on the map, lies so low in places as

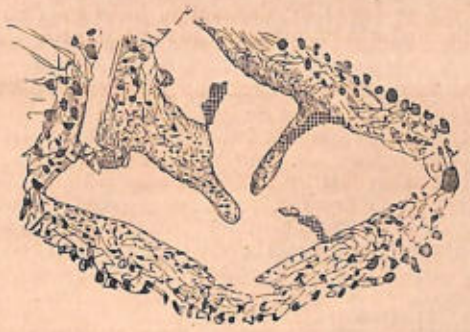


FIG. 5.

to be covered with driftwood. Some localities, too, exhibit a low sandy beach, bestrewn with large quantities of driftwood, the jaws and vertebræ of whales, bits of wreck, and seaweed.

"Nowhere on the shores of Jan Mayen has a harbour been found that could afford a ship or a boat shelter in all kinds of weather.[1] Hence, to land is possible only with the sea comparatively smooth, which it rarely is, save when drift-ice encompasses the island. Specially noteworthy are the two lagoons, cut off from the sea by barriers of black sand, only a few feet high and a couple of hundred paces broad. They both contain fresh water, the surface of which lies but very little above that of the sea. The lagoon on the west side of the island is deep enough to afford a good harbour were the barrier cut

FIG. 6.

through to a sufficient depth. The lagoon on the east side is comparatively shallow.

"Jan Mayen lies wholly within the Greenland Arctic current. At a depth of from 10 to 20 fathoms the temperature of the sea is all the year round below zero. In the winter there is frequently open water off the coasts of Jan Mayen, sealers often passing to the west of the island. The summer is naturally cold, from the presence of ice-cold water so near the surface of the sea. The northern part of Jan Mayen rises, at a height of about 2300 feet, into the region of perpetual frost. The upper cone of Mount Beerenberg is snow-capped, save on the steepest parts of its declivity, where the black mountain-wall is seen protruding. The base of Beerenberg is girt with a belt of snow, from which prodigious glaciers take their origin, nine of the largest reaching down to the water's edge. The southern part of the island would not appear to be glaciated. Large patches of snow are everywhere observed throughout the summer in the vicinity of the sea.

"Jan Mayen has but a meagre flora. Bright herbage, however, is not wanting; the green carpet of moss, in places of considerable extent, forms a striking and pleasant contrast to the black, brown, and red of the surrounding rocks. The plants collected by Dr. Danielssen

FIG. 7.

on the isthmus south of Mary Muss Bay, are, according to Prof. A. Blytt, as follows:—

"*Saxifraga cæspitosa*, L.
" *nivalis*, L.
" *oppositifolia*, L.
" *rivularis*, L.
Ranunculus glacialis, L.
Halianthus peploides, Fr.
Cerastium alpinum, L.?
Draba corymbosa, R. Br.
Cochlearia officinalis, L.
Oxyria digyna, Campd.
Catabrosa algida, Fr.

FIG. 8.

"Of mammiferous animals, the Polar Fox, *Canis lagopus*, is by no means rare on Jan Mayen. Of birds, Mr. Friele has noted the following species:—

"*Somateria mollissima*, Leach.—Rare.
Larus glaucus, Brün.—Common.
Fulmarus glacialis, Lin.—Exceedingly abundant.
Grylle Mandti, Licht.—Abundant.
Uria aara, Schlegel.—Abundant.
Mergulus alle, Lin.—Abundant.
Tringa maritima?

"If the land fauna of the island is meagre, that of the sea is proportionately rich, a fact which the numerous zoological memoirs published in this General Report will sufficiently attest."

[1] Little Sand Bay would appear, according to the account in the "Zeespiegel," to be a good harbour for boats, protected as it is by an outlying chain of islets.

Fig. 4 again shows the island in its winter garb, and is from a drawing made by Lieut. Ring, R.N., when commanding the sealer *Capella*.

"We have Sars's crater, on the slope shelving towards Cape North-East; we see, too, the great glaciers on the north side, also Cape North-West and Muyen's Cross Cape, in a line with the point of view; and the low tract of the island, with the heights of the southern part, are boldly defined in the picture. The crater of Beerenberg, with its sunken edge on the north side, is also seen, and lower down a huge, cauldron-shaped depression, from which the great northern glaciers take their origin."

Some very interesting mineralogical specimens were brought from Jan Mayen, on which Mr. H. Reusch, of the Norwegian Geological Survey, reports. We reproduce illustrations of four specimens of olivine in basalt.

In Fig. 5 the surrounding rock exhibits a remarkably fine granulation in immediate proximity to the crystals, which it pierces in sac-like ramifications. In Fig. 6 discoloured glass is seen piercing the crystal from the surrounding rock, which has a fine granulation. In Fig. 7 the surrounding base is finely granulated. At the top of the figure is seen basalt of the dominant degree of granulation. Discoloured glass pierces the crystal from the rock surrounding it. In Fig. 8 the iron ore occurring as rod-shaped corpuscles has a definite position towards the crystal of olivine.—Magnified 360 diameters.

Dr. Mohn concludes his instructive account of the geography of this fruitful expedition by some brief observations on Bear Island and Spitzbergen, at various points of which the *Voringen* touched.

SCIENCE AT CAMBRIDGE

WE understand that Dr. M. Foster, who, upon his appointment as Professor of Physiology at Cambridge, ceased to be Prælector at Trinity College, addressed to the Master of Trinity the following letter, which perhaps may interest those of our readers who are not acquainted with the peculiar organisation of our old Universities.

Shelford, Cambridge, July 28, 1883

MY DEAR MASTER,—The University having done me the honour to appoint me to the newly established Chair of Physiology, my connection with the College as Prælector comes to an end, though I rejoice that I am still counted among the Fellows of the Society. I cannot let this opportunity pass without making some attempt to thank you, and through you the College, for all you have done for me during the thirteen years of my Prælectorship. You called me, a comparatively unknown young man, to the College in 1870; you not only at once gave me leave to follow out my own views as to what I ought to do, but from that time onward have constantly supported me, not simply with cordial approbation, but also with most material assistance.

I have reason to believe that many persons not conversant with the organisation and working of the University, are under the impression that the necessary expenses which my work has entailed have been provided out of University funds. But I am sure that the authorities of the University would be the last to wish that anything done by the College should be considered as done by the University. And as a matter of fact, when I say that I was allowed the use for four years of one room, and for ten years of two rooms, in the University buildings, and that during the last three years I have enjoyed the advantages of the admirable laboratory which has been built for me, with use of gas and water, I have mentioned all that I have received from the University, with the exception of grant of microscopes to the late Prof. Balfour and myself in common. Not only my own remuneration has come from the College, but all the really large expenditure involved in my teaching physiology, save what has been met by the fees of the students, has been provided for in one way or another by the College.

At the outset the College gave me a large grant of money for apparatus, and some years afterwards a second smaller grant. During the whole thirteen years I have received from the College an annual sum for the payment of my laboratory servants; and for several years past two demonstrators (one at a comparatively high salary), as well as during the past year three assistant demonstrators, have been paid partly from the tuition fund of the College, partly by funds which, though furnished by private liberality, cannot be wholly dissociated from the College. I think I may fairly say that I have never asked anything of you in vain. I might add that what you have done for me did not prevent you from also assisting our lamented Balfour, working in a closely allied branch of science, or, upon his sad death, from affording material help in carrying on the work which he left behind through aid given to Mr. Adam Sedgwick.

Let me assure you that I fully appreciate all the College has done for me; but perhaps after all I feel still more keenly the sympathy and kindness with which as a stranger I was first received among you, and which have made the thirteen years of my Prælectorship the brightest as well as the best years of my life.

Yours ever truly,
M. FOSTER

THE ISCHIA EARTHQUAKE

A SLIGHT shock of earthquake occurred in Casamicciola at seven o'clock on Sunday morning, at the Gurgitello, where that of July 28 created the most ruin, but it was limited to that spot, and caused no damage. It is reported that a fissure a kilometre in length and thirty kilometres in depth has opened on the south-west flank of Mount Epomeo. The smoke ejected from the *fumaroli* at the summit of the mountain has considerably diminished in quantity. The Naples Academy of Sciences has appointed a Commission to investigate the telluric conditions of Ischia.

The following communication from the *Times* correspondent at Rome is important:—

"From a second report made by Prof. Michele Stefano di Rossi, head of the Central Geodynamic Observatory at Rome, to the Minister of Agriculture, on the phenomena connected with the earthquake in Ischia, it appears that not only were there for some days beforehand very distinct premonitory signs at Casamicciola of the impending catastrophe, but that throughout the peninsula forewarnings, identical in character, were numerous and widespread. On the island of Ischia there was an extraordinary increase in the temperature of the thermal waters and in the violence of the *fumaroli* (*i.e.* the natural smoke funnels) at the spot called Monte Cito. These phenomena were noticed eight days before the catastrophe occurred. On these important points the evidence which Prof. di Rossi obtained is abundant. There is less conclusive testimony concerning the shrinking and consequent scarcity of the drinking water in the wells. But he has absolutely certified that, commencing from a period a fortnight anterior to July 28, many slight shocks of earthquake, of almost daily recurrence, were felt, and subterranean rumblings were heard. Phenomena identical with these preceded the earthquakes in Ischia in 1828, 1851, and 1881; and Prof. di Rossi emphatically states that had an observatory been established in Ischia after the earthquake of 1881, according to the advice he then gave, and the phenomena which manifested themselves at Casamicciola from July 20 onwards been communicated to him at the Central Observatory in Rome, he would not have hesitated an instant in pointing out the imminent danger of an impending

seismic disturbance. While the above-mentioned phenomena were occurring in Ischia, without their being communicated to Rome, or even, for want of means, properly noted on the spot, the existence of unusual subterranean activity was simultaneously marked by the instruments in all the observatories on the mainland. That activity, though varying in intensity in different places, manifested a general and regularly progressive augmentation. Slight shocks of earthquake were felt at various points. On July 25 the Solfatara of Albano, on the extinct Latin volcanoes on the southern side of the Roman Campagna, sent forth sounds never before remarked. On the same day a widely extended earthquake, reaching from Cosenza to Catanzaro, occurred in Calabria. On Friday, the 27th, the hissing noises from the Solfatara of Albano were so acute that the people did not dare to draw the sulphur water for those who needed it, and simultaneously the seismic instruments at Pesaro registered severe oscillations. At Vesuvius on the evening of Friday, the 27th, shocks were felt, with an augmentation of activity. There were shocks at Latera, upon the Ciminian volcanoes, and shocks at Perugia. On the afternoon of the 28th renewed activity was manifested at Pesaro and at Fermo; and in short the observations during that afternoon of general calm throughout the peninsula gave indications of a vast subterranean disturbance, extending as far as all Umbria, the district of Viterbo, and the Marches.

"The direction of these extended movements was everywhere identical with those at Casamicciola—namely, from north to south, and from east to west. At the same time also, on the morning of the 28th, the flow from the principal source of the sulphur streams, near Tivoli, showed a considerable diminution; while simultaneously an increased quantity of carbonic acid gas was given forth. The regular observations at Bologna, at Pisanello, near Piacenza, and at Rome, showed that there was a distinct lowering in the levels of the wells before July 28, and as marked a rise after that date. These facts confer increased credibility on the imperfect evidence of there having been a deficiency of water in the wells at Casamicciola. Moreover, on the morning of Sunday, the 29th, the usually very cold waters of the Solfatara of Albano were in a boiling state. The intimate connection between these phenomena on the peninsula and the catastrophe in Ischia is more than evident, and their distinct dynamic and volcanic character absolutely excludes the idea of a mere local sinking in the level."

NOTES

TELEGRAMS from Drontheim to Vienna announce that the members of the Austrian expedition to Jan Mayen have arrived there safe and well, after an absence of six months. This was one of the circumpolar observing parties, and during the year's residence on Jan Mayen neither officers nor men suffered from scurvy or other disease. The chief of the expedition telegraphs to the Geographical Society of Vienna that they have made "perfect observations, rich collections, and taken geodetic and photographic views of the island."

DURING the coming year, we learn from *Science*, experiments will be made at the physical laboratory of Johns Hopkins University with a view to aid in establishing an international unit of electrical resistance. The experiments will be carried on under the direction of Prof. Rowland, with an appropriation from the Government of the United States. The results will be communicated to the International Commission of Electricians meeting in Paris.

DR. ROBERT MOFFAT, the famous African missionary, has died at the advanced age of eighty-seven years. He was among the first to show the way to Central South Africa, and added not a little to our knowledge of the Bechuanas and other tribes south of the Zambesi. He was Livingstone's father-in-law, and the special direction of the great missionary-traveller's African work was to a considerable extent due to Moffat's example and advice.

THE Ninth Annual Conference of the Cryptogamic Society of Scotland will be held at Dumfries on September 11, 12, and 13. Fellows who purpose attending the Conference are requested to communicate with the local Secretary, Mr. J. Rutherford, Jardington, Dumfries.

THE statue of the brothers Montgolfier was unveiled at Annonay on Monday, as part of the ceremonies commemorative of the centenary of the inventors of balloons. M. de Fonvielle writes to us from Annonay, August 12: "This celebration has been organised merely by private exertions in continuation of the banquet given by the Académie d'Aërostation of Paris on November, 1882, to commemorate the centenary of the first private experiment tried by Joseph Montgolfier at Avignon in his rooms. A local committee was formed in Annonay under the presidency of M. Séguin, the eldest son of Marc Séguin, Member of the Institute, a nephew of the Montgolfier to whom is attributed the creation in France of tubular boilers and metallic bridges. M. Henry Vidon of Annonay was appointed general secretary. The exertions of the Committee were very successful, and about 4000*l.* were collected, principally in the immediate vicinity of Annonay and at Paris; foreign subscriptions were very few. It was decided to erect on the Place des Cordeliers, where the first experiment took place on June 5, 1783, a statue representing the two brothers inventing the 'Montgolfière.' The plaster cast has been executed, and will be inaugurated to-morrow before a large audience. The ceremony will begin at two o'clock with a speech delivered by M. Séguin, after which a small Montgolfière will be sent up from the exact spot where the first experiment took place. On Saturday an aëronautical ascent was made from the Champs de Mars with a small balloon of 3000 cubic feet, the largest that the gas establishment could fill without inconvenience."

IN the just published parts 4 and 5 of his "Abbildungen von Vogelskelettes," Dr. Meyer, of Dresden, proves that the Notornis from the South Island of New Zealand belongs to a different species from that from the North Island—*Notornis mantelli*—and he names the former *N. hochstetteri*. It is known that Prof. Owen founded on some fragments of the skull and the bones from the North Island in the year 1848 the genus Notornis, and that he called the species, without then knowing a skin, *N. mantelli*, after the discoverer. The two skins, which were figured by John Gould in the years 1850 and 1869, and which now adorn the galleries of the British Museum, came from the South Island, and were identified with the bones from the North Island. The Dresden Museum having acquired the skin and skeleton of a specimen of Notornis hunted in the year 1879 on the South Island—all three specimens were procured from within a range of ninety miles—Dr. Meyer compared his skeleton with Prof. Owen's life-size figures in the *Transactions of the Zoological Society*, and found them to be different, which fact is not to be wondered at, as New Zealand has proved to be very rich in species of flightless birds, and as the Notornis fragments came from another island than the three skins and the skeleton, perhaps Notornis became extinct on the North Island, whereas it still survives in certain parts of the South Island. Dr. Meyer is of opinion that if the bones and the skull had been taken out of the skins preserved in the British Museum, one would have known already in the year 1850, or at least in 1869, that they differed from the *Notornis mantelli* fragments of the North Island. The name of those skins, therefore, must be altered, according to Dr. Meyer to *N. hochstetteri*. Dr. Meyer has figured the skeleton of *N. mantelli* in plates 34–37 of his work.

WE are glad to see that the system of appointing men as professors who only teach, and scarcely that, is now being discussed in the United States. It is to be hoped that it will soon be discussed here. The following letter from a correspondent in Germany to the *New York Nation* of July 26 gives the last contribution to the ventilation of the subject:—"SIR,—The controversy carried on in your journal in regard to professorial salaries has not failed to attract considerable attention in Germany, and especially the comparisons instituted between the financial condition of American and that of German professors. As some wrong ideas seem to prevail in America on the subject of the remuneration of university professors in this country, I should like to call attention to the real state of affairs. In the first place, it must be understood that a man who is elected to fill a chair at some German university is not expected to act merely as a teacher. His abilities as an instructor are, as a rule, regarded as a matter of minor importance, if they are at all taken into consideration on his appointment. But he is required to advance science; and, to enable him to fulfil the expectations entertained of him, the Government feels bound to make him financially independent. A grand laboratory or observatory or clinic is placed at his disposal, enormous sums are voted to defray the expenses of the most costly scientific experiments, and, in order to allow him to devote himself exclusively to the advancement of his science, a large salary insures him against the necessity of undertaking extraneous labour. The salary of an 'ordinary professor' amounts to 15,000, often 20,000 or 25,000 marks ($3500 to $5000) per annum. Besides his regular pay he receives the fees paid him by those who attend his lectures. At large universities, like those of Berlin, Breslau, Munich, and Vienna, these fees may reach extraordinary amounts. At Berlin, Reichert, the Professor of Anatomy, is paid 120 marks ($30) by each student for the lecture on anatomy and the concomitant dissecting exercises, during the winter term alone. There were over 400 students, and the sum thus received by one professor amounts to over 48,000 marks. A professor of law or philosophy generally gets 20 marks from each student for a course of lectures extending over one term, and delivered three or four hours a week. As a professor usually delivers more than one course of lectures a term, and as his lectures, especially at a very large university, may be attended by about 150 or 200 students, the emoluments which he enjoys besides his salary may be considered as affording him quite a respectable income. Added to this, the 'ordinary professor' holds his position during good behaviour. Should he choose to resign in his old age, he has claims to a good pension. Socially the professors rank as high as officers, which signifies the respect in which the devotees of science are held in this military country. Prof. Esmarch of Kiel is allied by marriage to the Imperial family of Germany. This care which the German people takes of its savants, in absolving them from the necessity of engaging in the 'madding strife' for existence, is the main secret of the success of the German university system and German scientific triumphs. When the brain-power of the American nation shall be concentrated under such favourable conditions at a few grand seats of learning, and the drudgery of the pedagogue be exchanged for the fruitful labour of the independent scientist, then the youth of America will no longer be compelled to seek opportunities for intellectual development in Europe alone.—L. N."

ESTES AND LAURIAT, Boston (U.S.), announce, the *Nation* informs us, several important new publications: "Ornithology of the World," a popular treatise by Dr. Elliott Coues, fully illustrated; the same author's "Key to North American Birds," revised to date and entirely rewritten, with the incorporation of a practical manual of field ornithology; "The Natural History of Man," a popular work based on Hellwald's "Naturgeschichte des Menschen," which has been translated by Mr. J. S. Kingsley, and edited by him in conjunction with Messrs. W. H. Dall, F. W. Putnam, and Stephen Salisbury, jun.; "Travels in Mexico," by Fred. A. Ober, well equipped with drawings from the author's photographs and with maps.

ON July 19 a terrible hailstorm is reported to have passed over the Government of Tomsk in Siberia. The hail-stones were as big as eggs. Two women struck on the head were killed on the spot, besides a number of animals and birds. A terrible hailstorm is also reported to have raged in Iowa on the night of August 7. The track of the storm was four miles wide, passing through three counties. All vegetation was destroyed in its course. One woman lost her life, and many persons were injured. Twenty-two cattle were killed. The hail fell in some places to a depth of five feet. On the Rock Island, Chicago, and Milwaukee Railroads the trains were blocked; and at Lonah station nine freight cars were blown from the rails.

A SPECIAL correspondent of the *Daily Telegraph*, who has been on a visit to Mr. Stanley, and has journeyed a considerable distance up the Congo, contributes the first of a series of letters to Tuesday's issue of that journal, accompanied by a map and a rough sketch.

IT appears from recent analyses communicated to the Kieff Society of Naturalists, that the *Sorghum saccharatum*, of Minnesota, U.S., which was recently introduced into the Russian provinces of Poltava and Kieff, yielded as much as 14·2 to 16·7 per cent. of its weight of crystalline sugar, thus exceeding the average percentage of sugar, which commonly is from 9 to 9·5 per cent.

AN illustrated "Circular of Information," distributed by the United States Bureau of Education, directs attention to a very general yet very sad deficiency, viz. imperfect hearing. Dr. Sexton in it points out that it causes, among other things, defects in pronunciation through children not knowing the correct sound; and failure and ill temper among teachers who may be unaware of their pupils' defects or their own. He urges that the hearing of all pupils should be examined each session, and no one accepted as teacher who has not passed an aural test. He strongly recommends dental inspection of pupils, as from diseased teeth especially arise deficiencies of hearing, from which follow, first, the appearance of stupidity, and eventually the reality. Among the practical precautions recommended, abstinence from bathing seems a very costly one, but few pamphlets could show so clearly the interaction of physical and mental education.

MR. MATTIEU WILLIAMS points out that on p. 350 of NATURE, the dimensions of Jan Mayen are stated in "geographical miles," but that it is evident the old Norwegian sea mile is the measure used. This is equal to four English geographical miles. The length of the island is, therefore, thirty of *our* geographical miles. Mr. Williams says the "old" sea mile and the long land mile have, since July 1879, been legally superseded by the kilometre.

VOL. III. Part VII. of the *Transactions of the Essex Field Club* contains several long papers of interest, besides a considerable number of shorter ones. Among the former are "The Ancient Fauna of Essex," by Dr. H. Woodward; "The Macro-Lepidoptera of the District around Maldon," by Mr. G. H. Rayner; "Deneholes," by Mr. T. V. Holmes; "Primeval Man in the Valley of the Lea," by Mr. W. G. Smith; "On the Species of the Genus *Primula* in Essex," by Mr. Christie; with Mr. Meldola's presidential address, and a notice and portrait of the late Sir Antonio Brady. The society has also issued in a sepa-

rate form a collection of papers and memorials on the protection of wild animals and plants, and on the present condition and future management of Epping Forest.

AT the recent examination for the Licence ès Sciences Physiques in Paris, an English student, Mr. P. J. Hartog, B.Sc. Vict. Univ., passed first of the sixty-six candidates, though by three years the youngest of any.

DURING the latter part of this and the early part of next month a geographical congress and exhibition will take place in Douai. M. Ferdinand de Lesseps has been elected president. Belgium, Holland, Denmark, and Sweden will be represented.

THE United Steamship Association of Copenhagen has offered a free passage by their vessels to all Danish fishermen desirous of visiting the Fisheries Exhibition.

ON August 2, at about 10 p.m., a brilliant meteor passed from south to north over the town of Linköping in Sweden. When in the north-west it burst, spreading an intense pale blue light, and leaving a light smoke in the air which could be distinguished for several seconds. On July 23, at 10.15 p.m., a magnificent meteor was observed at Södertelje in Sweden. It went in a north-westerly direction, leaving a luminous track on the sky.

AS the representative of Sweden in the International Phytopathological Association, recently formed, Dr. J. Eriksson, botanist at the Academy of Agriculture, has been chosen. He is now engaged in collecting statistics and examples of diseases of plants, which it is the object of the Association to study and eradicate.

THE additions to the Zoological Society's Gardens during the past week include a Bonnet Monkey (*Macacus radiatus* ♂) from India, presented by the Hon. Mrs. Pigott Carleton; two Maholi Galagos (*Galago maholi*) from South Africa, presented by Dr. Hugh Exton; a Rude Fox (*Canis rudis*) from Demerara, presented by Mr. Clement J. Bateman; a Suricate (*Suricata zenik* ♀) from South Africa, presented by Mr. Chas. H. Wootton; a Collared Peccary (*Dicotyles tajacu*) from South America, presented by Mr. Fritz Zurcher; three Peregrine Falcons (*Falco peregrinus*), European, presented by Mr. J. Snowdon Henry, F.Z.S.; two Javan Adjutants (*Leptoptilus javanicus*) from Java, two Indian Tantalus (*Tantalus leucocephalus*) from India, presented by the Hon. W. H. Ravenscroft; a Sclater's Curassow (*Crax sclateri* ♀) from South America, presented by Mr. John Ardran; a Wood Owl (*Syrnium aluco*), British, presented by Mr. G. Carrick Steet; two Ring-tailed Lemurs (*Lemur catta*) from Madagascar, a Black Bear (*Ursus americanus* ♂) from North America, a Greater Sulphur-crested Cockatoo (*Cacatua galerita*) from Australia, deposited; three Indian Pythons (*Python molurus*) from India, purchased; two Mule Deer (*Cariacus macrotis*), born in the Gardens.

OUR ASTRONOMICAL COLUMN

THE SATELLITES OF SATURN.—Dr. W. Meyer has published corrected, or what he calls definitive, elements of the satellites *Enceladus*, *Tethys*, *Dione*, *Rhea*, *Titan*, and *Japetus*, chiefly founded upon his observations at the Observatory of Geneva in 1881, the mean motions however being determined from a comparison of the Geneva observations with the elements assigned by Jacob from measures of the satellites made at Madras during the years 1856-58. The mean distances and periods resulting from Dr. Meyer's investigations are as follow:—

	Mean distance in equatorial radii of Saturn.	Period. d. h. m. s.
Enceladus	3·8661	1 8 53 6·92
Tethys	4·8116	1 21 18 25·62
Dione	6·1629	2 17 41 9·29
Rhea	8·6082	4 12 25 11·57
Titan	19·9111	15 22 41 23·16
Japetus	57·9303	79 7 49 24·84

The other elements of the orbit of the outer satellite *Japetus* are subjoined; those of Jacob are added for comparison. Meyer's epoch is 1881 Nov. 0·0 G.M.T.; Jacob's is 1858 Jan. 0·0 G.M.T.

	Meyer.	Jacob.
Mean longitude	200 8 53 ...	294 31·1
Longitude of peri-Saturnium ...	353 5 7 ...	349 20
,, ascending node ...	142 17 27 ...	143 1·3
Inclination to ecliptic	18 26 50 ...	18 37·9
Eccentricity	0·028916 ...	0·028443
Semi-axis major (for mean distance of Saturn)	514″·711 ...	514″·96
Mean diurnal motion	4°·538273 ...	4°·538042

TEMPEL'S COMET OF SHORT PERIOD (1873 II.).—Prof. Krueger, in transferring to the *Astronomische Nachrichten* the few positions lately given in this column, mentions that M. Schulhof of Paris, who has undertaken the calculations for the comet, promises an ephemeris in due course for that periodical.

THE BISCHOFFSHEIM OBSERVATORY AT NICE.—M. Perrotin, Director of the Observatory of Montgros, near Nice, lately founded by the munificence and scientific spirit of M. Bischoffsheim of Paris, has made an excellent beginning in the proposed work of that establishment. The Observatory is provided with a refractor of 15 inches aperture, and about 18 feet focal length, the object glass by MM. Henry of the Observatory at Paris, the mounting by Eichens and Gautier. This instrument M. Perrotin applied in June last to measures of a number of the more interesting double-stars, and amongst them several very difficult objects. The magnifying powers most frequently employed were 750 and 1000, with occasional use of 400 and 650. We make a short selection from M. Perrotin's results:—

Star.	Epoch.	Angle.	Distance.
		°	″
42 Comæ Berenicis ...	1883·51 ...	11·5 ...	0·535
44 Böotis	— ·47 ...	240·6 ...	4·925
γ Coronæ Borealis ...	— ·53 ...	138 ...	(0·17 elong.)
ξ Scorpii	— ·52 ...	11·5 ...	1·16
ζ Herculis	— ·52 ...	99·5 ...	1·49
Σ 2107	— ·49 ...	231·2 ...	0·57
Σ 2173	— ·53 ...	35·e ...	0·15 e
τ Ophiuchi	— ·51 ...	252·1 ...	1·66
70 ,, ...	— ·49 ...	45·6 ...	2·28
λ Cygni	— ·51 ...	80·3 ...	0·65

With respect to Σ 2173 M. Perrotin remarks that his results confirm M. Otto Struve's opinion that the star revolves in about forty-six years. The above measures of the rapid binary ζ Herculis are closely represented by Dr. Doberck's last orbit.

THE LATE TRANSIT OF VENUS.—The last number of the *Comptes Rendus* of the Paris Academy of Sciences is almost wholly occupied by the preliminary Reports from the various expeditions sent by the French Commission for the observation of this phenomenon, and one or two expeditions acting in co-operation with the Commission. The observations of contacts, &c., appear in these Reports. The stations included are Petionville, Hayti; Puebla, Mexico; Fort Tartenson, Martinique; St. Augustin, Florida; Santa Cruz, Patagonia; Cerro-Negro near San Bernardo, Chili; Chubut, Patagonia; Rio Negro (4h. 21m. 20s. W. of Paris and 40° 47′ 51″ S.); Hoste Island, Orange Bay, Tierra del Fuego; and Bragado, Buenos Ayres. It is gratifying to note the general success which attended these expeditions, even at the most southern station in Orange Bay, the latitude of which was 55° 31′ 28″.

A CONTRIBUTION TO THE STUDY OF THE TRANSMISSION EASTWARDS ROUND THE GLOBE OF BAROMETRIC ABNORMAL MOVEMENTS[1]

II.

WHEN the fact of these simultaneous movements is recognised, the irregularities in the transmission eastwards of the abnormal movements can be in great part explained. For instance, taking the movements B″ of the Zanzibar curve, it is found to recur at B′ and B in the Belgaum and Bombay curves after an interval of six months, that is to say, about one month longer than the average, and is moreover of much greater magnitude in these curves than at Zanzibar. But it is noticeable that in the

[1] Concluded from p. 356.

month of November there was a very prominent simultaneous downward movement at the three stations, a movement which must have bent the curves very considerably out of the shape they would have taken had it not occurred, and it is allowable to suppose that the proper minimum in the Belgaum and Bombay curves corresponding to B″ of the Zanzibar curve took place in the month of October, 1881, that is to say, after the normal interval of five months, but was masked by the greater minimum in November, due to the simultaneous movement. Then again in the case of the maximum movement C, C′, and C″, the period between C and C″ is, if five months be assumed to be the normal, quite regular; but between C′ and C″ it is only four months, that is, one month shorter than usual. A reference to the dotted lines shows that in the month of January, 1882, all three curves were upheaved by a simultaneous movement, while in the following month they were all three depressed simultaneously. By the co-operation of these two simultaneous movements, the maximum C′ was apparently quickened in its course by one month, and hence the irregularity. Again, with regard to the double oscillation D, D′, and D″ (1 and 2) in the Zanzibar curve the first downward bend D''_1 is greater than the second D''_2; but in the Belgaum curve they are very nearly equal, and in the Bombay curve the first is even less than the second. On glancing down at the Zanzibar curve for the month of April, it is observable that an upward movement took place then; and if it be supposed that the upward impulse was felt at all the three stations simultaneously, but that this impulse was not so great at Bombay and Belgaum as the downward impulse due to the travelling movement coming from Zanzibar, then the actual effect at those two stations would be the resultant of the two impulses, that is to say, a downward movement of less amplitude than would have occurred had there been no simultaneous movement in that month.

The apparent acceleration of the movement A, A′, and A″ is susceptible of a similar explanation, though not quite so satisfactorily, and it may perhaps be admissible to reserve for it an explanation which will present itself hereafter.

The existence of these simultaneous movements seems not only to afford an explanation in great part of the irregularities observable in the eastward transmission of the travelling movements, but also to clear away an objection that was brought forward by Mr. E. Douglas Archibald to the acceptance as an established theory of the eastward movement of abnormal variations. He asked (*vide* NATURE, vol. xxiii. p. 400) "Why the barometric waves should commence on one meridian rather than one another." Now it is very noticeable (if a reference be made to the curves) that all the marked features of the curves—those features that are transmitted eastwards—occur in months when there are simultaneous movements at all the three stations, that in fact the simultaneous movements are the initial ones. And in the light of this fact the answer to Mr. Archibald's objection is that they do not commence on one meridian rather than on another, but (so far at any rate as the three stations under consideration are concerned) on all meridians simultaneously. But it is likely enough that they may be greater on one particular meridian, or at one particular point on that meridian, than on those on either side of, or about it, that in fact they result from a slight heaping up or withdrawing of the atmosphere over, or from, one part of the earth's surface, in which case the heap, or depression, will have its greatest altitude or depth at one particular place, but of course will be felt over a more or less considerable area around that place, and the degree in which it will be felt will be less as the length of the radius from the centre is increased. And that this is not altogether a fanciful idea is apparent on a reference being made to the smoothed curves, when it will be observed, for instance, that in July, 1880, and also in June, 1881, the upward movements were much greater at Bombay, the most northern of the three stations, than at Belgaum, a more southerly one; and at this, again, they were much greater than at Zanzibar, the most southern.

Mr. Archibald brings forward another objection. He asks: "If, as Mr. Chambers thinks, the waves of pressure travel slowly round the earth, why they do not reappear at the place where they started, after an interval of about one year and eight months (calculated from the lags given in Mr. Chambers's paper). At present there does not appear to be the slightest evidence that they reappear at all, and if they do not, when and where do they disappear?" One answer to this question is that they must, in the course of their eastward journey, get completely masked by other simultaneous movements of the atmosphere that are constantly taking place. Another answer to this question, and the one not requiring the supposition of the simultaneous movements, is that, as the travelling waves get further away from the place of their origin, and consequently widen out, their amplitude gets constantly less, until at last, like the waves caused by dropping a stone in a pond, they become imperceptible. If it were possible to eliminate the effect of the simultaneous movements, and examine only the curve produced by the travelling waves, one might then see this gradual decrease in their amplitude as they proceeded along their journey. It is impossible, however, at present to separate the effects of the two movements. An alternative method, however, to eliminating the effect of the first-mentioned movements is to pick out a period during which they were small or imperceptible. If such a period can be found, it will then doubtless be possible in some degree to trace the comparatively undisturbed action of the travelling movements. Such a period occurred from March to August, 1882, during which time the simultaneous abnormal movements were not easily traceable. And it is then seen how the amplitude of the double oscillation D′ (1 and 2) of the Zanzibar curve has diminished at D′ and D (1 and 2) of the Belgaum and Bombay curves.

Another question which may be raised with regard to the matter, and a question which is not so easily answered is, why these waves should travel in an easterly direction and not in a westerly? It would be imagined that they should be transmitted equally in both directions, or if they are transmitted in one direction rather than in the other, it should have been a westerly one; in which case their motion might have been accounted for readily enough by supposing the atmosphere to lay behind in equatorial regions in a westerly direction due to the influx of air of a lower velocity from the polar regions; and perhaps also by supposing the sun to exercise an influence in the matter. The fact is, however, that the motion is in the same direction as, and ahead of, the earth's rotation. It would be interesting, however, to see if there is any evidence of a westward motion, and referring to the curves with this object in view, such evidence is perhaps discoverable. For instance, the simultaneous movement in July, 1880, causes a very marked upward bend of the Bombay and Belgaum curves; if, then, there is any motion westwards, this upward bend should make its appearance in some succeeding month in the Zanzibar curve; and, as a matter of fact, there is an upward movement shown by the dotted line in the month of September. It is difficult to find many instances of this westward transmission, owing to the somewhat intricate mixture of movements presented by the curves; but the following instances may be adduced as lending some support to the hypothesis: there is a simultaneous downward movement in May, 1880, and there is an independent downward movement at Zanzibar in the month of August in the same year, that is, three months later; there is again the instance already cited of the simultaneous upward movement of July, 1880, recurring at Zanzibar in September, that is, two months later. It may be that the excessive downward movement at Zanzibar in the month of March, 1881, was in part due to the recurrence there of the simultaneous movement which occurred, especially developed at Bombay, in January of the same year; that is, two months before. Again, the very large downward movement at Zanzibar in October and November, 1881, may have been in part due to the arrival there from Bombay and Belgaum of the wave produced by the simultaneous downward movement which occurred in August, two and a half months earlier. And lastly, two instances less difficult to trace, owing to the absence of any marked simultaneous movements during the period of their occurrence, are the upward and downward movements at Zanzibar of the months April and May, 1882, which may be regarded as due to the arrival there from the west of India of the waves resulting from the simultaneous impulses received at all stations in January and February of the same year; that is, at periods of three months for each.

And here may be given the explanation previously referred to of the apparent acceleration in the rate of movement of the wave A, A′, and A″. It is possible that A and A′ may not be due to the arrival at Bombay and Belgaum of the maximum A″, but of the wave caused by the simultaneous movement which occurred in July six months before, a period much nearer the normal than are the periods three and three and a half months; in which case the maximum A″ would be due to the arrival at Zanzibar from Bombay and Belgaum of the wave caused by the

simultaneous movement in July, 1880, together with the simultaneous movement of October, 1880.

If this be a correct analysis of the curves, then there is the remarkable fact to be noted, that the motion of these waves in a westward direction takes place at an average rate of two and a half months, that is to say, twice as rapidly as in the eastward direction. And this fact would readily accord with the supposed westward lagging of the atmosphere due to its inertia; and also with any supposed influence of the sun. The presence of this westward transmission is not so apparent, however, as that of the eastward. And whether it be present or not, there still remains the difficulty, substantially the same as at the outset, that the motion eastwards is by far the most defined and most readily traceable; a difficulty for which I cannot even guess at any solution. Facts, however, should not be overlooked because they cannot be explained, but rather an explanation sought; and in the explanation of this fact theoretical matters of considerable interest may perhaps be involved. The only hints at any facts which might by any possibility suggest an explanation are to be found in Mr. Chambers's summary of his discovery, where he speaks of the direction eastwards being like that of "the cyclones of extra-tropical latitudes"; and in the very interesting and more suggestive statement of Dr. Balfour Stewart (*vide* NATURE, vol. xxii. p. 151), in which he says, speaking of terrestrial magnetism, "that we have some evidence which leads us to suspect that particular states of declination range, like particular states of weather have a motion from west to east, the magnetical moving faster than the meteorological."

As to the cause of these widely-distributed simultaneous movements of the barometer, movements which I consider to be in the main the initial impulses of the complication of abnormal movements visible in the curves, I have no evidence of any value. The most natural idea is that a connection, direct or indirect, may be traced between them and changes in the state of solar energy; the downward movements perhaps being due to an excess of energy, and the upward movements to a deficiency. In some points, perhaps, they may bear analogy to magnetic storms. I have not a sun-spot curve for the years under consideration, and cannot therefore make the necessary comparisons.

As a working hypothesis to serve as a guide in further investigating the matter, I should be inclined to suppose that the atmosphere, if it could, without stopping the earth's motion, be divested of its regular diurnal and seasonal movements, and the eddies and storms resulting therefrom, would present to observation a somewhat intricate mixture of motions consisting of the following elements:—

1. Certain initial movements, resulting mediately or immediately from changes in the state of the sun's energy, and affecting very wide areas, and being of the form of heapings up or drawings away of the atmosphere over these areas, the movements attaining their maximum height or depth at the centre of these areas. The centres of these areas would be immediately under the sun, that is to say, within the tropical latitudes.[1]

2. Waves resulting from the propagation in eastward and westward (and perhaps, though in a less marked degree northward and southward) directions of the impulses given by the first movements; the waves which travel eastward being for some unexplained reason more pronounced than those travelling westward, but their rate of motion over the earth's surface being, on account of the rotation of the earth and the atmosphere's inertia, slower in the eastward direction than in the westward.

3. Small local movements over more limited areas resulting from the chance conjunction and interference of any two or more of the first and second movements.

An extensive and detailed examination of the barometric records of stations scattered over the globe will bring to light facts either favourable or unfavourable to this hypothesis; and after this examination has been made, it will then be time to decide whether or not it is worth while undertaking the labour of dealing with the subject mathematically.

The matter seems important even theoretically, for in it and investigations of a like kind are to be found attempts at a rational arrangement of the very complex collection of facts contained in the various records of barometric abnormal movements; and practically also, for on the results of further investigation into it depends the confirmation or dismissal of a hypothesis which has given promise of furnishing a useful method of weather forecasting.

A. N. PEARSON,
Acg. Meteorological Reporter for Western India

Bombay, January 10

[1] Mr. H. F. Blanford's discovery of "a barometric see-saw between Russia and India in the sun-spot cycle" (*vide* NATURE, vol. xxi. p. 477) seems to support this hypothesis.

SCIENCE IN RUSSIA

THE Kieff Society of Naturalists was opened in 1869, and soon had more than a hundred members, mostly belonging to the University. Like other Societies of Naturalists at the Russian Universities, its chief aim has been the exploration of Russian natural history in the neighbouring provinces, these explorations proving that though the region around the Dnieper was not quite unknown in its geological, botanical, and zoological aspects, still there were wide lacunæ to be filled up before arriving at a thorough knowledge of it. Prof. Feofilaktoff, who had already published a geological map of the province of Kieff, assisted by several young geologists, busily explored, therefore, the surrounding provinces, especially on the right bank of the Dnieper, and published in the *Memoirs of the Kieff Society* a series of valuable papers on the Cretaceous, Tertiary, and post-Tertiary of the region, as well as on brown coal on the Dnieper. The Phanerogamic flora of the Dnieper region being sufficiently well known from the former works of Professors Andrzeiovski, Trautvetter, Rogowicz, and several others, the chief attention of the Society has been devoted to the Cryptogamic flora; and numerous papers by MM. Borschoff, Plutenko, Wältz, Rishavi, Timofeeff, Ryndovsky, Moshinsky, and Sovinsky, on the algæ, mosses, lichens, and fungi of the Dnieper region, as well as of Caucasus, appeared in the *Memoirs*. In zoology the chief researches were directed towards the exploration of the invertebrate fauna of the Black Sea, and whilst M. Bobretzky thoroughly studied the Annelids of the Black Sea, M. Krich again carried out special studies of the Copepoda, and M. Paulson studied the Crustaceans of the Red Sea, in order to compare them with those of the great interior sea of Russia and Turkey. Several valuable papers were published at the same time on the anatomy and physiology of animals and plants, whilst the researches in chemistry and physics which were made at the Kieff University were mostly sent for publication to the *Journal of the Russian Chemical and Physical Society* at St. Petersburg.

Finally, the Kieff Society has undertaken, since 1873, the yearly publication of a most valuable systematic catalogue of papers in mathematics, in natural science, pure and applied, and in medicine, published throughout Russia in the numerous scientific publications which have grown up during the last ten years. These catalogues, which have reached during the last few years the size of large octavo volumes two hundred pages in extent for natural sciences and the same for medicine, are most valuable, as the number of provincial publications rapidly increases in Russia, and scientific papers of great value are virtually buried among the publications of the statistical committees, provincial assemblies, local scientific societies, and so on. The last (tenth) volume of this catalogue contains an index for the whole series of ten volumes.

The two last volumes of the *Memoirs* (*Zapiski*) *of the Kieff Society of Naturalists* (vols. v. and vi. 1879–1882) contains, like the preceding ones, a good many valuable papers. In geology we find several papers by Prof. Feofilaktoff and Schmalhausen. According to the former, the Eocene formation of the region has its central parts in the Government of Kieff, on the banks of the Dnieper. It consists of two series of deposits, the sandstones and sands of Traktemiroff, which only contain remains of Mollusks; and the Spondylus deposits which cover the former, and consist of sands, Spondylus clay, and greenish sands with plants (vol. v. fasc. 2). These plants, according to M. Schmalhausen's researches, which will soon be published by the Society, are the Alga *Chondrites*, similar to the Eocene *Chondrites Targionii*; a Conifer similar to the *Araucarites Duchartrei*; fruits of *Nipadites*, similar to those of the London clay; and pieces of Coniferæ and Palms and of a Bromelite (*Br. Dolinskii*, Schmalh.), fruits of tropical Leguminosæ (*Leguminosites Rogowiczi* and *L. Feofilaktowi*), and leaves of *Ficus prisca*. All these plants have been found in the upper parts of the clay, whilst in the sands that cover it M. Schmalhausen found a great number of stems and leaves of marine Monocotyledons, such as *Caulinites Rogowiczi* (a new species akin to the *Caulinites parisiensis*), and a new species of *Zorterites*, as well as parts of a new species of Graminea, *Polocapyrum incertum* (vol. vi. *Pro-*

ceedings). In another paper Prof. Feofilaktoff gives a description of the diluvium of Poltava (vol. vi. fasc. 1). It consists of three different series of deposits, namely, the lower boulder clay, the loess, and the upper boulder deposits. The yellow loess of Poltava is a quite characteristic loess, and contains the usual *Helix hispida*, *Pupa muscorum*, and *Succinea oblonga*, but it is well stratified at certain places, as it contains intermediate deposits of sandy clay. The upper boulder clay reaches a thickness of forty to fifty feet, and contains boulders five to ten feet in diameter. It consists of materials brought from the north, with a mixture of local materials—chiefly of the underlying loess—without any kind of stratification of the different elements of which it consists. M. Schmalhausen gives a description, with a plate, of the stem of the *Protopteris punctata*, Sternb., from the Government of Volhynia. This sample seems to be the best known up to the present time, and M. Schmalhausen doubts whether this cretaceous fern has been found anywhere in Western Europe in so well-preserved a state. The incomplete samples which were often found in Western Europe led to its being described under the names of *Filicites punctatus*, *Sigillaria punctata*, *Caulopteris punctata*, and *Protopteris Sternbergi*. A note by Prof. Borschoff, on the downs of the Kyzyl-Koum Steppe, has been previously noticed in these columns. We notice also several analyses of Caucasian mineral waters.

The zoological papers are numerous and important. M. Krichaguin gives an account of his dredgings on the north-eastern coast of the Black Sea, and describes the following new species of Copepoda: *Monstrilla intermedia*, *Monstrilla pontica*, *Longipedia pontica*, *Tachidius Abrau*, *Canthocampus æquipes* and *longicaudatus*, *Liljeborgia pontica*, *Cleta brevirostris armata*, *C. Thalestris*, and *C. Liljeborgia*, *Westwoodia pontica*, *Thalestris filifera*, and *Oithona minuta*. His conclusions are: that the fauna of the Black Sea has great originality, owing to the large number of original genera it contains; that the cosmopolite forms either appear as original species, or have a resemblance to the Mediterranean ones, and that those species which are common to the Black Sea and northern seas have undergone important modifications (vol. v. fasc. 1). M. Sovinsky's paper on the Amphipods of the Bay of Sebastopol (vol. vi. fasc. 1) contains a complete monograph of the twenty-seven species he has found in this bay, and a description of four new species of *Sunamphitoë*, *Dexamine*, and *Microdeutopus*. Another paper by the same author (vol. vi. fasc. 2) contains a comparison, with plates, of the Red Sea species *Virbius proteus*, as well as the genera *Nikoides* and *Alpheodes*, established by M. Paulson, with the Black Sea forms *Virbius gracilis*, Hell., *Nikoides pontica*, and the Mediterranean *Alpheus dentipes*, which are nearly akin to the above. M. Bobretzky, who published, in 1870, in the *Memoirs of the Kieff Society of Naturalists*, a systematic description of forty-three species of *Annelida Polychæta*, has recently revised his determinations on the ground of new observations, as well as of the researches by MM. Claparède and Marion; and, without seeking to establish new species, he has preferred to establish a comparison between the Black Sea and Mediterranean forms, and to maintain only the three following new species: *Polynoë incerta*, *Ophelia taurica*, and *Terebellides carnea*.

In the department of comparative anatomy we notice an elaborate paper by M. Rumshewich, on the development of the eye among Vertebrates, accompanied by numerous plates; on the internal muscles of the eye of Reptiles (*Lacerta agilis*, *L. viridis*, *L. Stirpium*, *Chelonia fluviatilis*, and *Ch. midas*), by the same; on the reproductive organs in Annelids, and on the origin of the blastoderm in insects, by M. Bobretzky; and on the structure of the brain in man, by M. Betz.

Botany is represented in volumes v. and vi., only by lists of Phanerogams and of Algæ in the district of Radomysl, on the Teterev River, by M. Sovinsky; and chemistry by an elaborate paper, by M. Barzilovsky, on the nitrotoluols.

After having largely contributed during the years 1855 to 1865 to the purely geographical exploration of the unknown parts of Siberia and the adjacent countries, the East Siberian branch of the Russian Geographical Society entered upon a period of more thorough scientific exploration of Siberia itself. The merely geographical expeditions, such as that of MM. Czekanovski and Müller to the land of the Chuckches, became few and rare, and we now find the members of the Society engaged in a complete exploration of the natural history of Siberia, so that the two last volumes of the *Izvestia*[1] of the East Siberian branch bring us a series of researches into the geology and anthropology of Siberia. The first rank among these undoubtedly belongs to the geological explorations around Lake Baikal, by M. Chersky. The young geologist of Irkutsk publishes for the first time a most interesting geological map of the coasts of Lake Baikal. It appears from this map that the great mass of the mountains on the western shore of the lake consists of Laurentian crystalline slates, mostly chloritic schists and gneisses, overlying the aphanite schists and amphibolitic slates, with intercalations of granites, granito-syenites, and porphyries. The upper horizon of the same formation consists of the same slates and gneisses, with thick intermediate deposits of limestones. The whole is covered to the west with Silurian deposits, a large Jurassic freshwater basin occupying the depression of Irkutsk. Smaller depressions are occupied by freshwater Miocene deposits. The most important result of M. Chersky's researches is that (as was foreseen on the ground of orographic and architectonic data) the depression of Lake Baikal is not a longitudinal valley, as might be supposed at the first aspect. The chains of mountains we see on its western shore reappear on the eastern shore, maintaining the same direction from south-west to north-east, and *crossing* the lake in the shape of submerged low ridges. On the south-eastern shore of Lake Baikal M. Chersky found the continuation of the high plateau of Eastern Siberia consisting of the same two parts of the Laurentian formation, and covered with lower Silurian deposits, the depressions of which were occupied during the Tertiary period with freshwater lakes; there are also numerous traces of great lakes which covered wide tracts during the Post-Glacial period. As to the glacial period, the number of accurate observations published by the East Siberian geologists is unfortunately not in proportion to the amount of theoretical discussion, the only sure and new facts we have to mention being the presence of *roches moutonnées*, due to glaciation, on the northern shore of Lake Kossogol, that is, on the high plateau at the foot of its border-ridge, the Sayan Mountains (they were described by the late M. Czekanovski); traces of glaciation in the higher parts of this ridge; polished *roches moutonnées* at several places of the high plateau in the basin of Selenga, requiring, however, a more careful examination; and glacial deposits in the valley of the Irkut, due to local glaciers, whose extremities reached a height of less than 2000 feet above the present sea level.

The Siberian branch of the Geographical Society has taken, during the last few years, a lively interest in anthropology and archæology, and we notice in the two last volumes of its *Izvestia* a series of papers on this subject. M. Vitkovsky's excavations of grave-mounds of the Stone period on the left bank of the Angara, at the mouth of the Kitoy, and also of the sand-hills which were inhabited by prehistoric man, have yielded a very rich collection of bones and implements. No less than twenty complete skeletons were dug out, twenty-five nephrite hatchets, numerous nephrite, jade, and quartzite arrow-points, bone needles, and implements for fishing. The most interesting feature of these implements is the presence in very great numbers of carved pieces of slate, pretty well polished, and representing seals. They occur in large quantities (160 in M. Vitkovsky's collection), and are of all sizes, from 150 millimetres to 15 millimetres long. These carvings of seals, as well as other implements, are illustrated in the plates which accompany M. Vitkovsky's paper. The skulls testify that the inhabitants of the Downs were a mixture of dolichocephals and brachiocephals, the former seeming to have predominated. The jade of which the hatchets were made was probably taken from the jade boulders which are found in the valley of the Byelaya River in the Government of Irkutsk. We notice, also, most valuable papers by M. Agapitoff on the hieroglyphics on cliffs on the western shore of Lake Baikal; and on the remains of prehistoric man in the province of Irkutsk, and on Olkhon Island. The hieroglyphic inscriptions on cliffs which are so numerous in the district of Minusinsk (they were lately figured in the St. Petersburg *Izvestia* of the Geographical Society) were supposed to be very rare towards the east; but simply because they remained unknown. Those on Lake Baikal (reproduced in the Siberian *Izvestia*) represent several men, of two different sizes, reindeer, deer, birds, and, most probably, a horse with a man upon it. The old graves are very numerous, too, on Olkhon Island, and they belong (according to the measurements of the skull) to Mongolians, as well as the remains of stone walls which were discovered on the shore of Lake Baikal. They contain iron implements, as well as glass globules and amber pearls.

The Siberian branch of the Geographical Society has also,

[1] *Izvestia* of the East Siberian branch of the Russian Geographical Society, vols. xii. and xiii. Irkutsk, 1881 to 1883.

during the last few years, devoted much attention to the meteorology of Siberia, and, besides the meteorological observations made at its stations, it has collected materials for ascertaining the dates of the freezing and breaking up of the ice in Siberian rivers. The list of these dates for the rivers of Siberia for the years 1874 to 1880 will certainly be consulted with profit, as also several brief notes on amber in Siberia, on chemical analyses of salt from various salt lakes, and of coral from the Nerchinsk district, and from the banks of the Amur, as also other smaller notes.

EXPERIMENTAL RESEARCHES ON THE ELECTRIC DISCHARGE WITH THE CHLORIDE OF SILVER BATTERY[1]

THE authors recall that at the conclusion of the third part of their researches (*Phil. Trans.* for June 11, Part I. vol. clxxi.) they stated that they intended to make an investigation on the dark discharge, and the special conditions of the negative discharge; this paper contains a number of experiments, more especially on the latter subject, and also others intended to throw light on the general nature of the electric discharge through gases.

The first part of the paper describes some experiments made with vessels of different forms in order to ascertain whether the dimensions and shape of the vessel have any effect on the pressure of minimum resistance to the electric discharge. This was found to be the case; for example, with a residual air charge in a spheroidal vessel 7 inches (17·8 centims.) long, and 5 inches (12·7 centims.) diameter (Fig. 1), the pressure of minimum resistance was as high as 3 millims., 3947 M; while in a tube 22·5 inches (57 centims.) long, and 1·625 inches (4·1 centims.) diameter, it was only 0·69 millim., 908 M; again in a smaller tube 23 inches (58·4 centims.) long, and 0·75 inch (1·9 centims.) diameter, it was 1 millim., 1316 M. It is evident, therefore, that not only the dimensions of the tube, but possibly also the shape of the terminals, have an influence on the pressure of least resistance, and it is very probable that in the atmosphere, where lateral expansion is practically unlimited, the conditions of minimum resistance are different from those which exist even

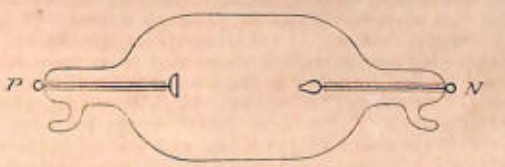


FIG. 1.

in very large tubes, and that this may influence the height of the aurora.

The paper next deals with the discharge in miniature tubes $\frac{1}{8}$ inch (2·2 centims.) long, and $\frac{1}{4}$ inch (0·63 centim.) diameter, with terminals nearly touching; at first it required 2400 cells to pass, then a single cell would do so, but after standing a short time it required 4800 cells to reproduce a discharge. In another tube $1\frac{3}{4}$ inch (4·4 centims.) long and $\frac{3}{8}$ inch (0·95 centim.) diameter), with the terminals distant 0·00104 inch (0·0264 millim.), it required 2240 cells to produce a discharge, then the potential had to be increased to 11,240 cells to do so. Ultimately even this number failed, but after the tube had lain by for some days 600 cells could pass. It is very possible that, the strong discharge in the first instance volatilised a portion of the terminals which were of platinum, and that this volatilised metal condensed afterwards, or else that the terminals absorbed the gas so completely as to produce a vacuum too perfect to admit of a discharge taking place; and that ultimately sufficient of the occluded gas was again given off to render it again possible.

In connection with the occlusion of gas by terminals a case is described in which the terminals are of palladium and the charge hydrogen (Fig. 2). After a few discharges the terminals occluded some of the gas, and when a fresh one was produced a volatile compound of hydrogen and palladium was given off, especially from the negative, and produced a dense, mirror-like coating on the inside of the tube (Fig. 3); this was reoccluded by standing for a couple of days, leaving the tube free, and again given off to form a new mirror-like coating with a fresh discharge; this property has continued since March, 1875.

The paper next describes experiments to ascertain the length of the spark in dry air and in air saturated with moisture. It was found to be practically the same in both cases. With 10,860 cells the mean length of the spark between two paraboloidal points was found to be in dry air 0·45 inch (1·1 centims.), in moist air 0·447 inch (1·1 centims.).

The next subject taken up is the discharge in a tube from two batteries, first in the same and then in contrary directions. In the tube are two terminals at each end, one pair at opposite ends being inclosed in two short pieces of tube 9 inches (22·8 centims.) long and $\frac{1}{2}$ inch (1·27 centims.) diameter; the main tube being 31 inches (95·2 centims.) long and $1\frac{3}{4}$ inch (4·4 centims.) diameter. The various phases of the stratified discharge are represented in an engraved mezzotint steel plate copied from photographs, and show the effect of the one stratified discharge on another stratified discharge produced by a second battery. It is seen that two discharges in contrary directions may take place in the same tube, and that the one modifies the aspect of the other.

Experiments are also described in a tube in the form of a cross with four arms at right angles (Fig. 4), with two separate batteries connected in various ways with the different members.

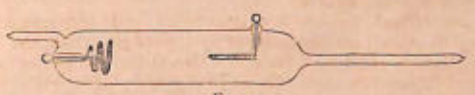


FIG. 2.

The experiments were made both in air and in hydrogen. By the introduction of external resistance of one of the batteries, the discharge could be readily identified as belonging to that battery by the effect of the resistance on the character of the stratification. In one of the mezzotint plates are several figures copied from photographs which show clearly the phenomena produced. Calling the poles P and N of one battery, A, and P′ and N′ of the other, B, it is shown in one case when two currents were equal 0·0083 ampere, that a discharge from A battery goes from P in the direction of N only so far as the junction at the cross, and then turns off to N′, the negative of the other battery B; while, on the other hand, the discharge of the B battery goes from P′ to N of the A battery. The case is different if an external resistance is introduced in one of the discharges, reducing it to 0·00087 ampere, then the discharge of the A battery goes from P to N, and that of the B battery from P′ to N′. There is a bending down, however, of the strata of the weaker discharge of the cross junction, in consequence of the action of the stronger one.

The authors remark that one cannot but be impressed, from the experiments described in the paper, and others in their former papers, by the apparent plasticity of the aggregate assem-

FIG. 3.

blage of molecules constituting a stratum which yields to external influences that modify its form.

The authors describe and figure a case of complex strata in the form of an outer bracket convex towards the negative (Fig. 5), and close to it an inner chord; also discharges in various gases in tubes of large dimensions, 37 inches (94 centims.) long, and $5\frac{1}{8}$ inches (14·8 centims.) diameter. In these the stratification, which is comparatively narrow at the terminals, extends in a conical form from the terminals to the full diameter of the tube.

They have found that the dark space in the discharge in vacuum tubes is only relatively actinically dark in comparison with a stratum, and they succeeded in obtaining a photograph of the dark space in thirty-five minutes as strong as that from a stratum in two and a half seconds; consequently they conclude that the dark space is 840 times less actinically bright than a stratum.

The authors next describe a number of experiments, by means of a Thomas-Becker electrometer used on a method, to avoid leakage, proposed to them by Prof. Stokes, to ascertain the difference of potential in different parts of a vacuum tube having a number of rings sealed within it, also in other tubes of special construction. These bring out instructive information, in reference not only to the relative resistances of different lengths of a

[1] Abstract of a paper read at the Royal Society on June 14, by Warren De La Rue, M.A., D.C.L., F.R.S., and Hugo W. Müller, Ph.D., F.R.S.

column of gas at various pressures, but also forcibly to the impediment presented by the terminals themselves to the passage of a discharge from gas to terminal and terminal to gas.

It is shown that, at moderate exhaustions, the resistance to the passage of the discharge is uniform along the length of the column of gas, and that at high exhausts it is not so, and that the total resistance increases but slightly with an additional length of the column; moreover, that, at these low pressures, the main impediment is in the passage of electricity between gas and terminal or terminal and gas; this is much greater at the negative than at the positive terminal.

The authors have next studied the electrical condition of a gas in the immediate vicinity of the negative terminal. In order to do this they constructed a tube 4½ inches (11·4 centims.) long and 1⅛ inches (4·8 centims.) diameter. One terminal is in the form of a point, the other in the form of a ring. The positive pole of the battery was connected with the point, and the negative either to the ring alone or to earth as well; the ring terminal of the tube was, when the battery was insulated, connected with earth either by means of a stout wire or 3 feet (91·4 centims.) of fine platinum wire, 0·002 inch (0·005 centim.) diameter, and offering a resistance of 81 ohms, or a moistened

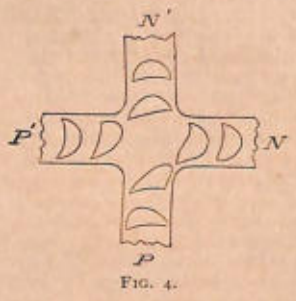


FIG. 4.

FIG. 5.

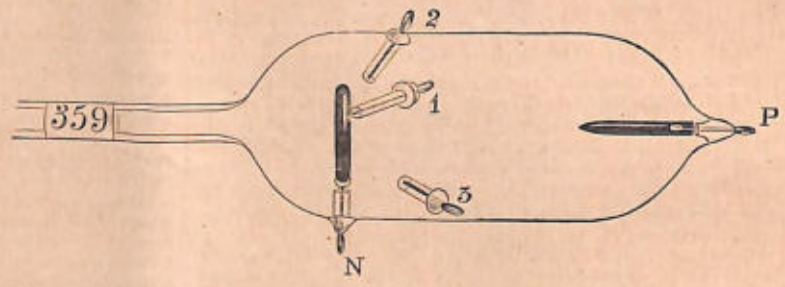


FIG. 6.

cork offering a resistance of 4,300,000 ohms. In the tube were sealed three idle wires, 1, 2, 3, covered with the exception of their extremities with fine glass tubing (Fig. 6). No. 1 idle wire is 0·002 inch (0·005 centim.); No. 2 0·2 inch (0·5 centim.); and No. 3 0·6 inch (1·5 centims.) from the ring. The ring terminal, when connected to earth, was found to be always at zero potential; notwithstanding this there was frequently observed, more especially as the exhaust was increased, a negative potential when the idle wires were connected successively with the electrometer, amounting in one case with an air charge, pressure 0·01 millim., at wire No. 2, to 1068 cells, at wires 1 and 3 to 912 cells. At other times a plus potential was observed. Many experiments were made to determine the precise conditions which developed a negative potential or a positive potential, but unsuccessfully, and it was inferred that this depended on the condition of the discharge itself within the tube. It is certainly very remarkable that, while the potential of the negative ring was absolutely zero, a high negative potential should be developed in its near vicinity.

The authors remark that every one familiar with the appearance of a stratified discharge will have noticed when the negative terminal is a ring, that as the exhaust proceeds a spindle of light

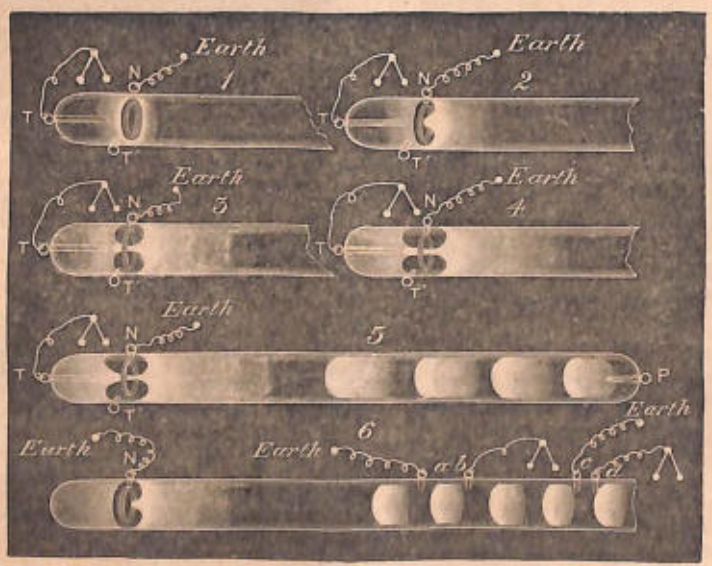


FIG. 7.

approaches and at last protrudes through the interior of it (Fig. 7, 1, 2, 3, 4, 5); this spindle they regard as a visible exponent of strong action among the molecules of gas composing it. In order to probe its electrical condition they prepared a tube with a central idle wire surrounded by a minute glass tube, except its extremity, and projecting to a distance of ⅛ inch (0·95 centim.) from the plane of the ring, which was made negative. Another idle wire was sealed in the tube 0·15 inch (0·38 centim.) from the periphery of the ring. As the exhaust proceeded with a charge of carbonic anhydride, the spindle approached the ring and ultimately protruded through it. It was found that the potential of the central idle wire increased with the exhaust, until it nearly or quite equalled that of the whole tube; while that of the external idle wire was only 0·054 that of the tube.

A great number of experiments were made to test the potential across a stratum *a*, *b*, and across a dark space *c*, *d*, respectively, by two idle wires sealed in suitable positions in a tube, one of which was connected with earth, the other with the electrometer (Fig. 7, 6). The gases used were carbonic anhydride and hydrogen respectively. As a mean of a great number of experiments it was found that when a dark space was straddled,

the potential being reckoned 1, then when a stratum was straddled the potential was 1·243, 1·229.

On testing two idle wires distant ⅛ inch (1·6 centims.) apart with a Thomson-Becker galvanometer, the current in this fractional part of a tube was found to go frequently in the reverse direction to that of the main current, and when the galvanometer was connected to two idle wires diametrically opposite, currents

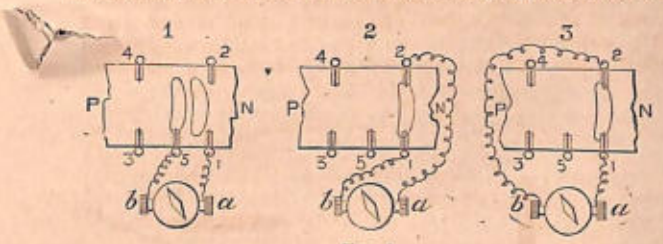


FIG. 8.

were indicated sometimes in one direction, sometimes in another across the tube (Fig. 8). These experiments seem to indicate that there are eddies in the gas during a discharge, as if the motion of the molecules conveying an electric discharge was of an epicycloidal character. The authors conclude by saying that it is possible that the eddies may be connected with the production of strata.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE

OXFORD.—We are requested to announce that the Savilian Professorship of Geometry is vacant, and an election to the office will be held before the end of Michaelmas Term (December 17). A Fellowship in New College is now annexed to the Professorship. The duty of the Professor is to lecture and give instruction in Pure and Analytical Geometry.

The combined emoluments of the office from both sources will be, for the present, 700*l.* a year, but may possibly hereafter be increased to an amount not exceeding 900*l.* a year.

Candidates are requested to send to the Registrar of the University their applications, and any documents which they may wish to submit to the electors, on or before Wednesday, October 31.

SCIENTIFIC SERIALS

Bulletin of the Belgian Royal Academy of Sciences, June.—On the action of amygdaline during the germination of bitter almonds, by M. A. Jorissen.—Determination of the specific heat of some organic bodies; variations experienced by this quantity through change of temperature, by M. de Heen. Of the eleven substances examined, three only—the formic salts of sodium, calcium, and barium—maintained a perceptibly constant specific heat within the limits of a temperature ranging from 10° to 93° C. A considerable increase of specific heat was shown by most of the other bodies tested.—Note on a double series of equations, by M. E. Catelan.—Anatomical study of the Æschnines (*Æ. grandis* and *heros*), by Baron Edm. de Selys Longchamps. Appended is a complete tabulated classification of the Æschnideæ (Æschna of Fabricius and Latreille).—On a deposit of *Oldhamia radiata* (Forbes) recently discovered in Tubize, Brabant, by M. C. Malaise. From its position in the Brabant schistose system the author is induced to refer this rock to the Lower Cambrian formations.—Attempted determination of the relation $\frac{C}{A}$ of the principal momenta of inertia in the terrestial spheroid, by M. E. Ronkar. In this paper a twofold series of calculations are made, based respectively on the hypotheses of Lipschitz and Laplace regarding the mean density of the crust of the earth.—Note by the editor on the explanation of the prevailing blue colour in large volumes of pure water advanced by M. Montigny.

Annalen der Physik und Chemie, July.—Electrical researches, by G. Quincke.—Researches on the slow discharge, by Heinrich Hertz, with six diagrams.—On the difference in the discharge from the positive and negative electrodes, by H. Hellman of Riga.—New observations on the thermo- and actino-electricity of rock crystal as a reply to a memoir of C. Freidel and J. Curie, by W. Hankel.—On the variation of the magnetic coefficient with the hardness of steel, by Hugo Meyer.—On the coefficient of friction of mercury and its variation with the temperature, by Synesius Koch, with three diagrams.—Theory of light for perfectly transparent light, by W. Voigt.—Concerning the theory of light, by E. Lommel.—On the sound of impinging flames, by K. Noack (three diagrams).—A new apparatus for showing Foucault's streams, by Dr. A. von Waltenhofen.—On the relation between the fundamental note and overtones of transverse vibrations in open metal cylinders, by Hugo Feukner.—On the reciprocal of the strain of closely-tuned elastic bodies, by Dr. G. Krebs.

SOCIETIES AND ACADEMIES

SYDNEY

Linnean Society of New South Wales, June 27.—Prof. W. J. Stephens, M.A., in the chair.—The following papers were read:—Descriptions of new genera and species of fishes by Charles W. De Vis, B.A. Two genera are described, *Dactylophora* of the family *Cirrhitidæ*, and *Leme* of the family *Amblyopina*. The new species described are: *Girella carbonaria*, *Girella neuralis*, *Dactylophora semimaculata*, *Platycephalus semermis*, *Polynemus specularis*, *Leme mordax*, *Sphyræna strenua*, *Trochocopus sanguinolentus*, *Labrichthys dux*, *Plagusia notata*, *Synaptura cinerea*, and *Crossorhinus ornatus*.—A fourth paper on plants indigenous in the immediate neighbourhood of Sydney, by Mr. E. Haviland.—Localities of some species of Polynesian recent mollusca, by John Brazier, C.M.Z.S., &c.

PARIS

Academy of Sciences, August 6.—M. Blanchard, president, in the chair.—Preliminary reports on the transit of Venus, December 2, 1882, at the Transit Stations of Haiti, by MM. D'Abbadie, Callandreau, and Chapuis; of Mexico, by MM. Bouquet de la Grye, Héraud, and Arago; of Martinique, by MM. Tisserand, Bigourdan, and Puiseux; of Florida, by M. Perrier; of Patagonia, by M. Fleuriais; of Chili, by MM. de Bernardières, Barnaud, and Favereau; of Chubut, by M. Hatt; of Monte Video, by M. de Penfentenyo; of Rio-Negro, by M. Perrotin; of Cape Horn, by M. Courcelle-Seneuil; of Bragado, by M. Perrin. These reports, deposited with the Secretary of the Academy on the return of the several expeditions, are here collected together for the convenience of astronomical students.—Active or dynamic resistance of solids. Graphic representation of the laws of longitudinal thrust applied to one end of a prismatic rod, the other end of which is fixed (concluded), by MM. de Saint-Venant and Flamant.—In reply to a recent communication by M. Jamin on the critical point of liquefied gases, a letter was read from Mr. W. Ramsay, who claims priority of discovery, and points out that he had already determined the critical point in a memoir which appeared in the *Proceedings of the Royal Society* for April 22 and December 16, 1880.—On the application of Ampère's method to the investigation of the elementary law of electric induction by variation of intensity, by M. Quet.—On boron, by M. A. Joly. In this paper the author determines the existence of a combination of boron and carbon, reserving for a future communication a study of the various compounds containing these two elements.—On the blood plaquettes of M. Bizzozero, and on Norris's third or invisible blood corpuscle, by M. G. Hayem. It is shown that the so-called "plaquettes," claimed by Bizzozero as a new discovery in the Italian *Archives of Biology* for January, 1882, *et seq.*, are simply the "hæmatoblasts" already described by M. Hayem. On the other hand Norris's "third or invisible corpuscle," which had been identified with the hæmatoblasts, appears not to be a new element at all, but merely an artificial product resulting from the various manipulations to which the blood had been subjected by the English observer.—Experimental researches on some phenomena relative to the absorption of animal fats, by M. A. Lebedeff.—On the true character of the ophthalmic affection known as astigmatic keratite, by M. G. Martin.—New researches on the curve of the muscular shock in various affections of the nervo-muscular system, with three illustrations, by M. Maurice Mendelssohn.—Influence of sea water on freshwater animals, and of fresh water on marine fauna, by M. Felix Plateau.—On barometric pressure in connection with igneous eruptions, by M. Fr. Laur. It is argued that gaseous and other eruptions are due exclusively to rapid variations of atmospheric pressure.

BERLIN

Physiological Society, July 20.—Prof. Kronecker reported a number of investigations recently carried out in the division of the Physiological Institute under his care: Dr. Openschewsky had continued his observations, communicated at the meeting of June 15 (NATURE, vol. xxviii. p. 264), regarding the influence of the vagus on rhythmical movements of the cardia produced by artificial anæmia. As the result of his further examination he found that the vagus sent two branches of nerves to the cardia: one causing its contraction, the other, when alone stimulated, its dilatation. In the vagus trunk the enlarging nerves were in the preponderance, and, on the whole of the vagus being stimulated, induced an interception of the contractions of the cardia. In a demonstration of the experiment it was shown that after destruction of the stimulating branch of the vagus the irritation of its trunk invariably provoked dilatations of the cardia.—Dr. Jacub had made experiments regarding the strength and rhythm of the movements of the uterus, and regarding the influence on these movements of a number of substances, such as secale, ether, chloral, strychnine.—Herr Aronsohn had instituted a long series of observations on the physiology of smell, observations which he himself communicated to the meeting. It is well known that Weber, from experiments made with eau-de-cologne, had laid down the statement hitherto universally accepted that gaseous substances were alone capable of stimulating the extremities of the olfactory nerves. In opposition, however, to this doctrine there was the fact of fishes being able to smell, a fact Herr Aronsohn conclusively established. Ants' eggs, which are greedily devoured by goldfishes, he saturated with a strong flavour of asafœtida, and on placing them within reach of a number of hungry goldfishes they all darted away from the otherwise savoury food. He therefore repeated Weber's experiment exactly in the manner prescribed, and had, like him, his sense of smell affected only during the infusion of the eau-de-cologne solution. Immediately, however, such an intense sensation of pain was experienced, that the experiment had very soon to be abandoned. It was evident that Weber's solution was much too concentrated, and that in order to achieve trustworthy results dilutions of much larger proportion would have to be made use of. Moreover, for the purpose of solution, instead of the water which produced so powerful an effect on the tissue, the common salt solution of '6 per cent., which was of indifferent effect, would require to be employed. Finally the due temperature would have to be imparted to the fluid. Under these conditions a long series of experiments was now instituted with oil of nettles, camphor, eau-de-cologne, and other smelling substances. In far the greater number of cases these experiments yielded positive results. Granted that the solutions had the necessary degree of dilution (which among the different materials varied from '1 to '001 per cent.) and the due temperature (which might range from 37° to 62° C., though from 40° to 44° C. proved the most suitable), then on their application to the nostrils a decided and lasting smell was perceived. These experiments were not only carried out by Herr Aronsohn himself, but were repeated by other competent observers, the due degrees of dilution and temperature, which differed according to the different observers, producing always the same effect. The result in the one case as in the other was invariably positive, and went to refute the hitherto current notion that gaseous substances alone affected the sense of smell and that fluids had no effect on the olfactory nerves. On emptying out the fluid there was mostly always left a scent of which one remained sensible for a very considerable time. Contrary to former declarations, the breath emitted from the lungs also decidedly affected the olfactory nerves, provided the experiment were conducted in such a way that the particles to be smelled on expiration could reach the upper parts of the nostril. Herr Aronsohn finally made observations tending to establish the liability to weariness of the sense of smell, a fact of which any one might readily convince himself by the following experiment:—Let him take two roses, A and B, as like each other as possible; let him now first smell A for fifteen consecutive seconds, and then on trying B he will find it has very much less scent, or none at all. Let the olfactory sense now recover itself, and then let him, conversely, first smell B for fifteen seconds, and pass to A; he will now find the same defective or negative scent in A as formerly in B.—Dr. Kireef directed his observations towards the discovery of the conditions determining the fact that now and again, by the cutting of one carotid animals could not be bled, but in order to this end a second carotid must also be cut. In the pursuit of this problem a series of important facts came to light demanding further searching study, and which therefore can here for the present only be alluded to. In all the larger arteries it has been observed that on the cutting of a blood vessel only a certain fraction of the total blood, from about two-thirds to five-sevenths, runs away, and then without any visible cause the bleeding stops, though the wound is still gaping wide, and no thrombus is forthcoming. Let another equally large artery be opened, and a quantity of blood, often considerable, will issue from it in turn, and then of itself cease; and still a third artery may be cut, which will again yield a further bleeding. The quantity of blood circulating in the body has no influence on this phenomenon. From a certain artery the same quantity of blood was discharged, alike whether a '6 per cent solution of common salt was beforehand largely injected into the animal, or a portion of blood withdrawn from it beforehand. Just as little influence has the blood pressure on the quantity of blood shed through the cutting of a larger artery. In an animal one *arteria femoralis* was freely cleared out of its integuments for a considerable extent of its surroundings, while another was left in its natural position. The last on being cut shed a certain quantity of blood at double the speed, *i.e.* in half the time taken by the freely cleared artery. The vagus showed a very remarkable influence on the bleeding from a cut artery, an influence to be further traced and demonstrated in the continuation of the experiments.

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THURSDAY, AUGUST 30, 1883

THE BRITISH ASSOCIATION

SOUTHPORT has been selected for the meeting of this body in 1883, and the fifty-third annual session will commence on the 19th and end on the 27th of September. It is not necessary to dilate upon the various reasons which led up to this arrangement. Suffice it to say, that there was strong opposition on the part of considerable University and manufacturing cities; and the success of Southport may, no doubt, be in great part attributed to the enterprise and business zeal which, within two generations, have raised it from a seaside village to a populous, well-built, easily accessible corporate borough.

To many people, perhaps the majority, in the southern counties, Southport is a name, and nothing more. It is doubtful whether the topographical knowledge of most educated Southerners would enable them to say, offhand, in what county it is situate. No one, however, has probably once visited the town without finding many things to admire and buildings to surprise. We may be pardoned for saying that Southport is less than eighteen miles from Liverpool, thirty-six from Manchester, sixteen from Preston; Wigan, Blackburn, Bolton, Burnley, Oldham, and other large centres of manufacture being within easy distances. It should be enough to say that a circle, having its centre at the Town Hall, with a radius of forty miles, would include 4,000,000 people. The public buildings are handsome and commodious, and every accommodation is at hand to render the forthcoming gathering, even if very large in number, a perfect success.

Liverpool being so near, a well-founded hope exists that the town will be honoured by a visit from numerous American, colonial, and foreign men of science. It must not be forgotten that Edinburgh and Dublin, Glasgow and Nottingham, Newcastle and Birmingham, are all within ready access of Southport.

Southport is about five hours from London, and has through communication by two railways with every important town in the United Kingdom.

On this occasion the Reception Room will be at the Cambridge Hall; the Council Room in the same building; the evening meetings and *conversazioni* will take place in the Winter Gardens, which have been specially retained wholly for this purpose; the General Committee Room will be at the Town Hall; Sections A and B at the Atkinson Art Gallery; Section C at the Temperance Hall; Sections D_1 and D_2 respectively at the West End and at the Congregational School Room; Section E at St. George's Hall; Section F at St. Andrew's Hall; and Section G at the Town Hall. After this list, no one can doubt that there is ample accommodation, both for the members as a body, and for the several Sections.

There are several first-class hotels, capable alone, it is estimated, of boarding and lodging 1000 people or more. Apart from this, there are houses where apartments are available to any reasonable extent. Probably the various "company"-houses, as they are styled locally, could accommodate between 10,000 and 12,000 persons. In addition to the regular places of this sort, many more householders are prepared to become amateur lodging-house keepers for the time in case of need. The Secretaries and Recorders of Sections will be boarded and lodged in houses on the Promenade, facing the sea, and within three minutes' walk of the Winter Gardens, or four to six minutes from the Reception Room, which is in the centre of the town.

Dealing in detail with the arrangements for the meeting, it may be mentioned that the Local Executive Committee has for chairman Dr. James Wood, Mayor of Southport. Among other members of the Committee in question, the names are found of the Earl of Derby, the Earl of Crawford and Balcarres, the Earl of Lathom, Prof. Greenwood, and Prof. Roscoe (all of whom are also vice-presidents of the Association for this year). Committees have been formed to deal with hospitality and lodging arrangements, excursions, *conversazioni* and evening meetings, audit and finance, and the lecture to the operative classes. The local secretaries are Mr. J. H. Ellis (the Town Clerk), Dr. H. H. Vernon, and Mr. T. W. Willis (B.A. Cantab.).

The retiring president, we may remind our readers, is Sir C. William Siemens, and the president-elect is Prof. Arthur Cayley, Sadlerian Professor of Mathematics in the University of Cambridge.

The first general meeting will be held on Wednesday, September 19, at 8 p.m., when Sir William Siemens will resign the chair, and Prof. Cayley will assume the presidency and deliver an address. On Thursday evening, September 20, at 8 p.m., there will be a *soirée* in the Winter Gardens; on Friday evening, September 21, at 8.30 p.m., a discourse on recent researches on the distance of the sun, by Prof. R. S. Ball, Astronomer-Royal for Ireland; on Monday evening, September 24, at 8.30 p.m., a discourse on galvanic and animal electricity, by Prof. J. G. McKendrick, Professor of Physiology in the University of Glasgow; on Tuesday evening, September 25, at 8 p.m., a *soirée* in the Winter Gardens; and on Wednesday, September 26, the concluding general meeting will be held at 2.30 p.m.

It must not be forgotten that on Saturday, September 22, at 7 p.m., a lecture to working people will be delivered by Sir F. J. Bramwell on "Talking by Electricity: Telephones"; it is expected that the usual flock of Saturday excursionists will furnish an overflowing audience.

In connection with the *soirées*, it may as well be stated here that there is to be an exhibition of objects of scientific and artistic interest in the covered skating rink, a very prominent feature of which will be an exceptionally complete installation of electric lighting on the Siemens system. We believe that this last is intended to be one of the most complete exhibitions ever yet seen of its kind. There will also be in the large Pavilion (where the presidential address and evening discourses will be given, and concluding general meeting held) an exhibition of Lewis's improved system of incandescent gas lighting. This will also be given on the nights of the two *conversazioni*. The entries for other classes of exhibits (microscopes, &c.) are very satisfactory.

A feature of these yearly gatherings is the arrangement for excursions to places of interest in the neighbourhood of the town selected from year to year. These are very numerous this time, and include Knowsley, Lathom House, Ince Blundell Hall, the Abram Colliery, Stony-

hurst College and Whalley Abbey, the Lake District, Haigh Hall, St. Helen's and Widnes, the Wigan Coal and Iron Company's Works, Chester and Eaton Hall, Liverpool (including a visit to a White Star steamer and a run along the dock's front), Clitheroe District (Geological), and others which may be announced in these columns next week.

Rufford Park and Rufford Old Hall will also be visited, as well as the county town, Lancaster, which deserves more than passing mention. There is the old church there, the ancient castle (the residence, ages ago, of John of Gaunt), aqueducts of some importance, the Roman camp in the vicarage grounds, the assize courts, and many other objects of attraction and public buildings, including asylums and hospitals of ancient and of modern establishment, and of very various character.

There will be garden parties at Knowsley (by the kindness of the Earl and Countess of Derby), at Lathom House (on the invitation of the Countess of Lathom), and at Ince Blundell (the residence of Mr. T. Weld Blundell). In addition, the Mayor of Southport will give a garden party at Hesketh Park on Friday, September 21; and it is rumoured that he will also have two afternoon receptions, on days to be arranged hereafter, at his own residence, Woodbank. The Rev. C. Hesketh Knowlys, the rector of the mother parish of North Meols, will also give a garden party in his grounds.

The three railway companies running into the town, two of which have terminal stations at Southport, are all offering advantages and facilities in order to help making the meeting a success. For instance, the London and North Western Railway will run through carriages to Southport on September 17, 18, and 19, from London (Euston Station), Willesden Junction, Northampton, Stafford, and Crewe, by the 7.15 a.m., 11 a.m., 1.30 p.m., 3.0 p.m., and 4.0 p.m. trains, and similar arrangements will be carried out for the return journey.

Liberal arrangements have also been made by the local railway companies for the benefit of excursionists to the many attractive districts in the north and west of England.

The arrangements at the Reception Room in Cambridge Hall will be of the usual complete kind at these gatherings, including postal, telegraph, ticket, reserved seats, lodgings, inquiry, lost property, daily journal, members' lists, local programme, guide-book, and other departments. The hall has been newly decorated throughout for the occasion, and, when furnished and in full work, will doubtless bear favourable comparison with similar rooms at previous meetings of the Association. The telephone will also be brought into play, so as to connect all the Section Rooms both with the Reception Room and the Winter Gardens, as well as with the principal hotels and other large establishments in the town.

A local fund has been raised of over 2600*l.*, and strenuous efforts are being made to increase that amount to 3000*l.* This will most probably be accomplished.

Looking to all these facts—bearing in mind that Southport has a promenade of over a mile facing the sea, on which are three of the chief hotels and a string of handsome private residences and lodging-houses; a pier, which, with its extension, is within a few hundred yards of a mile in length; the boulevards (in Lord Street and its continuations east and west), bordered by handsome edifices, public buildings of no mean architectural pretension, banks, &c.—enough has been said to justify the hope that Lancashire will once more distinguish herself as the hostess of the British Association, as she undoubtedly did in 1870 (the 'last time that it met within her borders), when, under the presidency of Prof. Huxley at Liverpool, one of the most characteristic, as well as one of the most numerously attended and in every way brilliant and successful meetings of the British Association was held.

PROFESSOR HAECKEL ON CEYLON

A Visit to Ceylon. By Ernst Haeckel; Translated by Clara Bell. (London: Kegan Paul, Trench, and Co., 1883.)

WHEN a man of scientific genius writes a popular book, it will generally be found to be either a great success or a great failure; mediocrity, as a rule, does not attend the work of such a man in either direction. Now Prof. Haeckel is already well known to all the world as one of the few leaders in science whose literary ability is on a level with his more professional attainments, and whose genius is therefore exhibited in exposition as conspicuously as it is in research. Thus it was that when we heard he intended to publish a popular account of his six months' travel in the tropics, we expected a great treat in the way of literary performance. We had, of course, read a good deal about Ceylon before, and thus knew that it was a part of the world which in point alike of natural scenery and natural history was well calculated to arouse the enthusiasm of such an artistic-minded naturalist as Prof. Haeckel; and knowing that his pen can paint almost as vividly as his brush, we were prepared for something of unusual interest in the story of his "Visit to Ceylon." Perhaps, therefore, it is not possible to say anything in higher praise of his book than that it has even surpassed our anticipations. The man of science has retired, as it were, into the background, and left the way clear for the man of letters, the shrewd observer of men and things, the poetic lover of Nature—the frank, open-hearted, wide-minded German character which finds so admirable an expression in this great German biologist. Whether he is diving down among the coral reefs, forgetting his wounds in the keen joy of exploring the beauty and the wonder of those biological treasure-houses, or whether he is scrambling to the "World's End" through almost untrodden and untreadable jungles 8000 feet above the sea; whether he is moving in English society and deeming it needlessly formal in the matter of dressing for dinner under a tropical climate, which has turned his carefully-provided swallow-tail coat as white as a sheet with mildew; or whether he is living for six weeks at a time zoologising in a remote native village without ever seeing a white man—wherever he is and whatever he is about, we are alike charmed by the character of the man which unconsciously looks out at us in every page, and throws around him, as it were, a halo of romance.

We have said that in all this the man of science has been allowed to retire into the background. But not on this account has the man of science been idle. Prof.

Haeckel went to the tropics to work and not to play, and work he did, with a vigour and pertinacity which, under the circumstances described, can only be called astonishing. To have gone out day after day and week after week surface-fishing in an open boat beneath the almost vertical rays of a tropical sun, is in itself to have performed a feat of physical endurance which, so far as we [illegible]ware, has never been performed by any other natu[illegible]st; and to have worked steadily for half a year from daydawn to night, exploring, collecting, and investigating as Haeckel investigates—feeling all the while, as he expresses it, that each day was costing him, as a mere matter of money, somewhat over 5*l.*—to have worked thus would have been to exhaust the strength of many a younger man even in a much higher latitude than that of Ceylon. The results attained by such a naturalist in such a region, and working at such a pressure, of course constitute an immense harvest—so much so, indeed, that he thinks he has more material in his collections than the term of his natural life will admit of his sufficiently investigating. But with all this, he has wisely avoided burdening his account of "A Visit to Ceylon" with any details of his scientific labours. The book is intended for general readers, and while a sufficient number of scientific observations on the flora and fauna of the island are thrown in here and there to complete the picture which he gives of the place, these are always judiciously subordinated to the main design of speeding an honest tale by telling it plainly.

After an entertaining account of his voyage and of a week spent in Bombay, the traveller proceeds to give his first impressions of Ceylon. He is most of all struck with the magnificent luxuriance of the tropical vegetation, some of his descriptions of which are admirable specimens of word-painting. Everywhere he meets with the greatest kindness and courtesy, of which he is lavish in his acknowledgments. Having been a guest at various houses, visited and studied botanical gardens, made sundry excursions, &c., he eventually sets up a zoological laboratory upon the coast. This having constituted the main object of his journey, he had taken with him sixteen large packing cases filled with all the equipments required for zoological and morphological research. The choice of site lay between one or other of two sheltered bays—Galle and Belligam. At the former he would have the advantage of living among civilised Europeans, and of being the guest of the hospitable and cultivated English consul, Mr. Scott, of whom he speaks in terms of high esteem; at the latter he would be the only European within a radius of many miles, and require to take up his quarters in a small government house. Such being the circumstances, he says:—

"After much hesitation, and long debating the *pros* and *cons*, I finally decided for Belligam, and I had no reason to regret the choice. The six weeks I spent there were full to overflowing of wonderful experiences, and never to be forgotten as forming the crowning 'bouquet' of my Indian journey, the sweetest and brightest flowers in a garland of delightful memories. Though I might perhaps have carried on my zoological studies better and more conveniently in Galle, I gained infinitely more on the side of general knowledge of nature and humanity in the charming seclusion of Belligam."

If the naturalist had no reason to regret this choice, assuredly his readers have not, for the account which follows of his residence among the natives is the most entertaining part of his narrative. On his first arrival he is met by a general assembly of the inhabitants, his advent having been expected in consequence of the governor of the island, Sir James Longden, having written to the native officials "to be in all respects civil and serviceable." The civility in the first instance takes the form of series of ceremonious addresses presented to him by one native magnate after another, emphasis being given to the close of each by "a grand rattle of drums performed by a row of tom-tom beaters squatting in the background." These high functionaries presented in their dress a sort of hybrid between the European and the Cinghalese. "Beginning at the top, a tall English chimney-pot charmed the eye—of all head coverings beyond a doubt the most hideous and inefficient. However, as the Cinghalese see Europeans wear this cylindrical headpiece on all solemn occasions as the indispensable symbol of birth and culture, never abandoning it even in the greatest heat, they would regard it as a serious breach of etiquette to appear without the singular decoration." Below the hat there came "an enormously high and pointed white shirt-collar, and a coloured silk scarf tied in a bewitching bow." Then a swallow-tailed dress coat, white waistcoat with jewelled buttons and gold chains. But instead of trousers wherewith to complete this grotesque imitation, each of the dignitaries ended off in a red or party-coloured petticoat and bare feet.

Having suitably acknowledged this unexpected ceremony, Prof. Haeckel sets to work unpacking and setting up his laboratory in one of the rooms of the government house. From that moment throughout his stay of six weeks he is pestered by the insatiable curiosity of the entire neighbourhood, and even by that of native visitors from a distance, which on one occasion presented themselves in the form of four old maiden ladies of distinction, "each more wrinkled and hideous than the last," who desired to be instructed in science and to have their photographs taken. The Professor is here ungallant enough to remark, "If they had been but three, I could have mistaken them for the three Phorcydes, the witches of the classical Sabbat, and might have made myself agreeable to them after the fashion of Mephistopheles." Hoping to satisfy the universal curiosity in a collective manner, he tried the experiment of giving lectures through an interpreter; but he found that there was no spark of real scientific interest underlying the childish desire to see something new. However, he managed to get on admirably with all around him, gave away multitudes of presents in the shape of coloured prints, &c., presided one day over the grand Buddhist festival for the 19th of December, and on the 20th filled the same office of president at the annual festival of the Wesleyan mission. "I had done honour to the sublime Buddha yesterday, and to-day I must pay tribute to worthy Mr. Wesley. . . . My friends in Galle and Colombo, who heard through the papers of my extraordinary proceedings, laughed at me 'consumedly.'"

But we have no space to give any sketch of the strange experience of these six weeks' sojourn among the primitive natives, so curiously composed of the instructive, the æsthetic, the ludicrous, and the pathetic. We have said

enough to show that the book ought to be read by every one, and therefore we shall now conclude by drawing more prominent attention to sundry opinions and suggestions, which, as Englishmen, we should desire to see our Government consider and act upon.

First, as regards the promotion of science:—

"The extraordinarily favourable climate and position of Peradenia especially fit it for more extensive use from a scientific point of view as a botanical station. In the same way as our young zoologists find the recently established zoological stations on the sea coast (at Naples, Roscoff, Brighton, Trieste, &c.) of inestimable value for their deeper scientific studies and experiments, a year's residence in such a botanical station as Peradenia would give a young botanist more experience and work than he could obtain in ten years under the various unfavourable conditions at home. Hitherto, less has been done in the tropical zones than elsewhere for such establishments for study and experiment, though they would be exceptionally beneficial. If the English Government would establish and maintain such a station for botany at Peradenia, and one for zoology at Galle—in the charming bungalow, for instance, belonging to Capt. Bayley, which is admirably suited to such a purpose [and would be sold by the owner to effect it]—they would be doing signal service to science, as they have already done by the *Challenger* Expedition and other great undertakings—and once more put to shame the great Continental States of Europe, who spend their money chiefly on breechloaders and big guns."

In reading this passage all true Englishmen should feel regret that their Government is not deserving of the meed of praise which the courtesy of the writer bestows. Seeing that we are the great maritime and colonising power, it is nothing short of a public disgrace that we are without a zoological station upon any of our thousands of miles of coast, and that hitherto there is no prospect of our escaping from the sarcasm (whether conscious or unconscious) wherewith the national seat of "deeper scientific studies and experiments" in marine biology is here specified as *Brighton*. Is it too much to hope that the Fisheries Exhibition may at length help to open the eyes of a Liberal Ministry to the importance of doing something in this direction?

Only in one particular does the English rule in India fall under censure, and this has reference to the atrocious treatment of the stage-coach horses. The scenes described are certainly monstrous beyond imagination—flogging by the whole village, dragging by the nostrils, wringing by the ears, and burning with torches. Truly, as Haeckel observes: "It is difficult to conceive how the English Government, which is generally so strict in its arrangements and discipline, has not long ago put an end to this brutality to animals, and more particularly extended its protection to the wretched horses that serve the 'Royal Mail Coach.'" Here is surely something for the anti-vivisectionists to memorialise upon with benefit.

We cannot take leave of this delightful book without congratulating the translator on the beautiful English into which she has rendered it.

GEORGE J. ROMANES

OUR BOOK SHELF

Elements of Histology. By E. Klein, M.D., F.R.S., &c. (London: Cassell and Co., 1883.)

THIS, which is the first of Cassell's "Manuals for Students of Medicine," contains 342 closely-printed pages, with 168 well-executed woodcuts, mainly reproduced from Klein and Noble Smith's "Atlas of Histology," or the "Handbook for the Physiological Laboratory," intercalated in the text. It is not too much praise to say that the information in this little volume is generally very complete, quite up to date, and written in a concise, though, at the same time, thoroughly clear style.

Dr. Klein wisely omits all reference to the titles of works and papers, introducing where necessary simply the name of the discoverer of, or observer most intimately associated with, the structure referred to. Where different opinions exist, this is obviously convenient, and the right thing to do; but why on page 7 the names of fifteen histologists, followed by the words "*and many others*," should be given, it is difficult to understand, especially as they are quoted with reference to the indirect division of nuclei or Karyokinesis, of which every worker at histology must have seen many examples.

In a work like the present, where all usually received ideas are given, it is curious to find that no reference is made to Schäfer's with regard to striated muscle. Surely this cannot be an accidental omission, especially as Haycraft is twice quoted.

That the action of tannic acid on human red corpuscles is not described in the text, although figured (p. 9, fig. 9*a*), is clearly an oversight, as that of boracic acid on newt's red corpuscles is both figured and described. In future editions it will be convenient if the same numbers be used in the text as in the diagram when describing the different parts of the kidney tubules, constant reference to the description of fig. 133 being now necessary.

With the exception of the above minor details, unqualified praise must be given, and the "Elements of Histology," which is really a very complete manual, should be used and re-used by every student and practitioner of medicine who wishes to acquire a sound knowledge of the normal histology of man. J. W. G.

LETTERS TO THE EDITOR

[*The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, or to correspond with the writers of, rejected manuscripts. No notice is taken of anonymous communications.*

[*The Editor urgently requests correspondents to keep their letters as short as possible. The pressure on his space is so great that it is impossible otherwise to insure the appearance even of communications containing interesting and novel facts.*]

"Elevation and Subsidence" again

A LETTER appears yesterday, again criticising Mr. Starkie Gardner's general views about pressure, in the same sense as was done by myself a fortnight ago. But, referring to that gentleman's opinion that pressure can render rocks molten or fluid, Mr. Young goes on to remark: "Is not the supposition the exact reverse of what is really the case, viz. that not only does pressure *not* liquefy rocks, but actually *prevents* their melting at a temperature at which they *would* melt were the pressure removed?" Your correspondent, offering this remark with a query, seems as if his mind was not quite made up on the subject; and with reason; for it must, I think, be considered at present an open question whether the temperature of rocky matter is, or is not, raised by pressure.

Sir W. Thomson stated, in an address to the Geological Society of Glasgow in 1878, that certain experiments by Dr. Henry Muirhead and Mr. Joseph Whitley seemed to show that iron, copper, brass, whinstone, and granite are less dense in the solid than in the liquid state at the melting temperature. If so, pressure would assist in liquefying these substances. On the other hand, some observations of Mr. Johnston-Lavis, made on lava at Vesuvius, point in the opposite direction. Granted that the earth is, as a whole, extremely rigid, we cannot gather from that fact any certain information about the effect of pressure on "rocky matter," when near the melting temperature. We do not know whether the nucleus of the earth consists of matter which could, under any conditions, be directly converted into surface rock; nor yet do we know anything certain about its

temperature at depths bearing considerable ratios to the radius. Indeed the state of our knowledge is best expressed by the words of the old song, "Oh dear! what can the matter be?" It is even conceivable that, whatever it be, it may be above its own critical temperature; in which case the laws affecting incompressible liquids become inapplicable.

An interesting paper upon this latter hypothesis was published by Prof. Zöppritz in the *Transactions* of the first Geographical Congress of Berlin, 1881. It is entitled "Ueber die Mittel und Wege zu besserer Kenntniss vom inneren Zustand der Erde zu gelangen," and published by D. Reimer, Berlin.

Harlton, Cambridge, August 24 O. FISHER

I OBTAIN NATURE in monthly parts, and am indebted to a friend for calling attention to the article on "Elevation and Subsidence" by Mr. J. Starkie Gardner in vol. xxviii. p. 323, in which he considers that, "wherever considerable weight is added to any part of the earth's surface, a corresponding subsidence of its crust almost invariably follows." As it is evident from the last paragraph in Mr. Gardner's paper that he esteems this opinion to be novel to the readers of NATURE, and being the first time it can be considered as having been discussed in your pages, it might have been more satisfactory perhaps had he passed in review the conclusions arrived at by others who have preceded him.

Sir John Herschel (see "Physical Geography," § 132, 1862, and "Familiar Lectures," Lecture I.), assumed in a general manner that "if continents are lightened they will rise; if the bed of the sea receives additional weight it will sink." It is to be regretted that the facts advanced as evidence by so great an authority did not prove sufficiently conclusive to claim general acceptance. Mr. T. F. Jamieson, F.G.S., in 1865 (*Quarterly Journal of the Geological Society*, vol. xxi. page 178), considered that the enormous weight of snow accumulated during the glacial period "may have had something to do with the depression of the land which then occurred, and that the melting of the ice at its termination would account for the rising of the land."

Under the advocacy of Prof. James Hall ("Palæontology of New York," vol. iii., 1859), the subject has received much consideration in America; this has been so great that Capt. C. E. Dutton, of the United States Geological Survey, was enabled to say that "few geologists now question that great masses of sedimentary matter displace the earth beneath them and subside" (NATURE, vol. xix. p. 251).

The principle that accumulation of material causes subsidence and that denudation results in elevation of the crust of the earth has been advocated by myself on numerous occasions during the last eighteen years, being considered equally applicable to rocks of every age during the whole series; in England from the Cambrian rocks of Shropshire to those now in process of deposition in the seas which surround our coasts. The idea originated to me from observations in the Longmynd and of the Upper Silurians of Shropshire and North Wales during 1864. Its universal application and the physical effects dependent on the phenomena formed the special subjects of two addresses as president of the Liverpool Geological Society in 1871 and 1872. The conclusions were deemed by NATURE (vol. vi. p. 379) of such importance that you considered my "interpretation of the facts deserved further consideration." Abstracts of these essays also appeared in the *Geological Magazine*, vol. ix. p. 119, and vol. x. p. 202. The views entertained have been subsequently advocated by me in the *Proceedings of the Liverpool Geological Society*, the *Geological Magazine*, and the *Reports of the British Association*, the last time being during the meeting of the British Association at Southampton (*Report*, 1882, p. 540), which paper has appeared in full in the *Geological Magazine* for July and August, 1883.

The only author who has considered this subject and to whom Mr. Gardner refers, is the Rev. O. Fisher, F.G.S., whom he deservedly praises for his masterly work, "The Physics of the Earth's Crust," 1881.

In spite of much adverse criticism I have been content to wait all these years, feeling convinced that after commendation similar to that accorded by you (by no means a singular occurrence), the subject of oscillation, as the result of changes in the distribution of sediments, would eventually be taken into consideration; for a frequent remark has been that "there appears to be something in it"; and no geological fact is more persistently referred to than that the formation of sedimentary strata of every age "*has occurred during a period of subsidence.*"

Birkenhead, August 22 CHARLES RICKETTS

"Decentralisation in Science"

I FULLY agree with the remarks on this important subject made in your leading article of last week; and the necessity for local scientific societies being in some way placed in direct communication with each other and with the central metropolitan societies has long been present in my mind. It is perhaps as yet premature to broach any definite scheme for effecting this object, which, as the writer of the article points out, would be surrounded by very great practical difficulties. The whole subject might very well be discussed by the Conference of Delegates about to attend the meeting of the British Association at Southport.

There are numerous scientific societies and field-clubs throughout the country whose work is being frittered away in useless directions solely from the want of proper scientific guidance. As a preliminary step towards this most desirable economising of individual energy it appears to me that centralisation in the various counties is the first essential. This has been well enforced in the Preliminary Report of the "Local Scientific Societies" Committee of the British Association, published in NATURE a short time ago by Mr. Francis Galton, the Chairman of the Committee.

It is most satisfactory to know that the British Association has taken the matter in hand, as this body is of all others the most competent to deal with the subject, if for no other reason because the Association is the only scientific society that holds its meetings in various provincial centres. Among the difficulties that would have to be met in any scheme of county affiliation not the least formidable is the purely local feeling existing in many small societies, which leads their officers and members to reject all overtures from larger and more influential bodies in the mistaken belief that cooperation would entail a loss of individuality. A good illustration of this kind of difficulty has quite recently come under my notice in attempting to bring about some kind of amalgamation between the local societies of the county of Essex.

Till such narrow views of the functions of a local society are successfully combated no great advance towards centralisation can be made. R. MELDOLA

21, John Street, Bedford Row, W.C., August 27

The Earthquake in Ischia

IN 1878, when touring in the Himalayas, we spent the last two Sundays in August at Kyelang, in the Lahoul Valley. On each of these days I felt a sharp shock of earthquake about 4 p.m.

On both occasions I was sitting in a room on the upper floor of the German missionaries' house. A broad wooden verandah runs round the front and sides of the lower floor of this building.

I was about to rise and leave the room, when I heard a loud rumbling noise; my first idea was that the children of the house were amusing themselves with dragging each other in a small wooden waggon up and down this verandah as they were in the habit of doing, but the sound was much louder, as loud as that of a railway train when near the spectator. A second later I felt a violent oscillation, and a padlocked door, opposite the door of exit, shook violently backwards and forwards several times. A week later another earthquake occurred almost at the same hour, and under the same conditions.

Three years later, in 1881, we again passed through the same part of the Himalayas on our return from the Spiti Valley, which we had reached by way of Kunówar.

This time no earthquake took place during our stay in Lahoul; we crossed the Rotang Pass, and went to stay in the Kulu Valley with our friend Col. S——, Deputy Conservator of Forests at Mañali, about sixteen miles on the southern side of that mountain. Col. S——'s house is raised high above the river on the right bank of the Beas; it is placed in the midst of a Deodar forest, and built of wooden logs placed horizontally, and alternating with courses of large stones laid one upon the other, but not mortared together. A wooden verandah runs all round the building, and forms a balcony to the rooms on the upper floor. I imagine it is its mode of construction which enabled this house to resist the severe test to which it was subjected on this occasion.

On October 1, about 1 p.m., we were sitting, a party of three persons, in a temporary verandah resting on the bare earth, and floored with matting, which our host had erected to supplement the permanent one where our native tailor was seated at work.

I had just risen to speak to him, but before I could do so, a loud rumbling sound seemed to come on my right hand (or from the direction of the Kulu Valley).

One of the party called out *thun*—we had had a thunderstorm the day before—but changed the word to *earthquake*. For a second or two I held my breath—I felt rooted to the spot; then the permanent wooden balcony over my head began to creak and groan most violently, and I distinctly saw the front wall of the house advance towards me, and recede from me, three or four times.

After the motion had ceased, the rumbling sound, which at its greatest intensity seemed beneath our feet, died away in the opposite direction (or towards Simla). I made many inquiries afterwards, but was unable to ascertain whether any shocks of earthquake had been experienced on these dates either in Kulu in 1878 or in Lahoul or at Simla in 1881.

The recent catastrophe in the Island of Ischia has called the attention of those who make a study of such disturbances of the earth's surface to the simultaneous occurrence of earthquakes in various parts of the world, which induces me to send you these facts, in the hope that they may interest some of your readers and lead them to form some conjecture as to the possible centre of the earthquakes in the Himalayas.

I am not aware to what extent the geological formation of the Himalayas has been investigated, but (speaking as a non-professional) during three long tours in various parts of these mountains I have never observed any traces of extinct volcanoes. I ought, however, to mention, perhaps, that there are hot springs at Beshist on the left bank of the Beas River, about four miles from Mañali, and also at Manikern, in the Parbuti valley, which debouches from the Kulu valley, about thirty miles lower down, also on the left bank of the river. Manikern is a great place of resort for Hindu pilgrims, who consider these hot springs miraculous; it is also occasionally visited by Europeans who have found these waters efficacious in rheumatic affections. Earthquakes do not seem to be uncommon in these valleys, but it has been remarked that they generally, if not always, occur in the autumn, just when the rainy season is at an end.

COSMOPOLITAN

Lime and Bones

THE observation of your correspondent in NATURE, vol. xxviii. p. 329, regarding the effect of lime in strengthening the bones of children, induces me to communicate certain facts which I observed during a recent tour of two months in Norway.

We travelled by land from Christiania to Throndhjem, thence by sea to the North Cape and back, and made expeditions into the interior at different points on our downward journey.

I noticed everywhere an extraordinary number of weak-boned, crippled, and bandy legged children, also a great number of men and women with weak bones and distorted limbs.

Almost the whole of Norway is a network of mountains composed of various forms of primitive and metamorphic rock, and though marble exists in this country I saw none in the districts through which we passed.

COSMOPOLITAN

Christiania, August 11

Copper and Cholera

REFERRING to the paper read before the French Academy (as reported in your last issue) on copper as a preservative against cholera, it may be worth while to state that when visiting the great copper mines at Fahlun in Sweden (probably the oldest and largest in the world) I was informed that cholera had never appeared there, and that so well was the fact known that on the last visitation of cholera in Sweden some members of the Royal family took up their abode in Fahlun to escape the disease. The atmosphere was there loaded with copper fumes to such an extent that not a trace of vegetation was visible on the hills surrounding the town; so that this really seems to confirm by experience on a large scale the theory alluded to.

WALTER R. BROWNE

Sulphur in Bitumen

FROM the abstract of the meeting of the Paris Academy of Sciences in your last number (vol. xxviii. p. 408), M. B. Delachanal appears to consider that the presence of sulphur is peculiar to the bitumen of the Dead Sea, and from this he deduces a theory as to its inorganic origin.

In some experiments which I had occasion to make this summer on the bitumen of the Great Pitch Lake of Trinidad I found that this substance contained a very considerable quantity of sulphur. Several per cents. of the volume of the gas obtained by its destructive distillation consisted of hydrogen sulphide. The origin of this asphalt is generally considered to be organic, but I am not aware whether the entire absence of calcium salts from its ash, a fact which was proved nearly a century ago, and has since been confirmed, has been explained on this theory.

HUGH ROBERT MILL

Edinburgh, August 27

Thunderstorms and Auroræ

A CONNECTION between these phenomena has been repeatedly suggested. J. W. Ritter has articles on the subject in Gilbert's *Annalen* (1803 and 1804), and Kupffer has a long one in 1827. Other writers who have dealt with it or with the connection between auroræ and atmospheric electricity generally are Schübler (1817), R. Phillips (1854), F. Dellmann (1860), E. Loomis (1860, 1861, and 1862), A. Poey (1861), A. De la Rive, F. Abbott (1863), E. Edlund; and in NATURE, vol. xii. p. 127, there is a summary of the observations by Herr von Bezold. This may serve as a partial answer at the end of Mr. Chadbourn's letter.

A. RAMSAY

4, Cowper Road, Acton, W., August 27

The Meteor of August 19

THE details of this meteor in the letter of your correspondent Mr. Mott and my own are for the most part in such close accordance that one might suppose we had been comparing notes. There is, however, one particular in which our respective accounts differ so widely that one feels inclined to ask whether there were two meteors or whether one of your correspondents has made a mistake as to the direction of the course of the meteor.

First let me correct an error of my own. I find now I was wrong in giving the point of starting as a *few degrees* eastward of the north star. I am somewhat of a stranger at the place where I saw it, and I now find that the point from which it started was as nearly as possible north-east, and about 65° or 70° above the horizon.

I am quite clear as to the path being downwards in an almost perpendicular direction inclining a little to the left. Mr. Mott, on the other hand, describes it as "nearly horizontal, inclined a little downwards about 10° or 12° above the horizon, apparently much foreshortened." It appears to me—perhaps owing to a want of scientific knowledge—quite impossible that a meteor visible a few miles south-west of London, falling as I have described, could be identical with one seen two hundred miles north-west of London travelling in the direction described by Mr. Mott. I of course lay the stress on the direction of the meteor and not the distances of the observers from London.

A. TREVOR CRISPIN

Lansdowne Road, Wimbledon, S.W., August 27

IT may be of interest to some of your readers to know that the meteor mentioned in NATURE as seen on Sunday evening, August 19, was also seen here, timed by me at 10.1 p.m. The compass bearings were from south-east past east to east-east-north, about 35° from horizon; colour, yellow orange; first seen coming from behind a cloud; divided due east, one part falling considerably.

W. M. POOLEY

Bath Road, Cheltenham, August 26

Stachys palustris as Food

I SHOULD be much obliged if any of your readers could give me any information as to whether the rhizomes of *Stachys palustris*, L., are used by the country people either in Great Britain or elsewhere for food. I believe the English name of the plant is Base Horehound, and that in the last century it was so used.

A. WENTZL

Krásnicza Wola, Grodzisk, near Warsaw, August 18

OYSTERS, OYSTER FISHING, AND OYSTER CULTURE AT THE FISHERIES EXHIBITION

AS long as the English "native" keeps its prominent place in the market all questions concerning oysters and oyster culture will have a special interest for the British public at large. For the man of science oysters are none the less interesting, although from a different point of view. For him it is a great puzzle that up to now we are in so profound a state of ignorance concerning certain of the most important phases of life of a mollusc so exceedingly numerous, which may indeed be called very common, if not always plentiful, all along a large extent of the European coast. Questions such as the following:—Are oysters functional hermaphrodites or not? At what age can oysters reproduce their species? How long do the oyster larvæ (the so-called "spat") swim about in the ocean as free and independent, although minute, living specks? What is the effect of currents and temperature, both upon the growth and upon the fertility of the oyster? are or were up to very lately wholly unsolved, and no really scientific inquiry had thrown any definite light upon them. Even the anatomy of the oyster was very imperfectly known, and it was only last year that the researches of Dr. Hoek, exhibited in the Netherlands department of the Exhibition, threw a flood of light upon this point. These are the first of a more extensive series of investigations which are still in preparation, and which will treat of the embryology and the food of the oyster, the fixation of the spat, and the physical conditions under which the apparently very fertile oyster beds of the Eastern Scheldt are placed. These investigations have been undertaken and pursued for three summers consecutively by the Netherlands Zoological Society.

The exhibit in the Netherlands department is the only one in which the scientific side of the oyster question comes into the foreground. Highly interesting from the point of view of practical oyster culture are, however, two exhibits—one in the Norwegian, one in the British department, which we propose to describe somewhat more at length.

The Norwegian one is a bottle containing oysters from the small lake of Ostrawigtjen, near Soggendahl, on the south coast of Sweden. This lake, which is only about 800 feet long and 500 feet wide, with a depth of about six fathoms, may be regarded as a real "hothouse" for oyster culture, the temperature of the water being at the end of last April no less than 22° C., whereas in winter the water at a depth of three fathoms never registers any lower temperature than 7° C., the average bottom temperature in summer being 27° C. Considering the latitude in which the lake is situated, these temperatures are indeed very remarkable, and have not yet been fully explained. Some would ascribe it to a most luxurious vegetation of Confervæ which is found in the lake, the partial decomposition and fermentation of which might increase the temperature. It is, however, open to question whether this confervoid vegetation must not perhaps be rather looked upon as an effect than as a cause of the high temperature.

This lake incloses a natural bed of oysters, and already *at the end of March some of these oysters contain ripe black spat.* In the summer months the productivity of course greatly increases, and up to November (*i.e.* nearly nine months consecutively) ripe oysters with larvæ in their gills are met with.

It need not be said that this is a splendid collecting ground. The spat is collected on birch twigs which are suspended in the water on wires stretched over it.

In 1882 one thousand collectors were brought out, each having a surface of about sixteen square feet, and on these 730,000 young oysters were obtained, which were than transferred to natural beds in the fjord close to Stavanger.

If the oysters were left where they are they would certainly grow very quickly; oysters of one year sometimes attaining a size of six to seven centimetres. For several reasons, however, the transfer is regarded as more suitable for them.

A most curious fact concerning this lake remains yet to be told, viz. that it is situated 2½ feet above high-water mark; that it is separated from the sea by a dry tract of land with large boulders; and that only between September and March, when the weather is very rough, fresh sea water can gain access to the lake by the sea being thrown across this tract of land. At the opposite side of the lake a small rivulet of fresh water enters the lake.

A second "hothouse" for oyster culture appears to have been discovered only very lately; it is in most respects similar to the first; the depth is about 3½ fathoms; the temperature in October was 18° C., in April 21° C. It is situated at Vesetvig near Stavanger, on the Hardanger fjord.

The British exhibit, to which we would wish to call attention more especially, bears the name of Wootton, Isle of Wight. It consists of models of ponds devoted to the "basin culture" of oysters, essentially different in principle from "foreshore culture," which is at present more successful and more generally recommended.

"Basin culture" is nevertheless perhaps a future stage, when once the acute practical intelligence of the oyster-culturist and the investigations of zoologists shall have succeeded in reproducing the natural circumstances under which the oyster spat lives and thrives. At the conference on oyster culture held by Prof. Hubrecht, we were told that investigations more especially relating to basin culture were at the present moment being carried on in Holland. The result obtained in the Isle of Wight was this, that in the first year (1880) the number of the spat obtained was about 25,000, in the second year (1881) 250,000, and in the third (1882) 1,500,000. Notwithstanding this successful commencement, the final results have as yet remained far below the expectation, since only a comparatively small number could be brought to be marketable oysters. A difference between these experiments and those carried on in the Netherlands, which may perhaps prove to be one of fundamental importance, is this, that no contrivances have been made use of in the Isle of Wight to sufficiently aërate the sea water in the basins. Lack of oxygen may have been the principal cause of the great mortality of the spat. Moreover, a certain amount of sea water was let in and let out at favourable tides, and this must to a certain extent have interfered with the reliability of the results.

These experiments were carried on with oysters that were imported from the Arcachon beds.

The exhibits in the ostreicultural department by Mr. Fell Woods, the well-known director of the South of England Oyster Company (Hayling Island), and by the Whitstable Oyster Company, likewise deserve attention. In both, specimens of shells of one-year-old oysters are shown, the occupants of which are said to have produced "black spat" at that early age. Even if these observations are well authenticated, it is nevertheless recognised that such facts are very rare exceptions, and that generally at three years, and more profusely still at from four to six years, the maximum quantity of ripe spat is produced by the oysters, whose generative organs are most active at that age (cf. Hoek).

France has only a comparatively small exhibit; the implements used in oyster culture at Arcachon are there shown. The Netherlands are represented by a more complete collection, showing both dredging and collecting apparatus, so-called "hospitals," tiles, knives, &c. Models of several oyster parks, partly constructed in old fortifications, and consequently having a very "defensive" aspect, are, moreover, exhibited, as well

as maps and charts showing the way in which the foreshores, &c., are leased by Government to individuals and companies interested in oyster culture. For further details concerning oyster culture in the Netherlands, we may refer the reader to the conference paper on this subject. On the whole oyster culture appears to be very successful in this country.

In the American department there is a large collection of the most various oyster-shells, as well as the model of a vessel occupied in dredging an oyster bed. "Culture" of oysters appears to be very little practised in that country up to the present day, the natural beds being as yet of a nearly inexhaustible richness, especially in the Southern States, where they are principally situated in the lagoons along the coast-line, and the oysters very often used as manure. Nor has the trade in these regions been developed to any extent. More northward Chesapeke Bay is the richest ground, and from thence oysters are transplanted along the coasts of the different Northern States, and at the same time brought into the market in enormous numbers. Together with the scientific investigations in the Netherlands, those in the United States, conducted by Brooks and Ryder, and those of Bouchon Beaudely in France, stand foremost as commendable efforts to bring pure science to bear upon fishery problems of great practical importance.

UNITED STATES COAST AND GEODETIC SURVEY[1]

THE author of this very important treatise states, in his preface, that he has attempted to give a sufficiently comprehensive account of the theory of projections to answer the requirements of the ordinary student of this subject. The literature of projections being extensive—the work of the most eminent mathematicians—the author has contented himself with making such extracts from the great mass of papers, memoirs, &c., which he deemed requisite for his purpose, giving, for further information, references to such original sources as are comparatively easy of access.

As the different conditions which projections for particular purposes have to satisfy are so wholly unlike, no general theory underlying the whole subject of projections can be given; it is therefore conveniently divided into several sections: and here the author mentions his obligations to M. Germain's most important "Traité des Projections" (Paris, 1865), which contains an account of almost every projection that has been invented. At the request of the Superintendent, Carlile P. Patterson, the treatise has been divided into two parts. The first part contains the mathematical theory of projections, while the second part contains merely such a sufficient account of the various projections as will enable the draughtsman to construct them.

The surface of the sphere being non-developable, the exact representation of even a portion of it upon a plane is impossible. Certain conditions can, however, be fulfilled which will render it sufficiently exact for any particular purpose. The areas may be proportionately preserved, in which case we have an equivalent projection; or the angles of small portions may be preserved, in which case we have an orthomorphic projection. The exigencies of any particular use for which a projection is designed give rise to a great number of other conditions corresponding to which projections have from time to time been invented: so that the history of projection has been peculiarly that of the solution of more or less independent problems: for a complete account of which the reader is referred to M. D'Avezac's "Coup d'Œil historique sur la Projection des Cartes de Géographie" (Paris, 1863).

[1] "United States Coast and Geodetic Survey" (Carlile P. Patterson, Superintendent). A Treatise on Projections. By Thomas Craig. (Washingt n: Government Printing Office, 1882.)

The author has treated his subject under the following heads:—

I. Orthomorphic Projection.
II. Equivalent Projection.
III. Zenithal Projection.
IV. Projection by Development.

The first part of the volume treats of the mathematical theory, and is subdivided into nine sections. The first section contains a brief introductory account of the principal properties of conic sections and perspective projection—the most natural and simple method of representation. Sections II. and III. treat of methods of orthomorphic projection. Section IV. treats of projections by development; Section V. gives an account of zenithal, and Section VI. of equivalent projections. Students of these sections are presumed to have a fair acquaintance with the methods of ordinary analytic geometry and the elements of the differential and integral calculus. The next three sections are extremely general, and will require rather more extensive mathematical knowledge. These sections were designed to connect the particular problem of the plane representation of a sphere with the much more comprehensive methods of representation of one surface upon another, and to induce in the student, having a real interest in the general theory, a desire to consult the original memoirs for fuller information.

The second part of the volume, which treats of the construction of projections, does not appear to require any detailed description; but as much of it is merely reprinted from the first part, the propriety of thus separating the "construction" from "theory" seems rather doubtful. The book ends with thirty-one tables, nearly all extracted from the original memoirs of the writers on different parts of the subject of projections. In some cases, however, improved tables by other authors are given. Where the ellipticity of the earth has been taken into account the tables are given unchanged, as the effect of small changes of ellipticity would be almost inappreciable; and, moreover, we have in p. xiii. of the introduction the important statement that "The United States Coast and Geodetic Survey will undoubtedly soon be able to produce a much better value of the ellipticity than has yet been given."

Such are the contents of this valuable book we have endeavoured to describe. It presents, however, some signs of hasty arrangement and want of strict attention to the correction of the press, which will doubtless be removed from the next edition. Indeed the copy under notice would scarcely seem intended for publication in its present form. For instance, "The accompanying plates . . ." mentioned in p. 230 are wanting; and we notice the following typographical errors, &c.:—

Preface, p. x. *Philosophical Magazine*, 1865, should be 1862.

Preface, p. x., and Introduction, p. xiv. There are obvious errors in the title of Gauss's Memoirs.

Introduction, p. xiv. *Phil. Trans.* vol. I. should be vol. L.

P. 80, line 12 from bottom, for platting read plotting.

Pp. 80 and 210. The descriptions of Cassini's projection do not seem to be correct.

Pp. 81, 82, and 210. The woodcuts defective.

P. 83. Curious error in the numerator of the general expression for ρ.

Pp. 67 and 197. Woodcuts of Fig. 13 not good.

Pp. 71 and 201. Fig. 15, woodcuts require correction.

Pp. 76 and 206. Fig. 18, woodcuts not very good.

P. 149. In the denominator of the value of m the power 2 of $(1 \mp \epsilon \cos \omega)$ should be ϵ. In the first term of the denominator of the value of k, $\sin^2 \frac{\omega_1}{2}$ should be $\sin^2 \frac{\omega_2}{2}$, and in the second term ω_2 should be ω_1.

P. 150, line 2. For $1 e^2 \cos^2 \omega$ in the denominator of the last term of the value of $\frac{dm}{n}$, read $1 - e^2 \cos^2 \omega$.

P. 214. Fig. 44, the letter P out of place; compare with Germain's Fig. 98; in the letterpress "angle $APC = \omega$" should be $= \pi$.

Also the nufnbering of the sections seems to require some revision. Section VII. referred to in p. xiii. of the introduction, as containing Mr. Schott's account of the polyconic projection, is not of course the Section VII. of the text, and though Part II. is not divided into sections, yet in p. 230 "The Tables" appear under § xii.

PROMISE AND PERFORMANCE IN CHINESE SCIENCE

UNDER the title of "Science à la Chinoise," a writer in a recent number of the excellent *North China Herald* dwells on what may be called the disparity between the promise and the performance of Chinese science. The ancient classics contain beautiful maxims on the necessity for research into nature. The "Great Learning" tells us that knowledge is perfected by the investigation of nature; Confucius urged his pupils to study the "Book of Poetry," because, among other things, they could become acquainted with the names of plants and animals; Mencius tells us that the careful study of phenomena is the road to knowledge, and in illustration says: "Though heaven is high and the stars distant, yet, having investigated their phenomena, we can sit down and calculate their revolutions for a thousand years." It has long been a proverb among the learned that to be ignorant of a single thing is a disgrace to the true scholar, and to be ignorant of nature is as if nature did not exist. When the revered ancient sages of China, whose words are in the mouths of all, thus encourage scientific research, we should be led to anticipate great results from the patience, intelligence, and ingenuity of the Chinese. But, as in so many other respects in that anomalous country, we have excellent maxims and little more. There is, says this writer, neither research nor knowledge; science has no existence. There is indeed a considerable natural literature. From ancient times the Chinese have taken note of natural phenomena. Their record of solar eclipses is perhaps the most ancient and accurate in the world. They have more or less elaborate works on astronomy, mathematics, botany, zoology, mineralogy, physiology, and many other sciences. Yet there is scarcely any true science in them. Classification, even in regard to plants and animals, there is none. Mineralogy is mainly a description of curious stones. Nor is there any progress, for the more ancient works are generally the best, and as a consequence the Chinese to-day are as their fathers were thousands of years ago. The superstitions respecting natural phenomena, which are as living active truths to-day for all classes in China, remind us rather of man in his state of barbarism than of the ancient culture and civilisation of the Middle Kingdom. The sun and moon are to the Chinese as they were to primitive man, living things, gods to be worshipped. The stars in their courses powerfully influence, if they do not absolutely determine all human events. In them the wise may read as in a book the destiny of man and the fate of empires. Their combinations make lucky and unlucky days, and we shall do well to note carefully their signs and silent warnings. Comets are the precursors of famine, pestilence, and war—prognosticators of the wreck of empires and the fall of kings. Eclipses are the periodic efforts of the dragon fiend to destroy the lights of heaven, and every notice of an approaching eclipse sent by the Imperial astronomer to the provinces is accompanied by a Government order to employ the usual methods of gong-beating and so forth in order to rescue the threatened luminary. Again, thunder is the roar of the anger of heaven, and to be smitten by a thunderbolt is to be marked as a thing accursed. Wind is born in the heart of great mountains, whence it issues at the command of the wind-god. Most districts have their wind-mountains. That at Lung-Shan in the northern province of Chilli is the most remarkable. It has a cave at each of its four sides. The spring wind issues from the cave on the eastern side, the summer wind from the southern, and so for the others. Wind eddies or whirlwinds are raised by the hedgehog in his rapid passage from one place to another, the dust serving to screen him from the vulgar gaze. Rain is produced by the dragon god, who carries up vast quantities of water from the lakes and rivers in his capacious jaws, and pours it down in showers over the earth. Every mountain has its spirit or genius, every valley its nymph, every spring its naiad. Hence mountains and rivers, old trees and curious rocks, become objects of worship.

These and the like superstitions which enter every domain of nature are not confined to the poor and illiterate; they are shared by the rich and learned, nay, they are repeated and acknowledged by the Imperial Government itself in its decrees in the *Peking Gazette*. The highest scholar in the empire knows no more of nature than the humblest peasant. The years have come and gone, repeating the same old story, but there has been no ear to hear it, no mind to understand it. Nature has found no interpreter among the Chinese; during their long national life they have contributed nothing to science. How are we to account for this? In other fields of national effort, and especially as inventors, they must be allowed a high place. It cannot be indifference, for they have written largely on the beauties, marvels, and mysteries of nature, and many have shown keen interest in the discoveries of science. It may partly, perhaps, be due to the fact that the intellect of the nation is employed in the struggle for place and power along grooves in which science has no part. The writer we quote thinks it is mainly owing to the narrow and perverted system of education; and while the present system continues the study of science will be impossible to the youth of China. The cleverest young men find it as much as they can do to take their first degree at twenty. The higher degrees, which are also the avenues to office, can scarcely be won for years later, and thus they cannot afford a thought for anything beyond the common curriculum.

ON THE PROPERTIES OF WATER AND ICE[1]

DR. PETTERSON'S memoir is a most valuable contribution to our knowledge of the natural history of the waters of the globe. Every reader of Arctic voyages must be familiar with the variety of names attached to the different kinds of ice met with in these regions, such as "pack-ice," "bay-ice," "brash-ice," and the like. To one who has never seen them, the names convey very little information either of their appearance or of their mode of formation. Dr. Petterson's paper explains in a satisfactory and very remarkable manner the nature of the difference between the different kinds of ice.

In the first part of the work the subject is treated physically, and in the second chemically. In both parts there is much that is new and valuable.

In the Arctic Ocean, and especially in that part of it visited by the *Vega*, the saltness of the water varies much from place to place. The large rivers of Siberia constantly pour forth fresh water which lies on the surface of the ocean and spreads round the coast like a fringe. This layer often extends a considerable distance out to sea, where it gradually thins out. Nearer the shore it is thicker, but wherever the depth exceeds 20 or 30 metres the dense ocean water is found below and the two layers

[1] "On the Properties of Water and Ice." By Otto Petterson. Publication of the *Vega* Expedition. (Stockholm, 1883.)

persist without sensible mixture. As an example may be cited some observations made on board the *Willem Barents* in the Kara Sea on August 3, 1881 :—

Depth, fathoms.	Temp. °C.	Density.
0	+8·2	1·006
1	+6·2	1·009
2	+1·7	1·020
3	−1·0	1·0236
5	−1·5	1·0247

Here, while we have what is practically fresh warm water at the surface, and to a depth of a fathom from it, at two fathoms we have cold Arctic Ocean water. Looking therefore to the great variety in the composition of the waters exposed to the winter cold and therefore likely to produce the ice met with in Arctic regions, Dr. Petterson has studied separately the change of heat and volume by the freezing of (1) pure water, (2) brackish water of little saltness, and (3) ocean water of ordinary saltness. With regard to the freezing of brackish or salt water no previous investigations of a quantitative character exist, and the author's results are all new. With regard to the freezing of pure water the most important investigations were those of Plücker and Geissler. While verifying their result as to the *average* coefficient of dilatation of ice, the author made the important discovery that the volume of ice *decreases* as the temperature rises, in the vicinity of the melting point. In extending his researches to brackish and salt waters he found this anomaly more and more accentuated the more salt was contained in the ice formed. Rightly seizing the importance of this very remarkable observation the author makes the behaviour of pure ice in the vicinity of its melting point one of the main objects of the investigation. The "dilatometer" used was a glass vessel of peculiar construction and of a capacity of 41 cubic centimetres. The water to be experimented on was frozen in it, so that it formed a cylinder of ice surrounded by mercury, which extended also into a capillary tube and indicated changes of volume. As the accuracy of the results depends, amongst other things, on the correctness of the determinations of the absolute dilatability of mercury; and as this is somewhat uncertain, and indeed variable, at low temperatures, the author adopted the device of Plücker and Geissler for producing a practically undilatable envelope for his experimental substance. The principle of it is very simple. The envelope is of glass with a coefficient of expansion 0·000028; that of mercury is 0·000181. If the volume of the glass envelope is to that of the mercury contained in it in the inverse proportion of their coefficients of expansion the residual volume will be constant even though the temperature vary. If the volume at 0° C. of the glass be 18·1 cc. and that of the mercury 2·8 cc the residual volume is 18·1 − 2·8 = 15·3 cc. If the temperature is t° the volume of the glass is $18{\cdot}1\,(1+0{\cdot}000028t)$ and that of the mercury $2{\cdot}8\,(1+0{\cdot}000181t)$, and the residual volume is $v = 18{\cdot}1 - 2{\cdot}8$ as before. The effect of variation in the coefficient of expansion of the mercury is thus reduced to a minimum

When a cylinder of ice had been frozen in the instrument, it was immersed in a mercury bath, and subjected to variations of temperature, either with freezing mixtures, or, in winter, by exposure to the atmosphere.

These series of experiments were made with distilled water. The first series was made with water taken from the store jar in the laboratory. It gave a slight opalescence with nitrate of silver, and cannot therefore claim to have been pure. The ice formed by its congelation expanded with rise of temperature from − 20° C. to − 0°·3 C. Here it began to contract until it melted at 0° C. Two other series of experiments were made with water repeatedly distilled. The ice from it did not begin to contract till the temperature had risen to − 0·03° C.

There can be no doubt, especially in view of later experiments with brackish waters, that the not chemically pure distilled water did contract at a measurable distance from its melting point. With regard to the other two samples, the temperature at which the ice began to expand with heat is so close to its actual melting point, that it is impossible to have implicit reliance in the result claimed. The author's own view will be best judged from the following paragraph (p. 282):—

"It is impossible to decide if absolutely pure water would be entirely free from this weakness or not, since we cannot assume that water which has boiled for a quarter of an hour or more in a glass vessel is absolutely free from minimal quantities of foreign substances as, for example, sodium salts, silica, &c. For my own part I am rather inclined to think that absolutely pure water, if it could be tested, would show an absolutely fixed melting point, but I think that this problem very much resembles another question still undecided, viz. is absolutely pure water a conducting or non-conducting substance for electricity?"

It would be well to repeat the experiment with pure freshly distilled water, freeing it from air by boiling *in vacuo*, which Dr. Petterson's apparatus would easily admit of. There would then be very much less risk of the glass being attacked.

Experiments made with sea-water ice proved that the property of contracting with heat, as the melting point is reached, becomes more and more marked the greater the quantity of salt in the ice. Three series of experiments were made. In the first, the ice when melted had a specific gravity of 1·0003, and contained 0·014 per cent. chlorine. It began to contract at − 4° C. The second had a specific gravity of 1·00534, and contained 0·273 per cent. chlorine. It began to contract at − 14° C. The third had a specific gravity of 1·0094, and contained 0·649 per cent. chlorine. It was contracting at the lowest observed temperature, − 19° C.

In connection with these remarkable results it must be mentioned that at the same temperature, as, for instance, − 15° C., the volume of the ice which on being melted furnishes 1 cc. water at 0° C. is less the greater the amount of salt contained in it. Sea water being an exceedingly complex body, it is to be hoped that Dr. Petterson will extend his research so as to examine in the same direction the ice formed by simple solutions of each of the more important ingredients of sea water. How different ice produced by the freezing of sea water must be from what we are accustomed to see on our lakes and ponds in winter, will be evident when we read (p. 286):—". . . The new ice which arises by sudden freezing of the calm surface of the Arctic sea is a *tough* substance, which can be wrinkled and folded by external pressure without breaking. Although it may be thick enough to bear the weight of a man, it is so plastic that a footstep makes a deep impression as in mouldable clay."

The physical part of the work closes with the investigation of the latent heat of fusion of fresh and salt ice. The result is that "the latent heat developed by the freezing of sea water is *extraordinarily inferior to that of pure water.*"

Hardly less interesting than his physical experiments are the investigations into the chemical composition of sea water ice.

It has been very generally believed that sea-water ice owes its salinity to mechanically entangled brine, and that all that is really solid in it is pure ice. Scoresby, probably the most acute observer amongst Arctic voyagers, referring to this subject, says :—[1]

"Although I have never been able to obtain from the water of the ocean, by experiment, an ice either compact, transparent, or fresh, yet it is very probable that the retention of salt in ice may arise from sea water contained in its pores; and, in confirmation of this opinion, it may be stated that if the newest and most porous ice be removed

[1] "An Account of the Arctic Regions," Edinburgh, 1820, vol. i. p. 230.

into the air, allowed to drain for some time in a temperature of 32° or upwards, and then be washed in fresh water, it will be found to be nearly quite free from salt, and the water produced from it may be drunk."

During the Antarctic cruise of the *Challenger* the writer of this notice made some experiments to decide the question whether or not sea-water ice is a mixture of pure ice and sea water or brine. The *melting point* of salt-water ice of various sources was carefully observed, with the following results. Ice formed in a bucket of sea water over night melted at −1·3° C. The bulk of ice formed was insignificant compared to the volume of water in which it was formed, so that this was a specimen of *bonâ fide* sea-water ice, without admixture of snow or spray. In the same way the melting point of pack-ice was determined. The freshly collected ice began to melt at −1° C.; after twenty minutes the thermometer had risen to −0·9°, and two hours and a half afterwards it stood at −0·3°, having remained constant for about an hour at −0·4°. Another portion of the ice rose more rapidly in temperature, and when three-fourths of the ice was melted, the thermometer stood at 0° C. In the case of the ice frozen in the bucket, the melting point remained constant for twenty minutes at −1·3°, after which no observations were made, so that we do not know if this ice, formed under the most favourable circumstances, showed the same irregularities as the pack-ice, picked up out of the sea; but as the bulk of ice experimented on did not much exceed 10 cubic centimetres, the greater part of it must have melted in the twenty minutes. Indeed as the amount of ice formed in the bucket did not sensibly alter the composition of the water left liquid, there seems to be no reason why the ice should not be a homogeneous substance.

Adhering brine can have no influence on the melting point of ice, consequently, if sea-water ice consists of pure ice with entangled brine, it must melt at 0° C. If its melting point is different from 0° C. then the solid matter of the ice is not pure ice. We have seen that frozen sea water has a melting point of −1°·3, which is fairly constant, and that pack-ice, which must necessarily be formed by the freezing of salt water, the congealing of spray, and the accumulation of snow, begins to melt about −1°, the temperature gradually rising as the constituents of lower melting point are liquefied. It is thus readily apparent how it is that Scoresby found that such ice "allowed to drain for some time in a temperature of 32° or upwards," produced in the end potable water. The salt-water ice of low melting point effectually prevents the intermingled snow from melting, which finally remains practically intact, and of course can be drunk on being melted.

Dr. Petterson on purely chemical grounds comes to the same conclusion. He says (p. 303): "Those who support the common theory that sea ice is in itself wholly destitute of salt, and only mechanically incloses a certain quantity of unfrozen and concentrated sea water, must confess that we in this case ought to find by chemical analysis exactly the same proportion between Cl, MgO, CaO, SO_3, &c., in the ice and in the brine as in the sea water itself." That this is not the case is shown by a number of analyses of sea-water ices in which the proportion of Cl: SO_3 varied from 100: 12·8 to 100: 76·6, the average proportion in sea water being 100: 11·88. The results of his investigations may be summarised as follows:—

Ocean water is divided by freezing into two saliniferous parts, one liquid and one solid, which are of different chemical compositions. Taking the relation Cl: SO_3 as standard of comparison, the most striking feature of the freezing process is that the ice is richer in sulphates, and the brine in chlorides. The extraordinary variation, both in saltness and in chemical composition of every individual specimen of sea ice and sea brine, shown by the tables, depends on a secondary process, by which the ice seems to give up its chlorides more and more, but to retain its sulphates. Hence the percentage of chlorine is no indication of the saltness of the ice, though it may to a certain extent be taken as an index of its age.

In connection with this part of the subject, the author cites Prof. Guthrie's work on Cryohydrates, and gives the following table:—

Cryohydrate of		Contains			Solidifies at
NaCl	...	76·39 per cent.	water	...	−22° C.
KCl	...	80·00 ,,	,,	...	−11°·4 C.
$CaCl_2$	...	72·00 ,,	,,	...	−37° C.
$MgSO_4$	...	78·14 ,,	,,	...	−5°·0 C.
Na_2SO_4	...	95·45 ,,	,,	...	−0°·7 C.

Supposing that these cryohydrates are formed in the freezing of sea water, it is easy to see how, as the temperature rises, the chlorides melt out first and leave the ice richer and richer in sulphates.

Before concluding this notice, attention must be called to a statement in a note at the foot of p. 318: "As a thermometer immersed in a mixture of snow and sea water, *which is constantly stirred*, indicates −1°·8 C., we may regard," &c. This can be true only if the temperature of the atmosphere is −1°·8 C.; if it is 0° C. or higher, the temperature of the sea water will assuredly rise to the melting temperature of snow, or 0° C.

Even though it should turn out that chemically pure ice does, as the author suspects, melt suddenly without previous contraction *as ice*, the discovery of the existence of a *minimum density point* of ice, not chemically pure, which includes all the ice on the globe, is one of the very highest importance.

It is to be hoped that we shall soon have a further instalment of work on a subject so large and so important, and with which the author has shown himself so well qualified to deal.

J. Y. BUCHANAN

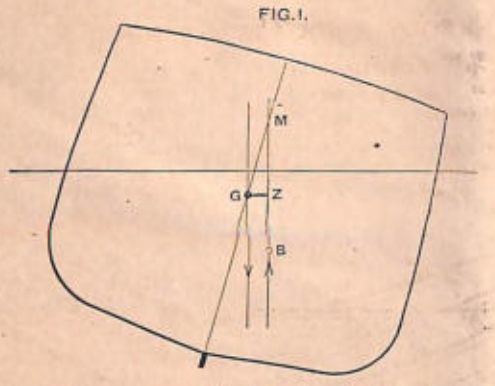
THE STABILITY OF MERCHANT STEAMSHIPS

I PROPOSE to state, and in part to restate, the more important scientific considerations concerning the stability of merchant steamships which the investigation of the *Daphne* disaster has brought to light, following the main lines of the second part of my Report, which has been published *in extenso* in several newspapers. In this case, as in all cases touching the complicated question of ship stability, it is very necessary to be careful not to draw hasty inferences or any inferences at all which are not strictly deducible from the facts or principles established.

It is desirable to guard the reader in the first place against considering the cases of the ships *Daphne* and *Hammonia*—which I have had occasion to associate somewhat closely in my Report—as identical in more than a certain number of features, there being other features in respect of which there is little or no resemblance. I will presently point out both the resemblances and the differences, but first let me remind the reader unfamiliar with naval science what is meant by a curve of stability, quoting the Report as far as may be necessary for the purpose. Fig. 1 may be taken as the transverse section of a vessel inclined at an angle of 15 degrees to the upright. The total weight or gravity of the vessel will act downwards through the centre of gravity G, and the total buoyancy will act upwards through the centre of buoyancy B, as the arrows indicate. It will be obvious that the vessel cannot rest in the inclined position with these forces and no other operating upon her; she must revolve until gravity and buoyancy act in the same vertical line, but in opposite directions. The further she is inclined the more will the ship be immersed on one side and emersed on the other, and therefore the further out will the centre of buoyancy move. Now as neither the gravity nor the buoyancy need be altered in amount by mere inclination,

and as they are equal and opposite in direction, it follows that, whatever the inclination, the force acting will always be the same, but the leverage, marked G Z, will vary as the centre of buoyancy moves. At 30 degrees inclination, for example, G Z is much greater than it is in Fig. 1 at 15 degrees. In Fig. 2 these lengths are set up as

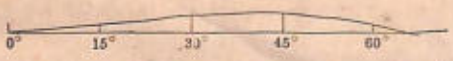
FIG. 1.



ordinates of a curve, and similar lengths for inclinations of 45 and of 60 degrees are similarly set up; the curve drawn through their upper extremities is this vessel's "curve of stability," observing that the base line is divided into equal lengths for equal angle intervals on any convenient scale.

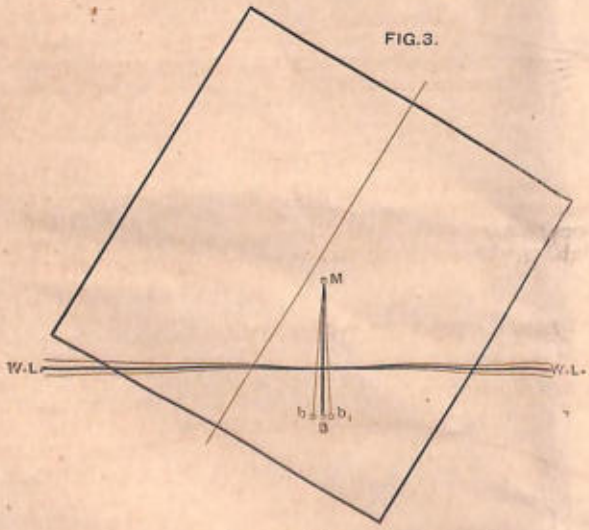
As regards the "metacentre," I must explain here, as

FIG. 2.



I did in my Report, that in former times, when "initial stability" alone was calculated, the word "metacentre" had a much more limited meaning than it possesses now. It formerly had relation to the upright position of the vessel, in which case the buoyancy acts upwards through the centre line of the ship's section—along G M, for example, in Fig. 1. After receiving a slight inclination,

FIG. 3.



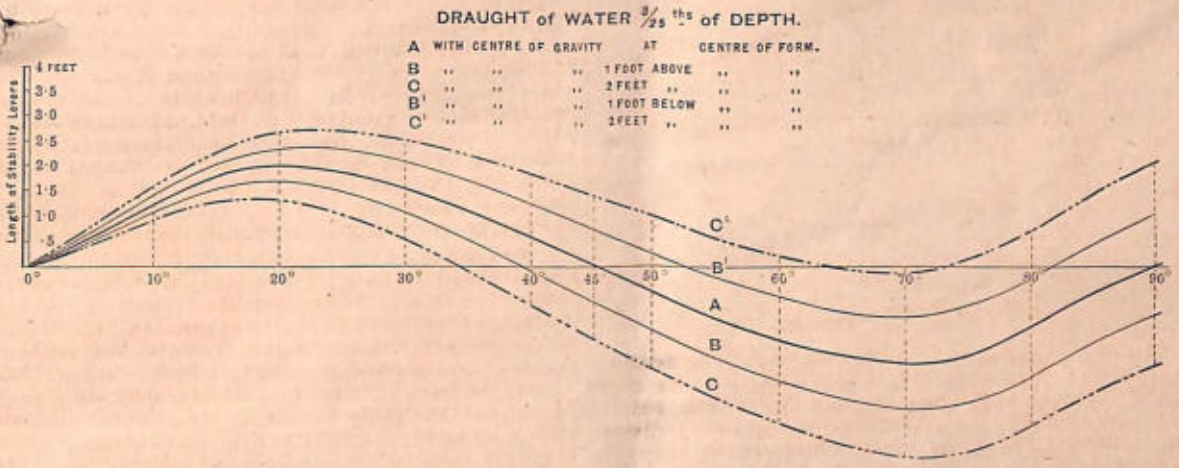
the vessel has, as we have said, a new centre of buoyancy, and the buoyancy itself will act upwards along a fresh line slightly inclined to what was previously the upright line, and will intersect it at some point, M. This point was called the "metacentre," and if we suppose the angle in Fig. 1 to be very small (very much less than 15 degrees), then the M shown there approximately marks the "metacentre." When a ship is much more inclined, the point at which two consecutive lines of the buoyancy's upward action will intersect may not be, and often will not be, in the middle line of the ship at all, but this point is nevertheless called the "metacentre," and the use of the word in this extended sense has recently become general. In Fig. 3 is shown a floating body of square section, inclined in the water at an angle of about 30 degrees. W L is the water line or line of flotation; B its centre of buoyancy. By giving it a "slight" inclination from the position, it will of course have a new centre of buoyancy given to it. If we incline it one way *b* will show this, if we incline it the other way *b'* will show it, and for each of these positions there will be a new line of action or buoyancy. But these lines of action, together with that through B, will all meet or intersect in one point, and this point (M) will be the metacentre at 30 degrees of inclination. In Fig. 4 I have shown curves of stability for a prismatic body, with the centre of gravity in the centre of form, and also with that centre in some cases raised and in others placed below the centre of form. In this figure the draught of water is taken at 3/25ths of the total depth of the prism. In Fig. 5 I have given curves of stability for the prismatic body with the centre of gravity and the centre of form taken as coincident, but with different draughts of water. In Fig. 6 I have given the curve of stability of a similar prismatic body, immersed 2/5ths of its depth, and having its centre of gravity situated 6 inches below its metacentre. These figures serve to illustrate very clearly the error involved in the assumption that with stability at the upright position and stability at 90 degrees—or but little instability at the latter, which is what some authors have instructed the profession to be content with—there need be no apprehension of any deficiency of stability at intermediate angles of inclination. They show that with square sections and prismatic forms there may be various dispositions of centre of gravity and draughts of water, with which stability in the upright position and again at 90 degrees are not proofs of safety, but indications of the gravest danger.

With these figures before us, we now have both the *Hammonia* case and the *Daphne* case amply illustrated, and can carefully distinguish between the two. The *Hammonia* case—as put forward by Mr. Biles, who conducted her calculations—is that of a high-sided vessel with her stability reaching a maximum soon after she had inclined 30 degrees; and she therefore finds her analogy in one or other of the cases shown in Fig. 5. In the latter figure it will be seen that with the centre of gravity in the centre of form all positive stability vanishes at an inclination of 45 degrees in the two cases A and B; but the *growth and decline* of the stability are very different indeed at the different immersions. When the immersion is smallest the stability rises in a steep curve (A), attaining a comparatively large maximum something under 20 degrees, and then declines, more gradually than it rose, as the inclination goes on. By increasing the immersion from 3/25ths to 5/25ths the curve B is produced, and here we see a vast change of stability, the curve, which rises very slowly from the base line, never reaching one-fourth the maximum ordinate of curve A; only attaining its maximum beyond 30 degrees of inclination, and then declining less slowly than it rose, until it vanishes. Immerse the body to double the last immersion, and we find in curve C that now, instead of vanishing at 45 degrees, the stability only there begins, rising to a small maximum a little beyond 60 degrees and vanishing at 90 degrees. It is in curve B that we find a state of things very closely analogous to that disclosed by the *Hammonia* curve, which I now give in Fig. 7. In both cases the stability increases but slowly; in both it reaches early a maximum; and in both it disappears altogether before the vessel is more, or much more, than

inclined through half a right angle. The case of the *Daphne* resembles this in the slowness with which the stability increases as the vessel is inclined, this slowness being due to the same causes in both cases doubtless; but an examination of the triple-branched curve of her stability given in Fig. 8 shows that the analogy between the two cases ends at quite a moderate angle of inclination, say 30 to 31 degrees. In this figure (8) the curve A

FIG. 4.

CURVES of STABILITY of PRISMATIC BODY of SQUARE SECTION

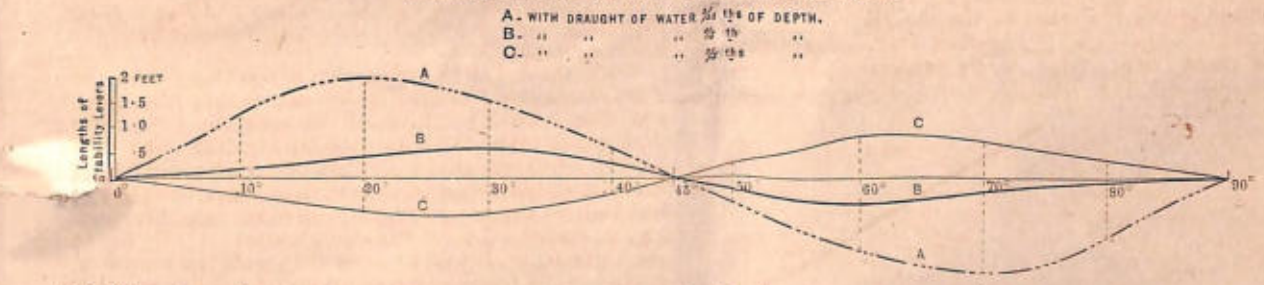


is constructed on the assumption that the ship was free to take water on board as the main deck became immersed; the branch B presumes the poop to have been watertight; and the branch C is calculated to show how the stability curve would have increased until the bulwarks came under water, provided these bulwarks had been watertight. It will at once be seen that the *Daphne* cannot be regarded as analogous to the *Hammonia* or to the curve

FIG. 5.

CURVES of STABILITY of PRISMATIC BODY of SQUARE SECTION

WITH CENTRE OF GRAVITY AT CENTRE OF FORM.



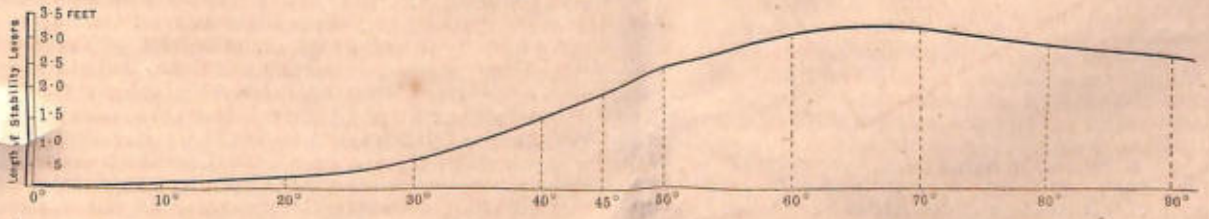
B in Fig. 5, in so far as the stability at very large angles is concerned. On the contrary she would have more resembled the case of Fig. 6, provided her sides had gone as high as her topsides and been there decked over. The *Daphne's* curve A ceases to rise soon after the main deck becomes immersed, and then falls rapidly away in the same manner and for the same reason as all ships lose stability when, or soon after, the freeboard has become

FIG. 6.

CURVE of STABILITY of PRISMATIC BODY of SQUARE SECTION

DRAUGHT of WATER 2/5 ths of DEPTH.

WITH CENTRE OF GRAVITY 6 INS. BELOW THE METACENTRE.



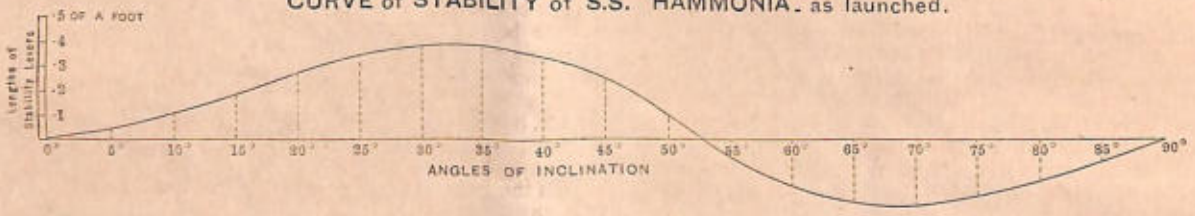
exhausted. It must therefore be clearly understood that it is in the early stages of the two curves that the cases which I have had to make public find their resemblance; at the later stages the *Daphne* illustrates the consequences of the immersion of the deck, while the *Hammonia*, by losing all stability before the deck became immersed, opened up a state of things which startled her builders, surprised the profession, and confounded the text-books, and

must force extended calculations upon all those who hereafter undertake to launch ships upon the stability of which any doubt can by possibility exist.

It is pretty widely regarded as a remarkable fact that there should have been any deficiency in the knowledge of shipbuilders concerning the conditions or possible conditions of the stability of ships at their launching draughts. But to me this deficiency seems the most natural thing possible. It needs no explanation to those who remember what immense transformations and extensions have come upon the shipbuilding trade during even my own professional experience. I well remember looking with wondering interest in Sheerness dockyard at the first iron ship ever seen there; and yet the construction of iron ships had become so universal fifteen years ago that I wrote my work on "Shipbuilding in Iron and Steel" to meet a widespread necessity, the idea of writing descriptions of wood ships having already passed away. I equally well remember the building at Sheerness of the first screw steamship ever constructed there; but where now are any but screw steamships built for ordinary ocean work? Some sailing ships and some paddle steamers doubtless are built even now; but the screw steamer has almost undisputed possession of the world's ocean trade. With these changes have come in wholly new developments of shipbuilding science, and the present is not by any means the first instance in which it has fallen to my lot to point out errors of doctrine—false deductions from former practice—which were misleading the shipbuilder. In the case of the strains to which ships

FIG. 7.

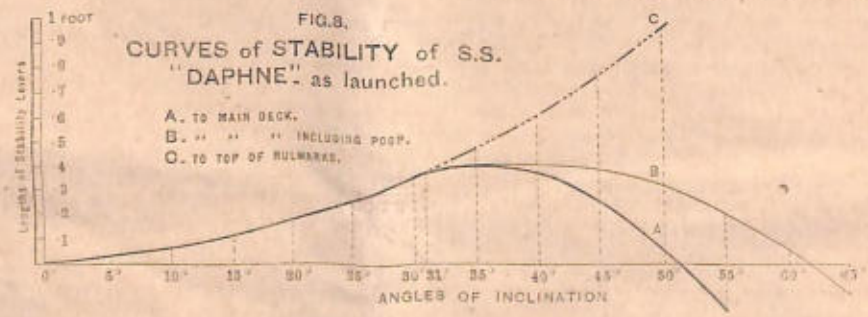
CURVE of STABILITY of S.S. "HAMMONIA" as launched.



are subjected, the deductions made by the most eminent men who discussed the subject scientifically at the end of the last and the beginning of the present century seemed to me to be irreconcilable with the conditions of modern ships, and after lengthened investigations I found that they were not only wrong, but in some cases the reverse of the truth, and I contributed to the Royal Society a paper on the subject which has brought modern theory and modern practice into better relationship. In the matter of stability it was most natural that as we abandoned the employment of wind as our propelling power—which of course imposed upon ships the necessity for large stability to withstand the wind-pressure—shipbuilders were able to resort to greater proportionate length and to enlarged proportionate area of midship section; and thus to bring about conditions in which large initial or early stability, so to speak, fell out of demand. Nor is it easy to say when deficient stability would have come under close investigation, had it not been for the accident of certain ships of very *low freeboard* coming under consideration at the Admiralty, as explained in my Report. These led to the calculation of stability at successive angles of inclination, and to the method of recording the results in the form of the "curve of stability" previously described. But besides the *change* of the seagoing ship, there has been the enormous extension of its employment, our carrying trade on the sea having increased by leaps and bounds. Every one knows that when the demands of commerce are very urgent, science and scientific research are apt to be neglected. The necessity for great carrying power and speed at sea has been attended by an equal necessity for

FIG. 8.

CURVES of STABILITY of S.S. "DAPHNE" as launched.



quickening the loading and discharging of ships in port, and consequently steam windlasses and cranes, and many other modern appliances involving upper weight have come into vogue, and their effect upon stability has not been always considered. From these and other causes there has been brought about that somewhat extensive employment of ships of small stability, or of no stability at all in themselves, to which it lately became my duty to direct attention. It is no doubt the general belief that a high-sided ship having some initial stability, will, as she inclines, gather large additional stability, and will retain some even at very large angles; that, as my Report states, has greatly encouraged people to be satisfied with very small initial stability, in some cases with none at all, and even less than none. Many steamships of large tonnage have been built of late years for influential steam companies and other owners, which ships are totally incapable of floating upright without the aid of ballast or of cargo, and which cannot be unloaded in dock without being held upright with hawsers attached to the shore. Such ships, even when capable of floating unballasted without capsizing, can only do so by lolling over at large angles of inclination, and there finding a position of stable equilibrium. When carefully watched over and stowed with suitable cargoes, these ships can usually be made safe at sea, and sometimes even safer than ships with larger initial stability but less range—a circumstance to which undue prominence has perhaps been given, and which has diverted many from the grave elements of danger which more often are associated with small initial stability. "There is not the least doubt, however, that a very small initial stability given to many modern mercan-

tile steamships—given in the belief that much more is safe to be gained as the ship inclines (within large limits)—has resulted in the capsizing of many ships at sea, and in grave danger to many that are still afloat, not in the same manner, because not in the same condition as to lightness as the *Hammonia* and *Daphne*, but from other not less real deficiencies." Sad and serious as this statement is, I repeat it here with perfect confidence in its accuracy.

Sometimes such vessels are brought into a condition of apparent safety by the stowage of their own coal, but as the coal is consumed their stability diminishes, they capsize, disappear, and the word "missing" is recorded against them in an official return. No means exists, notwithstanding all our shipping legislation, for insuring that the facts will be brought to light—indeed, at the official inquiry which follows under the present conditions, the question of stability may not even be mentioned. As the stability of a ship is often an intricate matter which can be effectually controlled only by close and careful calculation, and as no Government department is at present charged with the duties even of collecting, recording, and making known those dimensions and particulars of ships which determine their stability, the matter must be left to right itself. Maritime ships of small stability incur dangers from, and are doubtless lost by, the operation of causes which are but very imperfectly appreciated.

It is under the urgent pressure of a very rapidly growing mercantile steam marine that the shipbuilding trade has somewhat, I fear much, outrun the companionship and regulation of science. It is only quite recently that the necessity for developing their scientific staff and appliances has been borne in upon the minds of shipbuilders. There never, even yet, has been so much as a training school or college established by them for the education of young naval architects and draughtsmen throughout the country. But the Admiralty have had their dockyard schools at work for nearly forty years; school after school of Government naval architecture has been established; the Institution of Naval Architects has been formed, and done invaluable work, for more than twenty years; and some private shipbuilders have at length entered with spirit and enterprise upon the labour of developing the practice of scientific naval architecture. No part of my duty in connection with the *Daphne* inquiry has been so agreeable to me as that of bearing witness to the admirable efforts of several Clyde firms in this respect; and there is no result that can follow from the inquiry which I should esteem so highly as the emulation of their efforts throughout our shipbuilding establishments generally—unless, indeed, it were that of a general awakening of *shipowners* to their great and enduring responsibilities in this matter.

EDWARD J. REED

INTERNATIONAL POLAR RESEARCHES

AT the present moment, when every student of modern science is anxiously awaiting the result of the labours of the international observation parties which have for nearly a year been self-imprisoned around the Pole, I venture to make the following suggestions relating to international Polar researches.

The state of the ice in the Arctic seas is, as is generally known, very changeable during various seasons. It is thus impossible beforehand to draw conclusions as to the probable state of the ice one summer by its state the year before, and this circumstance has greatly impeded active researches in the Arctic regions. From time to time valuable and expensive expeditions have been despatched, but these have in most instances been unfortunate enough to encounter the adverse seasons, and the purely geographical gain has in consequence not been in proportion to the cost. At other seasons, on the other hand, when the ice seems to have promised a far advance northwards there has not been any expedition ready to take advantage of the circumstance. Had there at certain times and seasons been expeditions prepared to use the opportunities which have presented themselves, and in the right locality, I have not the least doubt that a very far advance into unknown Polar regions might have been made at a very small cost. In spite of the, in many respects, exceedingly valuable discoveries which have resulted from these expeditions to geology, meteorology, and other modern sciences, they seem certainly on the whole as if they had been started under an unlucky star, which is, in my opinion, caused by the circumstance *that the period and season selected have not been the proper ones.* What we have thus gained has generally been obtained with great loss of time, money, and valuable lives. A most remarkable contrast to this is, however, the voyage of the *Vega*, which from beginning to end seemed to have been attended with success only, as the forced wintering, when having practically accomplished its object, only tends to heighten the charm of this venture.

From the experience we have gained of the changes in the ice, it is however evident that Polar researches have hitherto, in one respect at all events, been effected in an erroneous manner, and great loss of money and life caused thereby. The *geographical* researches around the Pole should in my opinion be conducted in a different manner. Instead of, as has hitherto been the case, that finely equipped expeditions are despatched at random and at unconsidered periods, an arrangement should be made between the various European nations to equip a certain number of expeditions, which should be despatched *every* summer to the *same* locality *during a period of ten to eleven years.* During a period of this length it is probable that the conditions of the ice, which we may assume undergo periodical changes, have run their cycle, and during certain years of such a period opportunities would undoubtedly occur which would enable a very far penetration into the Polar basin.

The expenses attending such expeditions would, if skilfully arranged, not exceed those of one of the costly ones which have hitherto been despatched, while they would not result in the great loss of life which seems to attend the larger one or two years expeditions under which ambition naturally leads the members to venture on any undertaking which may give returns equivalent to the expectations of the equippers.

Hitherto the Dutch alone have arranged their expeditions to the Polar regions in a systematic manner. They have, as is generally known, for some years regularly despatched an expedition every summer to the regions around Spitzbergen and Novaya Zemlya; but that they have not, geographically, obtained any great results may be ascribed to the circumstance that they have employed sailing vessels instead of steamers. Neither have they in all probability laid special stress on geographical achievements in these parts; the expeditions hitherto despatched may thus be considered as mere pioneering ones. From next year it is, however, the intention of the Dutch to employ a steamer instead of a sailing vessel, and then their researches will, no doubt, be more fruitful.

It is now admitted by every student that Polar researches are of great importance in several respects, and the establishment of the international circumpolar stations is a proof of this, while the manner in which these have been arranged seems to promise to be the first step towards a series of researches in the Arctic regions, which would, as the meteorological ones, be best carried out through an international cooperation. In order to advance in the unknown Polar basin, it appears to me to be essential to abandon the random expeditionary attempts hitherto persevered with, and organise instead systematic researches. And if these are carried out by international

cooperation, the levy on the individual participators would be very small indeed.

There are in my opinion three points in the Arctic seas which offer, I believe, special advantages as bases for penetrating towards the Pole, and on which particular attention should be concentrated, viz. the north of Spitzbergen, the north-east of Novaya Zemlya, and the Behring Straits.

To the north of Spitzbergen, *i.e.* to the north of the Seven Islands, Norwegian hunters have, in the autumn of certain years, found the sea to the north and north-east so free from ice that they have deemed it a very easy matter to have penetrated with a steamer considerably northwards. Such was, for instance, the state of the ice in the autumn of 1881. And similarly the sea to the north-east of Novaya Zemlya has in certain years been easy of navigation, and finally, judging by researches, it may be assumed that the same is the case with the sea north of the Behring Straits.

Now, in order to carry out the programme which I have here suggested for a more systematic research of the Polar regions, I advocate that four small but excellent steamers should be provided, of which one should every year be despatched to a station on the north coast of Spitzbergen, another to one at the northern point of Novaya Zemlya, and the remaining two to respective stations north of the Behring Straits. This should be carried out during eleven consecutive years. Then when the state of the ice in certain seasons was very favourable, the vessels should take advantage of the opportunity and proceed northwards.

The advantage of this plan is that it would be attended with very little risk, while the object should be not to attempt to force an advance, but rather to wait patiently until the favourable opportunity presents itself, and then to act with boldness and decision. There is on the other hand every reason to assume that the time of the members of these expeditions would be employed throughout in a way beneficial to science. As a matter of safety it would also be advisable to establish fixed stations or depots in suitable places, to which the expeditions could resort in case of need.

From the experience we have gained of late it may be safely assumed that the Polar basin is not during any whole summer or autumn covered with continuous ice; it is in fact evident that the sea shows large tracts of open water during these seasons. The ocean ice north of Spitzbergen is thus always in a constant—at times even exceedingly violent—state of drifting in the most varied directions, according to the currents and winds prevailing. At times, too, the ice has been found to drift in a direction contrary to those of currents and winds. North of Spitzbergen there must, therefore, during certain periods of the season be large tracts of open water which are capable of receiving the enormous ice masses in drift.

As is generally known, Petermann advanced the hypothesis that Greenland extended in a more or less broad belt of land towards the Pole, from whence it diverged downwards to Behring Straits. If this is so, the great Polar basin should be divided into two parts with a common outlet into Behring Straits, although distinctly separated from each other by the land belt in question. They would at the other end discharge themselves into two different channels, viz. one in Baffin's Bay and the other in the Greenland and East-Spitzbergen ocean. This hypothesis has been supported by many eminent *savants*, as for instance Parpart, Jäger, and Chavanne.

Without, however, disputing the correctness of the reasons for this assumption, it would not be difficult to point out circumstances which would refute the hypothesis. And although several things seem to corroborate the assumption that the real Polar basin contains a belt of smaller and larger islands, it is perfectly obvious that the climatological and consequently the glacial conditions of these regions would have been quite different from those now prevailing had a large continent of the kind described by Petermann occupied the greater portion of the central Polar basin. I myself believe, judging by the strong motions of the ice north of Spitzbergen and Novaya Zemlya, and certain circumstances attending the same, that the climate of the Polar regions is a sea- or insular climate rather than a continental one. In making this assertion, however, I do not say that a continent such as that referred to has not existed there in the Tertiary or early part of the Quaternary period.

However this may be, the question to be solved is one of preeminent importance to men of science, and I feel certain that a mode of research effected in the manner I have here advocated would certainly result in its solution.

KARL PETTERSEN

Tromsö Museum, July

NOTES

A MEETING of the General Committee of the International Fisheries Exhibition was held at South Kensington on Tuesday. Mr. Birkbeck presided, and read the Report of the Executive Committee, which stated that the number of visitors to the Exhibition has, up to the present, been very large. The numbers up to Saturday, the 25th inst., were 1,444,515, showing a daily average of 16,050. The juries have, with few exceptions, now completed their labours, and their reports will be laid before the Special Commissioners, appointed by Her Majesty's Government, for consideration and approval. The Report closes as follows:—"With regard to the future, it is indispensable that the Executive Committee should obtain the necessary powers from the General Committee to announce the closing of the Exhibition on some day to be fixed hereafter, and that they should further be invested with authority to carry out any negotiations and make any agreements they may deem necessary for the subsequent utilisation of the buildings, which have been erected at so great a cost, in order that a fair proportion of the money that has been expended upon them may be recovered. In furtherance of the latter object, the Executive Committee have much pleasure in stating that they have received from Her Majesty's Commissioners of 1851 an intimation that, provided the grounds are used solely for the purposes of holding exhibitions, they would be willing to extend the existing agreement (which expires on December 31 next) for a further period of three years. The Executive Committee have every reason to believe that, with the approval of the Prince of Wales, exhibitions of great importance will be held in each of these years." Under these arrangements the authorities, which His Royal Highness may be pleased to constitute for carrying out each of these exhibitions, will become tenants of the Fisheries Exhibition, and would accordingly pay a proportion of the original cost as rent for the use of the buildings. The Chairman said it was a matter of congratulation that the numbers admitted had proved to exceed the most sanguine expectations of the general public, and the Committee had every reason to believe that for the future, especially during the month of September, large numbers of visitors would attend. The most important portion of the Report referred to the future use of the buildings. Next year it was proposed to hold a great international exhibition of horticulture, floriculture, and forestry, and they had every reason to believe it would be successful. There had been some question of the conferences being continued later on. The discussion on the paper by the Duke of Edinburgh was adjourned *sine die*, and probably, if His Royal Highness was in London at the end of September or the beginning of October, he might be disposed to attend. There was also another promise given that there should be a fishermen's

congress, which it was proposed should be held at the end of September. The only other matter was with reference to the juries. The reports had nearly all come in, and they had only now to wait for the meeting of the Government and Special Commissioners to confirm the various awards.

On the occasion of the unveiling of the statue of Daguerre at Cormeilles on Sunday, it was stated that the family is not extinct, The present representative being M. Behon-Daguerre, a contributor to French scientific journals. It was on August 19, 1839, that the Daguerreotype was publicly exhibited by Arago at a sitting of the Academy of Sciences. This communication was made in accordance with the provisions of a law granting to Daguerre and Niepce a joint annuity of 400*l.* for the purchase of their invention on behalf of the French nation. Of the members of the Academy sitting on August 19, 1839, only two are now alive—M. Dumas, the Perpetual Secretary, and M. Chevreul, who was then in the chair. It was M. Chevreul who congratulated M. Daguerre in the name of the Academy of Sciences.

An excellent paper taken from an address delivered to secondary school teachers in Switzerland has been circulated by the U.S. Education Bureau to answer the question, How to teach natural science. It urges that knowing facts is not the object of such education; in that case a supply of works of reference would be a royal road. "One gets on faster with a child by carrying it, but it is for the child's interest to teach it to run and swim by itself." A teacher, therefore (who must be laboriously grounded himself), must patiently bring *all* his scholars, not the most promising only, to discover and observe facts for themselves—teach them to *see*. Cram is most dangerous in scientific teaching, because most easy to both of them. Books, therefore, should be little used, and nothing about an object should be taught without such object before them. After *seeing*, the next lesson is *describing*, with the help of drawing if possible, both leading to accuracy in the use of language. Plants first, which are plentiful for experiments, then animals of different classes; later on minerals should be chosen, mechanical effects on these latter first, later on chemical. The district museum of natural history and such classes would mutually assist each other greatly; in fact neither, to be successful, would long go on without the other. And, indeed, the lecturer wisely cautioned his hearers that making collections must not become a rage with the pupils.

M. Pasteur has addressed a telegram to M. Dumas, Perpetual Secretary of the Academy of Sciences, to inform him that he has received telegraphic news from the French Mission which has gone to Egypt to study the cholera. M. Pasteur says that it contains very curious observations of a highly novel character.

The Royal Commissioners on Technical Instruction are now engaged in preparing their Report, which promises to be a work of considerable magnitude. The completion of it will probably occupy more time than was originally contemplated.

Prof. W. M. Hicks, M.A., has been appointed Principal of Firth College, Sheffield, in the room of Prof. Jones, the newly-appointed Principal of the South Wales College. Mr. Hicks is a Fellow of St. John's College, Cambridge, and was seventh Wrangler in 1873. He worked in the Cavendish Library under the late Prof. Maxwell.

In addition to the observations carried on around the Pole the physical institution at Upsala has also carried out others in that place during the winter, which were brought to a close on August 15 last.

We have received from the President of the University of Tokio the Calendar of the Departments of Law, Science, and Literature for the session 1881–82. Like the Report of the Japanese Department of Education, this volume comes somewhat late. As is the case with all the Japanese educational establishments, we notice here the rapid reduction in the number of foreign teachers, and the increase in the number of qualified natives who take their places. Thus in the department of science we find thirty-six instructors of various grades, of whom only seven are foreigners, and there have recently been still further reductions. Many of the native professors appear to have excellent academical degrees from European and American universities, and one is a Cambridge Wrangler. Among the changes in the curriculum during the session we observe that the permission to students to choose between the study of French and German is taken away, and the latter language made compulsory. "This change has been made in order to enable students to pursue their studies or professions in future to the best advantage, since it is believed that Germany is the country where the sciences here pursued have reached the highest comparative development." Several graduates were despatched during the year to Europe to continue the study of zoology, mechanical engineering, medicine, and political science. The total number of students was 170, 91 of whom had entered for the scientific course; while the total number of graduates was 133.

The new biological laboratory of the Johns Hopkins University, which will be opened next September, has, *Science* states, been especially constructed with reference to providing opportunity for advanced work in experimental physiology. It contains two large rooms for general advanced work in animal physiology, in addition to others specially designed for work with the spectroscope, with the myograph, for electro-physiological researches, and for physiological chemistry. It also contains a special room constructed for advanced histological work, and well supplied with apparatus and reagents, a room for micro-photography, and rooms for advanced work in animal morphology.

A telegram from Batavia, dated August 27, states that terrific detonations from the volcanic island of Krakatoa were heard on the previous night, and were audible as far as Soerakarta, showers of ashes falling as far as Cheribon. The flashes from the volcano were plainly visible from Batavia. Serang is now in total darkness. Stones have fallen at that place. Batavia was also nearly in darkness. All the gaslights were extinguished during the night. It was impossible to communicate with Anjer, and it is feared that some calamity has happened there. Several bridges between Anjer and Serang have been destroyed, and a village near the former place has been washed away, the rivers having overflowed through the rush of the sea inland. This rush is spoken of in the telegrams as a "tidal wave," but it is evidently more of the nature of an earthquake wave, a phenomenon so well known on the west coast of South America. Java is the centre of one of the most active volcanic regions on the globe; it has about sixteen active volcanoes, and many more which are mostly quiescent, not extinct.

A terrible tornado broke over the south-eastern part of Minnesota on August 22. At Rochester forty persons are reported to have been killed and fifty injured. A third of Rochester is stated to be wrecked, and it is feared that the whole country around that town is in ruins. The number of killed is estimated at some hundreds. A passenger train on the Rochester and Northern Railway was blown off the line, and it is reported that twenty-five passengers were killed and thirty-five injured. The storm also visited Utica, St. Charles, and neighbouring counties.

On August 5 at about 9 p.m. a very fine meteor was observed from several places around Lake Vettern, in Sweden. It passed across the sky from west to east, and possessed a magnificent lustrous head and tail somewhat resembling a large rocket. Its speed was as slow as that of the latter, its passage

occupying exactly two minutes, while it left a shining track for several seconds in the sky. On August 12 at about 9 p.m. a meteor was seen at Sarpsborg, in Norway. It represented a fireball with a long shining tail, passing in a straight line across the sky in an easterly direction. It was in view for about one minute.

A SHOCK of earthquake of a rather severe nature, but of short duration, was felt at Agram at 3.40 p.m. on the 28th inst. It was accompanied by subterranean rumblings.

M. JACQUELAIN has endeavoured to prepare a pure carbon for electric purposes that should be as hard and as conductive as gas carbon. He first takes gas carbon, which he submits to four processes: (1) treatment with dry chlorine at a red heat for thirty hours; (2) treatment with hot alkali for about three hours; (3) immersion in hydrofluoric acid (1 to 2 of water) at a temperature of 15° to 25°; (4) carbonised by heating strongly in the vapour of a high-boiling hydrocarbon, for commercial purposes gas tar will do well. All these operations may be performed after the carbon has been cut into sticks. By these processes the impurities have been reduced to a minimum and a good, pure carbon obtained.

THE director of the Jardin d'Acclimatation of Paris has just received an entire tribe of Kalmucks from the desert lands in the neighbourhood of the Caspian Sea. It consists of 9 men, 8 women, 4 girls and children, 18 camels, 15 mares and young horses, 10 Kirghiz sheep, with tents, instruments, arms, &c. They will probably visit London after having made in Paris a stay proportionate to their success.

ON Sunday week an extraordinary ascent was made at Nogent-sur-Marne. The aëronaut ascended at 4.30 p.m., and landed near St. Cloud on the following day at 7 a.m. He remained 14½ hours in the air, and travelled no more than 30 kilometres.

M. FRIEDEL has found that at certain temperatures blende, chloride of sodium, and boracite exhibit pyroelectric phenomena. Boracite he found to be so most markedly at the point when it lost its cubical form whilst cooling after being heated to 265°.

MESSRS. LONGMANS AND CO. have issued the eleventh edition of Prof. Atkinson's translation of Ganot's "Elementary Treatise on Physics." About thirty-two pages have been added to the new edition, while the chapter on the steam-engine has been entirely recast.

MR. FISHER UNWIN has added to his useful series of Half-Holiday Handbooks a Guide to Wimbledon, Putney, and Barnes. The same publisher also sends us a little Handbook to the Fernery and Aquarium.

M. DE FONVIELLE asks us to say that by mistake he stated in his note on the Montgolfier statue that it was cast in bronze; it is in plaster, and the cast is being executed.

THE additions to the Zoological Society's Gardens during the past week include a Maholi Galago (*Galago maholi*), purchased; a Vervet Monkey (*Cercopithecus lalandii*), presented by Mr. J. H. Sheppard; two Golden Eagles (*Aquila chrysaëtos*) from Scotland, presented by Mr. A. H. Browne; two Short-toed Eagles (*Circaëtus gallicus*), purchased; a Yellow-headed Conure (*Conurus jendaya*), presented by Her Grace the Duchess of Wellington; a Slender-billed Cockatoo (*Licmetis tenuirostris*), presented by Mr. R. Keele; a Land Rail (*Crex pratensis*), presented by Mr. M. Bryant; a Partridge Bronze-winged Pigeon (*Geophaps scripta*), and a Modest Grass Finch (*Amadina modesta*), presented by Mrs. J. Abrahams; a Martinique Waterhen (*Porphyrio martinicus*), a Mississippi Alligator (*Alligator mississippiensis*), presented by Mr. Cuthbert Johnson; six Chameleons (*Chamæleon vulgaris*), purchased; a Hog-nosed Snake (*Heterodon platyrhinos*), presented by Mr. F. J. Thompson.

OUR ASTRONOMICAL COLUMN

THE DIVISION OF BIELA'S COMET.—Those who have made themselves acquainted with Hubbard's masterly researches on the motion of Biela's comet will be aware that he arrived at the conclusion that the disruption of the comet, by whatever cause effected, took place in heliocentric longitude 318·6°, and latitude + 12·0°, distance 4·36, which position he states the comet occupied in November, 1844. In fact, if we adopt Hubbard's final elements for perihelion passage in February, 1846, we find for 1844, November 16·0 G.M.T., longitude 318° 36′, latitude + 12° 2′, radius-vector 4·3665, and the true anomaly 209° 57′. At the time when Hubbard's investigation was made, no one of the known minor planets attained this distance from the sun. We are now acquainted with several which recede further, towards aphelion passage, and an encounter between the comet and a small planet might explain the phenomenon which occasioned so much astonishment in 1845-46. The orbits of some 230 of these bodies have been calculated, but on submitting them to examination with a view to discover whether any one of the planets could pass through the point indicated by Hubbard as that of the separation of Biela's comet, we arrive at a negative result. *Andromache* recedes to a distance of 4·723 from the sun, *Irmene* to 4·590, and *Hilda* to 4·632, but at such distances all three are much nearer to the plane of the ecliptic than Hubbard's position. We may therefore say that if the Biela catastrophe was occasioned by collision with a small planet, it was not one of the large number already calculated.

VARIABLE STARS.—Mr. Knott has succeeded this year in following the variable S Virginis almost if not quite to a minimum, but unfortunately the long twilight, moonlight, and hazy and cloudy skies in July preventing him from fixing the exact date. On April 4 the star was 9·7m., and ruddy; April 25, 10·15; May 4, gauged 11·5; May 31, 12·1; June 25 and 28, 12·2 and 12·3; June 30, 12·7; and on July 4, by a doubtful observation, 12·75. The observations made by Mr. Hind, soon after the discovery of the star's variability in 1852, compared with those of Prof. Schönfeld to 1875 give the following elements:—

		Days.
Minimum	1875, April 27·4 +	373·77 E.
Maximum	1866, June 7·15	,,

This formula assigns July 4, 1883, for minimum, a date closely borne out by Mr. Knott's observations, and for next maximum, 1883, October 30, not observable.

The star varies from about 5·7m. to 12·7. It is XIII. 420 of Weisse's Bessel, and its position for 1884·0 is in R.A. 13h. 26m. 56·9s., N.P.D. 96° 35′ 46″.

Mr. Knott has also found a maximum of R Scorpii on 1883, July 9, magnitude 10·1. S Scorpii had already passed maximum when the observations commenced in the middle of May.

THE GREAT COMET OF 1882.—It may be hoped that one or more of the larger instruments in our observatories will be employed in a further attempt to fix positions of this remarkable body during the absence of moonlight in September. Positions were given in NATURE, vol. xxviii. p. 334, and will also be found in the *Astronomische Nachrichten*.

Now that the period of revolution resulting from the most reliable calculations approximates to eight centuries, it would be interesting to bring together in their original form the numerous descriptions of the great comet of 1106, the substance of which is given by Pingré, more especially the references to the direction of the tail (between the east and north) in the latter part of the comet's appearance. Like the comet of 1882 it was seen close to the sun: one historian says it was so observed from the third to the ninth hour of the day on February 4.

GEOGRAPHICAL NOTES

WITH reference to the Austrian Meteorological Expedition which on Tuesday last arrived in Vienna from Jan Mayen, we are now able to give the following particulars of the wintering at the island. Leaving Iceland on August 1 the *Pola* sighted the southern point of Jan Mayen on the 3rd, but a thick fog prevented landing until the following day. Lieut. von Wolgemuth, with some officers, at once came on board, and great were the rejoicings on both sides at the meeting. The chief of the expedition states that at the end of August, 1882, the northern storms began with a heavy fall of snow. September was, how-

ever, fine and warm, but with October the storms from the north again came back with cold weather, accompanied by magnificent auroræ of yellow, blue, and sometimes even red colour. The aurora borealis was always seen, and in constant motion, at times covering the whole firmament. On November 12 the Polar night commenced, but the darkness was not appalling, as the ever-recurring auroræ lit up the night. Terrible snowstorms often compelled the members to keep indoors, and not until December came the ice began to form along the coast, but it was often after broken up under terrific storms. During these the spray from the surf on the coast was often thrown several hundred feet inland and covered every object with salt crystals, so that fresh water had to be fetched long distances. In January the greatest cold occurred, −35° C., but even during that month southerly winds often brought the glass up to +20° C. On January 30 the Polar night came to an end. March was on an average the coldest month, and during the same the station was for a short time snowed up. During April and May fresh weather reigned. Early in June a whaler passed the island, but did not observe the station, and by the end of the month no ice was found on the island. Throughout the winter but little stove firing was necessary, and both houses and the provisions fully answered their purpose. During an exploration of the island a grave was discovered which is believed to be that of one of the shipwrecked Dutch sailors who wintered here in 1633, and died through scurvy. The scientific observations of the expedition are, the members state, very valuable, and have been carried out in accordance with the international programme. There was no case of scurvy among the members or the crew, against which every precaution had been taken by the munificent patron of the expedition, Count Wilczek.

In September it will be exactly twelve months since the *Dijmphna* and the *Varna* were last seen in the Kara Sea, since when no news whatever as to the fate of the two vessels has been obtained. It was hoped that the *Willem Barents*, which has been cruising in the Kara Sea during the summer, would have brought some tidings of the missing vessels, but this expectation has failed, as recently stated in NATURE, the Dutch exploring vessel neither finding any trace of the same, nor learning anything from the Samoyedes on the coast of Siberia. If the rumour, which was current early in the year, that the Samoyedes had seen the wreck of a large vessel on the *east* coast of Waigatz Island, is remembered, and which was proved to be incorrect, we may assume that there is as little truth in the recent one to the effect that a vessel had wintered off the *east* coast of that island, a spot which it is hardly likely that either vessel could have reached. On the other hand there is little probability of the hope expressed by Hovgaard in his last despatch and by Nordenskjöld having been realised, viz. that the equinoctial gales of October would set the vessels free and enable them to winter at Port Dickson or adjoining port, as Hovgaard had instructions from Herr Gamél, in such an eventuality, to despatch a message thereof to Yakutsk, and if this was done it would have reached us ere now. There is now only the hope left, if no mishap has occurred to the vessels, that they got free early in the spring, as Norwegian smacks found open water in the Waigatz Strait as early as in May last, and have proceeded to Port Dickson, from whence news may now be looked for. This port may have been reached in safety, although it seems remarkable that the Dutch Meteorological Expedition should not have returned to Europe instead during the summer in accordance with the instructions of the Circumpolar Congress, by which all parties were to return in August of the present year. If to this are coupled the circumstances that the *Varna* is merely a third class Norwegian coasting steamer of inferior qualities and the *Dijmphna*, although strengthened for Polar exploration, an old vessel of no great strength, and that the vessels were last seen in a place which is notorious for the terrible pressure and drift of the pack-ice, with sudden hurricanes, there certainly seems ground for the anxiety for the ships which is now becoming manifest in Copenhagen and Amsterdam. The Dutch have, we learn, taken decided steps to ascertain the fate of their countrymen, it having been decided at a meeting in Amsterdam last week immediately to equip and despatch a steamer in search of the *Varna* from Hammerfest, in Norway.

The *Elida* left Hammerfest last week to try to discover the missing Dutch Expedition. The Meteorological Institution has now contracted with the owners of a second ship, the *George*, which started on Saturday from Archangel with orders to land on the west coast of Waigatz, and to send help overland to the Kara Sea if the entrances by water are closed. A telegram from Utrecht announces that a Dutch gentleman offers a reward of 50,000 Norwegian krone to the ship which shall find the Dutch Polar Expedition, last seen in the autumn of last year on board the *Varna* in the Kara Sea. This expedition had assigned to it the carrying out of the magnetic and meteorological observations at the mouth of the Yenisei, under the command of M. Lamie, a lieutenant in the Royal Netherlands Navy.

In the *Bolletino* of the Italian Geographical Society for August, Sig. C. de Amezaga gives a detailed account of the Galapagos Islands, based on the recent reports of MM. Icaza and Wolf. The archipelago, which belongs politically to the Republic of Ecuador, is a sort of No Man's Land, at present almost uninhabited except by cattle, goats, swine, horses, asses, and dogs, placed there early in the present century, which have multiplied exceedingly, and partly reverted to the wild state. The dogs especially are very numerous and savage—like their wolfish ancestors preying on the goats and cattle. Similar propensities have been developed by the "bimana" from the mainland, who, at various dates between 1831 and 1878, have attempted to establish settlements on Floriana (Charles Island) and one or two other members of the group, but who generally ended by mutually exterminating each other. The archipelago comprises thirteen volcanic islands, and numerous rocks scattered over a space of about 6000 square miles, but collectively forming scarcely more than 720 square miles of dry land. Within this limited area are represented two remarkably distinct physical and climatic zones, one low, hot, barren, and rainless, extending from the sea-level to an elevation of about 650 feet, the other thence to an extreme altitude of 1435 feet (cone at north extremity of Albemarle Island), subject to tropical rains from February to May, followed by heavy dews for the rest of the year. Here the igneous rocks have been completely disintegrated, forming a thick layer of argillaceous clay and humus, on which flourishes a varied and vigorous vegetation. But this upland wooded region is of such limited extent compared with the arid lowlands, that probably not more than 60 square miles altogether are suitable for cultivation. The native flora, while in general of the American type, presents many peculiarities, especially in the phanerogamous plants, all of distinct species, which have not been satisfactorily explained by the special climatic and physical conditions. There is also a total absence of lianas, creepers, palms, musaceæ, aroideæ, and the other monocotyledonous families which form the glory of the Amazonian forests. The indigenous fauna is represented chiefly by reptiles, including four or five species of snakes, none of which are venomous. The huge turtles and land tortoises, the strange marine iguanas, and other survivals from remote geological epochs, impart a certain antediluvian aspect to the landscape, especially of the low-lying coastlands, which are little frequented by the animals recently imported from the mainland. The climate, everywhere healthy, with an average temperature not exceeding 73° or 74° F., even in the hot zone, is favourable both for stockbreeding and the cultivation of sugar, bananas, and all kinds of vegetables and fruits of tropical and temperate regions. There, are, however, no mineral resources, and a complete absence of guano, phosphates of lime and carbon, all of which were formerly supposed to abound in the archipelago. On the other hand, there are a few good and easily-accessible havens, such as those of Post Office Bay and Black Beach Roads on the east side of Floriana. Hence the Galapagos Group, lying at about 900 miles from Panama on the direct route to Australasia, cannot fail to acquire great economic importance as a provision and coaling station as soon as the projected interoceanic ship canal is constructed. The notice is accompanied by a good chart of the archipelago on a scale of 1 : 889,000, showing elevations, cones (of which two are still active), marine and prevailing atmospheric currents.

It may be remembered that Baron Nordenskjöld, at the moment of leaving Iceland on the present expedition, discovered in the possession of an Icelander an old map of North Europe, which he, judging from his announcement of the discovery through the medium of the Royal Geographical Society, believed to be very old, perhaps as old as the famous Zeno map, to which reference has previously been made in NATURE, and which he appeared to consider further supported his views concerning the Norse settlements in Greenland. We have, with reference to the map in question, received a communication from an eminent Swedish geographer, informing us that, having had an opportunity

of examining the map now in Stockholm, he is convinced that it is simply a Dutch sea chart from the beginning of the seventeenth century, and of no value whatever, which he believes Baron Nordenskjöld did not, under a mere cursory examination, discover. In consequence of the opinion pronounced by our correspondent, the Swedish Geographical Society has decided not to have facsimiles of the map taken.

INDIAN METEOROLOGY[1]

II.

THE title of Paper IV.—"Storms in Bengal, accompanied by increased Atmospheric Pressure and the Apparent Reversal of the Normal Diurnal Oscillation of the Barometer," by Prof. J. Eliot,—must necessarily appear somewhat strange to those accustomed in our latitudes to the frequent masking, if not actual reversal, of the normal diurnal oscillation, by the large and rapid non-periodic oscillations to which the atmospheric pressure is subject.

There are two reasons why this reversal should be rare in the tropics, and of such frequent occurrence, as to be more often the rule than the exception, in higher latitudes. One is, that the range of the diurnal barometric oscillation is greatest near the equator, and diminishes as we approach the poles, and the other, that the range of the non-periodic oscillations varies in precisely the opposite way, increasing very nearly in the ratio (as Ferrel has shown) of the square of the sine of the latitude to unity.[2]

Instances of such inversion, are said by Prof. Eliot to be extremely rare in Bengal, but a perusal of the paper leads us to conclude that it is rather a case of *de non apparentibus* than *de non existentibus*, and that a tendency towards reversal takes place to some extent in all north-westers and analogous storms of a sudden and violent character.

Humboldt, Col. Sykes, and Allan Broun, have all graphically described the regular march of the diurnal barometric oscillation, but their observations were mostly made a good deal nearer the equator than Bengal, and thus in regions where reversal of the diurnal oscillation would be a still rarer phenomenon.

In the cases cited by Eliot, including one observed by Hill at Allahabad, the following characteristic changes were observed about the time of reversal:—

1. A marked rise of the barometer.
2. An equally marked and simultaneous fall of the thermometer.
3. A sudden decrease of the tension of aqueous vapour.
4. An instantaneous change of wind direction.

A consideration of all these features, leads the author to conclude that in these cases a downrush of cold air belonging to an upper current (which is known to travel seawards in Bengal, and is therefore dry) takes place in the centre of the area of low pressure belonging to the storm. On no other hypothesis, does it seem possible to explain all the facts, especially the rise in the barometer, and the fall in vapour tension.

A close study of these north-westers, whether accompanied by reversals or not, and their analogues in other parts of the world, is certain to unravel much of the complexity surrounding such and all aërial disturbances, and as all facts bearing on them are valuable, and the present writer was for some time resident in a locality (Dacca) where they occur with marked intensity, he may perhaps be allowed to remark that one of the most peculiar features he has noticed in connection with them, is the almost instantaneous return of the wind to its original direction after the rear of the storm-cloud has passed the zenith. Both before and after the storm, the wind in Bengal blows from the direction of the sea (south-east). The storm-cloud appears to form in the north-west by an aggregation of vapour that is carried thither in cloudlets from the sea. After a time, the threatening mass advances towards the sea, the sea-wind meanwhile blowing towards the advancing cloud with increased force, until the latter has arrived pretty close, when a lull takes place, after which the wind instantaneously changes to the opposite quarter (generally through the north), from which it blows with great violence. Then come the characteristics already noticed, together with continuous lightning and hail, the latter often very large.

When the storm-cloud, the rear of which presents a very definite outline, passes the zenith, the wind invariably returns to its former direction, and gradually dies down as night approaches. The whole phenomenon appears to favour the notion which has always been entertained by the writer, and is merely a slight extension of the explanation given by Prof. Eliot, that a sudden *oblique* uprise of moist hot air takes place, deflecting the upper current into a corresponding *oblique* downward course, which determines the direction of the storm and continues as long as the uprising air interferes with its regular motion parallel to the surface. This explains why the storm always follows the course of the upper current, as well as the immediate readjustment of the original conditions, as soon as the region of ascending air which causes the deflection has passed the spot.

Paper V. "On the Rainfall of Benares in Relation to the Prevailing Winds," by S. A. Hill.—The observations utilised in this paper, as far as the velocity of the wind is concerned, raise a question of general importance, and one which we think ought to engage the attention of all thoughtful, and certainly all practical meteorologists. Up to 1872, the anemometer was only 15 feet above the ground, but in that year it was raised to a height of nearly 80 feet. Now what are we to think of the effect of such a change of position on the observations?

According to Mr. Stevenson, 15 feet is the lowest elevation at which an anemometer should be placed, since below this height the velocity is found to be enormously affected by the nature of the surface. On the other hand, 80 feet is an elevation which would not only cause the instrument to register a considerably higher velocity,[1] but also secure for it nearly complete immunity from the disturbing influences which would be sure to affect it in the lower position.

It is indeed very much to be regretted that in setting up anemometers in India no sort of uniformity seems to have been attempted. Thus from a list of their elevations above the ground given in the "Meteorological Report for India" in 1876, every variety of height imaginable occurs, ranging from 5 feet 7 inches at Khandwa to 76 feet 11 inches at Benares! At no two stations are the anemometers at the same level, and though it is somewhat complacently admitted by Mr. Blanford "that it can hardly be affirmed that in the majority of cases the anemometric records are strictly comparable," one is naturally inclined to ask why the instruments could not have been placed, if not exactly, at least more nearly, at the same level. Such an arrangement would seem to be a cardinal requisite where such a sensitive element as air motion is involved, and indeed Mr. Stevenson's experiments have shown that while observations below 15 feet are almost useless, the velocity increases rapidly with the height through the first 100 feet; so that until a correction is made for the height, it would be vain to attempt a comparison of observations made at lower, with those at higher levels.

Fortunately in this case the discussion mainly relates to the direction of the wind, so that the conclusions are not seriously affected by the change in the position of the instrument.

The chief conclusion arrived at by the author is similar to that obtained by Mr. Blanford in the first paper of this series for Calcutta, except that Benares affords no corroboration of the conclusion drawn from the former register, that "rain is the more probable in proportion as the deflection of the monsoon current is greater."

It appears, nevertheless, that there is a well-marked connection between the amount of rain that falls *in a day* and the deflection of the rain-bearing current, the maximum amount being from the opposite quarter (north-west) to that from which the monsoon blows.

Paper VII. "Variations of Rainfall in Northern India," by S. A. Hill.—This is one of the most interesting and important papers of the whole series, its ostensible object being partly to test the soundness of the idea which was propounded by Dr. W. W. Hunter and others in 1877, that sunspots, rainfall, and the occurrence of droughts and famines were closely associated in India. Regarding this *vexata quæstio* it may be said at the outset that while the general results of an investigation embracing an area which covers eleven degrees of latitude and twenty of longitude (equal to that of the British Isles, France, Germany, Austria, Holland, and Belgium combined), like those of Mr. Blanford for Southern India, bear out Meldrum's theory of an eleven-year cycle of rainfall, they exhibit certain irregularities, or, more properly speaking, double oscillations, which, as Prof.

[1] Concluded from p. 407.

[2] "Relation between the Barometric Gradient and the Velocity of the Wind," by W. Ferrel. *American Journal of Science*, vol. viii., November, 1874.

[1] According to Mr. Stevenson's formula, which holds near the surface, the velocity would be increased by this change of position in the ratio 1·32 : 1. Thus for 1872 the observed mean value was 67·8. To make this comparable with the years that follow, it should be 89·4!

Hill shows, are probably due to local reacting circumstances, and which afford but little hope of our ever being able to forecast droughts and famines in North-West India solely from a knowledge of the state of solar maculation.

The fact that the terrestrial effects of solar changes are conspicuous in some localities and almost totally absent in others seems to many persons incompatible with the cosmical nature of the influences at work, but to those who study the subject it appears, on the contrary, the only result to be reasonably expected both from experience and analogy.

Thus ordinary weather is the integral of all the differentiations effected during the regular seasonal changes in solar declination, and it need scarcely be remarked what an endless variety of conditions we have in this case, due primarily to the operation of a gradual and periodic cause. Owing to diversities of superficial character, elevation, contour, latitude, &c., we have meteorological oscillations set up, differing from each other in phase and amplitude, which, like the tides of the ocean, in some places tend to exaggerate and in others to annihilate each other. So also must it be, where we have solar changes which gradually perform their cycle in a period of years. The forced oscillations they originate, though small, may in some localities, by a unison of oscillations of the same phase, or an absence of opposing oscillations, be exaggerated above the mean amplitude, just as in others they may, owing to an inequality of phase or the clashing together of opposite variations, be rendered inappreciable.

Prof. Eliot, in his "Report on the Meteorology of India for 1877" (p. 3), evidently recognises this fact, when he admits the probability that "at one part of the sunspot period one effect of the variation of solar radiation may be to exaggerate local irregularity." While therefore it is probable that we shall find only a few places, where the terrestrial effects of solar spot variation are of sufficient magnitude and regularity to render secular forecasting possible (assuming that our foreknowledge of solar changes is reliable), such a fact ought by no means to be used as an argument against the utility of studying the relations between solar physics and terrestrial meteorology.

Mr. Blanford, who from the first attacked the somewhat crude hypothesis propounded by Dr. Hunter regarding sunspots and famines in Southern India, has in his own person furnished a practical protest against any such idea, since his researches on the connection between barometric pressure and sunspot variation have tended, not only to confirm the belief in the bond existing between solar and terrestrial changes, but have also opened out new collateral facts, which, if followed up, are certain to yield results of the highest importance to the science of meteorology. His own views on this question, which have frequently been misunderstood in certain quarters, and referred to as adverse to the general question, are concisely expressed in the following sentence, which we quote from an official report recently made by him to the Indian Government :—

"While, however, I am unable to concede to the conclusions hitherto placed on record, that degree of importance which has sometimes been claimed for them, as affording rules of guidance for the prognostication of scarcity and famine, I am fully in accord with the Famine Commissioners as to the importance of following up such clues as they afford, and of pursuing with all the means at our command the investigation of the class of phenomena to which they belong. It has happened again and again in the past history of science, that hypotheses, which in their original form were more or less erroneous, have nevertheless been most fruitful in their results. In giving system and definite purpose to research they have served a most useful office; and although the course of their verification may have resulted in demonstrating their error, the same process has brought to light the germs of new and unsuspected truths which might have long remained hidden but for the stimulus to investigation afforded by rejected theories."

The nature of the entire question indeed, seems to have been a good deal misunderstood in this country, at least to judge from the extraordinary amount of obloquy and opposition which it has encountered in various quarters.

On the one hand, it must be obvious to any one who casts even a merely superficial glance at the vast changes in the physical condition of the sun, indicated by the spots, prominences, &c., and the dependence of all terrestrial meteorology on the quantity (and perhaps quality) of the heat radiated from our great luminary, that such changes in the former, must be reflected to some extent in the latter, as indeed they are universally allowed to be in the case of terrestrial magnetism. On the other hand, it is equally obvious to the merest tyro in meteorology, that such meteorological fluctuations, though in many cases distinctly recognisable, are not only of small average amplitude (especially in high latitudes) when compared with those which occur, as we say at present, non-periodically, but take a period of years to accomplish their cycle. To imagine therefore, that such changes, even if thoroughly determined, will *alone* enable us to forecast the general weather of a season or a year, is manifestly irrational as far as these latitudes are concerned, while even in India and the tropics generally, we have grounds for believing that there are only a few places, where the extreme range of the oscillation bears a ratio to the non-periodic changes large enough to constitute it the dominant factor of the weather.

That when the conditions which regulate the larger and more irregular changes are better understood, a knowledge of the underlying secular meteorological changes coincident (or nearly so) with the varying phases of solar activity, will be of great *assistance* in framing seasonal forecasts, it is impossible to doubt. At the same time it seems strangely to have been overlooked by the majority of those who have interested themselves in this fascinating question, that though the sunspot variation in meteorological elements may alone be insufficient to form the basis of a practical system of weather prophecy, it is very likely to prove *the key by which the entire weather problem may be solved*, since, when once we know the precise qualitative as well as quantitative meteorological effects of a gradual *secular* change in the solar radiation, coincident with the sunspot cycle, we shall gain an immense insight into the way in which the larger and more rapid oscillations are effected by the *ordinary* changes in solar radiation, brought about by season, latitude, geographical locality, &c., these latter oscillations only differing from the former, in being more frequent and of greater amplitude.

Prof. Hill in his investigation, adopts a plan which is obviously necessary to any one who knows the peculiarities of Indian meteorology, viz. the separate treatment of the summer and winter rainfalls.

The former season embraces the period from May to October, and the latter the remaining months. An eleven-year period, in favour of which there is a good deal of preliminary evidence, is assumed, in order to see if there is any correspondence with the analogous mean period of solar spot variation. The oscillation of the summer rainfall for the whole area about its mean, is then estimated for the cycle, and is found to accord generally with the results for Southern India, and with Meldrum's supposed universal law, in showing a direct variation with the sunspots, the range being twice as great as in Southern India. At the same time considerable irregularity is visible, some of the stations at the border of the monsoon region giving results contrary to the average variation. The winter rainfall on the other hand shows a much closer relation to the sunspots, the remarkable thing about it being, that instead of varying *directly*, as the summer fall, it varies *inversely* with the spotted area.

The variation of this winter fall shown in the text is very regular, and confirms a conjecture hazarded by the present writer in 1877, that the similar variation which he had previously shown to exist in the winter rainfall of Calcutta would be found to be more decidedly marked in the sub-Himalayan zone to the north of it (NATURE, vol. xvi. p. 267, Meteorological Notes).

In a postscript to the paper Prof. Hill has worked out the variation from a longer series of observations, which were discovered, apparently by accident, at the Board of Revenue in Allahabad, and which, by means of registers kept in the Himalayan province of Kumaon, "to which the civil disturbances following the mutiny of 1857 did not extend," allows the cycle to be worked out for the period 1844 to 1878. The final result given in the form of percentage variations from the mean, is as follows :—

Winter Rainfall of North India

Years of Cycle.	1	2	3	4	5	6	7	8	9	10	11
Mean per-centage variation.	−6·8	−0·6	−3·6	−15·5	−17·3	+0·8	+27·3	+24·7	+9·1	−5·6	−5·4

For the summer rainfall the variation given in the text is as follows :—

Summer Rainfall of North India

Years of Cycle.	1	2	3	4	5	6	7	8	9	10	11
Mean per-centage variation.	+3·6	+7·4	+9·8	+12·6	+7·8	−5·6	−10·8	−8·1	−10·0	−7·0	−0·6

In the cycle as arranged above, the first year is that which contains the year of maximum sunspot, and the eighth that of minimum sunspot.

With the figures in the text, the maximum winter rainfall occurs on an average rather more than a year before the minimum of sunspots, and the minimum of rainfall appears either to coincide with, or to follow the maximum of the sunspots, at about an equal interval.

While, therefore, the facts are so far favourable to a close connection between sunspots and rainfall in Upper India, they do not lead so much to the conclusion that the former directly affect the latter, as to their both being effects of some common and as yet undetermined cause.

It should be further noticed, both as a result of this investigation, and an example of one of the "new and unsuspected truths" which Mr. Blanford says are often incidentally brought to light, that the variations of the summer and winter falls are almost exactly contrary to each other, and as this has been found to occur not only in the years of the mean cycle, but also in individual years, it has been concluded by Prof. Hill that *in Northern India the winter rains are excessive when the summer rains are defective and vice versâ*.

This contrary variation, which is of itself a valuable discovery, is moreover shown to be due in some measure to a reaction of the winter on the summer rainfall. Thus, in years of heavy winter rainfall in Northern India, and therefore of heavy snowfall in the Himalayas, an excess of barometric pressure attended by diminished temperature, is found to occur during the earlier months of the year, which causes the air to move outwards from the centre of relatively highest pressure, and so bar the approach of the Arabian Sea current from the south-west, as well as the Bay of Bengal current from the south-east, and by thus compelling them to part with their moisture in other districts, such as the hills of Central India, or East Bengal and Burmah respectively, causes deficiency and drought over the Punjab and North-West Provinces, or Western Bengal.

On the other hand, in years of defective winter rainfall, the temperature is generally high, and the pressure low, in the early months of the year; while the currents from the south-east up the Ganges valley appear in full strength, and are accompanied by early and abundant summer rains.[1]

Mr. Blanford has partly attributed the high atmospheric pressure which occurs in the years of heavy snowfall, to the cooling thereby produced, but as this abnormally high pressure sometimes extends right down the Bombay coast, it is plain that the snowfall is not the only determining cause, and that we must look to some more general cause to explain the matter. Prof. Hill speculates very intelligently on this cause, but as the speculation requires confirmatory evidence, it will be as well perhaps not to dwell on it at present.

It may, however, be observed that this speculation accounts satisfactorily for the double oscillation of the Bengal summer rainfall with its *maxima* at both sunspot epochs, as well as the double oscillation of the annual rainfall of Southern India, noticed by the late Mr. J. A. Broun, F.R.S., in NATURE, vol. xvi. p. 334 (which, unlike that of Northern India, is solely due to the *summer monsoon current*) with its *minima* at both epochs, two remarkable facts, which might at first sight appear to be almost irreconcilable, if not unaccountable.

Before leaving this interesting and suggestive paper, it should be remarked that the variation in the winter rainfall of Northern India is shown to be closely connected with the curves of air-temperature in the tropics calculated up to 1862 by Dr. Köppen, and continued up to 1877 by Prof. Hill from Indian observations alone.

The following table gives the epochs of maxima and minima of both elements, and the conclusion can, we think, scarcely be resisted that there is a causal connection between them, since in every case but one, the rainfall epochs slightly *follow* those of the temperature :—

Maximum and Minimum Epochs of Tropical Temperature and Winter Rain

Minima.				Maxima.			
Temperature.		Rain.		Temperature.		Rain.	
1836·9	...	1837·8	...	1842·7	...	1842·7	
1847·7	...	1848·1	...	1854·7	...	1855·0	
1858·4	...	1860·6	...	1865·1	...	1865·5	
1874·8	...	1874·7	...	(1876·3)	...	(1876·9)	

[1] These opposite conditions are now so universally recognised, as almost to form a canon of Indian meteorology.

Similar variations are shown to exist in the winter rainfall of other parts of the world, as well as in the humidity of Russia and Siberia, which favour the hypothesis long entertained both by Prof. Hill and the writer, that "the winter rains in Northern India occur simultaneously with an increase in the quantity of aqueous vapour in the atmosphere over Eastern Europe and Western Asia, and that the cause of both may *possibly* be found in an unusually high temperature in the tropics, whereby the evaporation of the waters of the ocean is accelerated and the upper current of moist air known as the anti-trade has its velocity increased."

SCIENTIFIC SERIALS

American Journal of Science, August.—Principal characters of American Jurassic Dinosaurs, part vi.: Restoration of Brontosaurus, with plate, by Prof. O. C. Marsh. The restoration is effected by bones belonging almost exclusively to a single individual, which when alive was about fifty feet long; chief characteristics: long flexible neck, very short body, massive legs and feet, the latter plantigrade, and leaving footprints about a square yard in extent, very large tail with solid bones, remarkably small head, smaller in proportion to the body than that of any other known vertebrate, skull being less in diameter or weight than the fourth or fifth cervical vertebra. The living animal must have weighed over twenty tons, and appears to have been a stupid reptile of slow motion, without offensive weapons or dermal armature, amphibious in habits, feeding on aquatic and other succulent plants.—The evolution of the American trotting horse, by Francis E. Nipher. The minimum time of trotting a mile, in a previous paper determined at 93, is here reduced to 91 seconds, and it is suggested that the trotter will very probably finally surpass the race-horse in speed.—On concave gratings for optical purposes, by Henry A. Rowland, Professor of Physics, Johns Hopkins University, Baltimore.—Glacial markings of unusual forms in the Laurentian Hills, by Dr. Edmund Andrews. Several illustrations are given of the peculiar marks here described, which are chiefly curved striæ, serrated striæ, and curious scoop-marks, both striated and unstriated, very difficult to explain on any theory of glacial action.—Response to the remarks of Messrs. Wachsmuth and Springer on the genera Glyptocrinus and Reteocrinus, by S. A. Miller.—On the present status of the eccentricity theory of glacial climate, by W. J. McGee. In reply to recent critics the author urges several arguments in defence of Croll's theory of secular variations in terrestrial climate.—On the commingling of ancient faunal and modern floral types in the Laramie group, by Charles A. White.—Notes on some fossil plants from Northern China, by J. S. Newberry. From the general character of these plants, which were collected by Mr. Arnold Hague, the author considers that Pumpelly and Richthofen's estimates of the great area and value of the North China coal and iron deposits are by no means unwarranted. The plants, all of the Carboniferous age, seem to prove that the Chinese coal basins belong to two great geological systems, one answering to that of the European and American coal-measures, the other probably referable to the Rhœtic and Lias.—Review of De Candolle's "Origin of Cultivated Plants," with annotations on certain American species, by Asa Gray and J. Hammond Trumbull.—On the supposed human footprints recently found in Nevada, by O. C. Marsh.

THE *Journal of the Franklin Institute*, August.—Cranes; a study of types and details, by Henry R. Towne.—A remarkable error in the common theory of the turbine water-wheel, by J. P. Frizell.—Béton in combination with iron as a building material, by W. E. Ward.—The grindstone, by J. E. Mitchell.—The Glover tower and the working of sulphuric acid chambers, by Moses A. Walsh.—On radiant matter spectroscopy, a new method of spectrum analysis, by William Crookes, F.R.S.—The cause of evident magnetism in iron, steel, and other magnetic metals, by D. E. Hughes, F.R.S.—National Exhibition of Railway Appliances, Chicago, Ill.—Obituary, Benjamin Howard Rand, Franklin Institute.—Notes.—Induced currents in reciprocal movements.—Twinkling of stars during auroras.—Spanish copper tubes.—Photozincography.—Orange peel.—Constitution of the sun.—Colour of distilled water.—Deep-sea explorations.—Generation of inflammable gases in the diffusion of beets.—Amber.

Journal of the Russian Chemical and Physical Society, vol. xv. fasc. 5.—On the formation and properties of oxide of

sodium, by N. Beketoff. The amount of heat disengaged during the complete hydration of sodium has been found equal to 55,000 calories, which figure, combined with that of Thomsen, gives 100,260 calories for the heat of oxidation of one molecule of sodium (50,130 for each atom).—On the naphtha lamp for burning heavy oils, examined at the Chemical Society's competition, by M. Andréeff.—On the naphtha of Caucasus, by MM. Markovnikoff and Ogloblin; second part.—The chief constituent parts of this naphtha, about 80 per cent. of it, would be hydrocarbons of the C_nH_{2n} series—C_8H_{16}, C_9H_{18}, and so on to $C_{15}H_{30}$. The authors propose to call them naphthenes, and describe their properties at length. The aromatic hydrocarbons constitute about 10 per cent. of the naphtha, partly known before, and partly seeming to belong to new series isomeric with the styrol series and its isologues. The oxygenated products, partly acid and partly neutral, play also an important part in the naphtha, which contains also a few phenols and lower hydrocarbons.—On naphtha; an answer to MM. Markovnikoff and Ogloblin, by Prof. Mendeléeff.—On the continuous graphic determination of the depth of shallow waters, by Prof. Petrushevsky. The author proposes to adjust to a boat a pole whose longer end would be dragged at the bottom of the river, whilst its shorter end would draw on a board the configuration of the bottom.—On the determination of the average coloration of a surface painted with different colours, by the same.—On the influence of light on the electrical conductibility of selenium, by N. Hesehus.

Archives des Sciences Physiques et Naturelles, July 15.—Verification of some atomic weights, by M. C. Marignac; first memoir, bismuth and manganese.—American ants, by Henry MacCook.—Ripple marks studied in Lake Leman, by Dr. F. A. Forel (one sheet of illustrations).—New researches on the Saturnian system, by W. Meyer.—Hypoxanthine in potatoes, by A. Weber.—Chloride of calcium, by V. Meyer.—Remarks on methods of determining vapour densities, by Alois Janny.—Acetoximes, by J. Petraczek.—On the aldoximes, by V. Meyer.

Rendiconti of the Royal Lombard Institute of Sciences and Letters, July 12, 1883.—Descriptive catalogue of a new series of rare or unpublished Greek coins and medals preserved in the Royal Numismatic Cabinet of Milan, by the curator, E. B. Biondelli. Amongst the 128 extremely rare and in some cases even unique specimens here described are medals of Julius Cæsar with Augustus from Achulla in Zeugitania, and of the two African Gordians from Cilicia, besides several coins from Sabrata, Thæna, Clypea, and other North African towns, including one of the Mauritanian king Ptolemy, son of Juba II., absolutely unique. The general catalogue of all the oriental and mediæval series, together with the historic and commemorative medals, is making rapid progress, and its publication is promised in a short time. The complete legends as far as legible are given in all cases, together with a brief description of the subjects.—The structure of the seeds in the family of the Oleaceæ fully described, by Prof. R. Pirotta.—On the functions of a single variant with more than two periods, π, π', π'' . . ., by Prof. F. Casorati.—Meteorological observations at the Observatory of Milan, with tables of barometrical and thermometrical changes, and records of relative humidity, direction of the winds, and cloudiness during the month of June.

SOCIETIES AND ACADEMIES

PARIS

Academy of Sciences, August 20.—M. Blanchard, president, in the chair.—Observations on the smaller planets made at the great meridian of the Paris Observatory during the second quarter of the year 1883, by M. Mouchez.—On a letter of General Stebnitski concerning the figure of the earth, by M. Faye. The Russian *savant* holds that the actual form of the globe, as expressed by the ideal continuation of the sea-level beneath the continents, differs from the theoretic ellipsoid not only in the undulations produced by the attraction of mountain ranges, and of the denser parts occurring here and there in the crust of the earth, but also in the deformations due to the attraction of the continents. In reply M. Faye contends that the mathematical surface of the globe is not modified by these causes, and that the level of the oceans is not sensibly affected by the influence of the mainland.—A study of the deformations and development of heat produced by the use of round-faced hammers in forging, by M. Tresca.—Observations touching a passage in M. V. Burg's recent communication on the use of copper as a preservative against cholera, by M. Vulpian. The author explains that a statement attributed to him by M. Tresca, regarding the use of copper as a prophylactic by English and French officers in Egypt, India, and Cochin-China, is groundless. He adds that he regards the advantage of the use of copper as a preservative as extremely doubtful.—On the separation of gallium (continued). Separation from tungsten and phosphoric acid, by M. Lecoq.—Experimental researches on explosive gas motors, by M. A. Witz.—Researches on the iodide of nitrogen; on chemical radiometers or iodide of nitrogen photometers; on the preparation in a low temperature of nitrogen, iodide of ammonium, and iodate of ammonia under the influence of light, and on the double iodide of copper and nitrogen, by M. Antony Guyard.—A contribution to the history of the formation of coal, by M. B. Renault. The author concludes that in many cases fossil coal is produced by the transformation *in situ* of the constituent elements of the plants whose forms it has preserved; that both the wood and bark have entered into the formation of coal, and that in the process of transformation the organic elements have diminished in size in a determinable proportion depending on the primitive density of the constituent organic matter.—Remarks on the *Phylloglossum Drummondii*, by M. C. Eg. Bertrand.

BERLIN

Physiological Society, July 27.—Prof. H. Munk spoke regarding the doctrine of the functional restoration of the cerebrum first deduced by Flourens from experiments he made on the cerebrum of doves. Flourens had observed that, on the excision of but a small part of the greater brain, the disorders which resulted in the sensuous perceptions and intelligence of the animal operated on ceased after some time, and the animal then acted as before in its normal state. On the excision, however, of a larger part from the cerebrum, the subsequent restoration was only incomplete. Were, again, a very large part cut off from the greater brain, the resulting disorders continued to the end of the animal's life. Flourens had further concluded that the functions of the whole of the cerebrum were strictly equivalent to one another, and that every part of it was capable of vicariously taking the place of every other part. This doctrine propounded by Flourens regarding cerebral functions having, however, been overthrown in consequence of investigations by Fritsch and Hitzig and replaced by that of the localisation of particular functions in particular parts of the cortex cerebri, the phenomenon which to all observers, on the removing of less than a quarter from the hemisphere of the cerebrum, had suggested the idea of functional restoration of the brain, now received a different interpretation. By some investigators it was maintained that the restoration was to be explained by the function of the excided part of the brain being taken over either by the corresponding part of the other side or by some other part of the brain situated on the same side, in the cortex, or in the interior, in either case in addition to its own special function. Others, again, deemed the restoration only an apparent one; in reality no function was suspended by the removing of a part of the cerebrum, it was only a check that was imposed through the irritation of the act of separation, and when that was relieved, the normal functions came again into play. Prof. Munk has for several years carried on investigations into the functions of the cortex cerebri, leading, as is known, to the conclusion that a limited part of the cortex situated on the flap of the occiput was the seat of the central visual perceptions (the sphere of vision) and that another exactly defined part of the cortex, situated on the flap of the temples, marked the site of the acoustic perceptions (the sphere of hearing), while a third region was appropriated to the sphere of feeling. He has further prosecuted his inquiries into the question of the restoration of cerebral functions, and by experiment has endeavoured to determine whether the assumed restoration of functions previously discharged by parts of the cerebral cortex now removed were a true statement of the fact, and if so how this was accomplished. He first affirms the universally recognised fact that the restoration of matter lost to the brain by the excision of a part or parts of it in no case ever happened, but in every case after the excision the remaining mass only cicatrised. As regards functional restoration, then, his experiments in the spheres of sight and hearing led him to the following conclusions:—Were the spheres of sight or the spheres of hearing removed from an animal, it remained blind or deaf for the rest of its life; no restoration of the faculty in question ever took place in either case, though only limited por-

tions of the brain were removed and the whole of its remaining mass were left intact; this latter could nevertheless in no case ever take the place of the excided parts. Were, again, only one sphere of sight or one sphere of hearing removed, the animal became blind or deaf on the opposite side, and this one-sided blindness or deafness likewise continued throughout the whole of the rest of the animal's life. Even should only small parts of one sphere of sight or one sphere of hearing be removed, restoration of the functions of these parts never followed. Were, for example, the outer half on the left side of the sphere of sight taken away, the median half of the right retina would then continue blind so long as the animal survived this operation. Were the inner half of the sphere of sight taken away, the lateral half of the opposite retina would be rendered blind throughout the rest of the animal's life. Were the hinder part of the sphere of hearing destroyed, the animal would for the rest of its life continue deaf to deep tones. Were the anterior half of the sphere of hearing taken away, the animal would be rendered for ever insensible of high tones by the corresponding ear. Even though ever so small portions of the sections in question of the cerebral cortex were removed, the corresponding part of the retina would be rendered blind, and the animal become deaf to the tones appropriate to the part where the excision was made. It is true that in time the animal learns to make up for the defects caused by the operations and with the remaining unaffected parts of the retina (supposing the operation has reference to the sight) will contrive to see so well, and act in general in such a way as to superficial observations to convey the impression of an animal endowed with normal powers of sight. On close examination, however, of the particular parts of the retina it will in every case be found that the parts corresponding with the excided part in the central cortex is blind. Functional restoration of an excided part of the cerebral cortex never therefore occurs, however small be the part excided. Otherwise, notwithstanding, it would seem to be the case with another function of the sphere of sight which is concerned not with the first visual perceptions but with visual representations or conscious images consequent on perceptions. Has an animal, for example, taken from it the central sphere of sight, it then loses all conscious images; the mere seeing of objects with the intact peripheral parts of the retina is still possible for it, but not the recognition of them. After some time, however, the animal will regain the power of forming conscious images, and will then recognise the objects it sees. Here, then, we have the restoration of a lost function on the part of the cerebrum. In this case, however, the functional restoration is, according to Prof. Munk, only an apparent one. The actual state of the case is as follows:—Conscious images are formed in this way. Visual perceptions becoming an object of attention produce visual representations which give rise in one place of the central organ to a change which, existing as latent conscious image, is aroused by an equivalent or similar visual representation, which in its turn is begotten of perception and attention. These conscious images have their seat in the central part of the sphere of sight corresponding with the central part of the retina, the place of clearest vision. If this central part of the sphere of sight be removed, the animal loses its conscious images, it is soul-blind. According to Prof. Munk's conception, however, the seat of conscious images lies in the centre of the sphere of sight only for this reason, that usually the visual perceptions coming from the central part of the retina, and therefore the most distinct, alone become the subject of attention, and are transformed into visual representations. The images of perception, on the other hand, reaching from the peripheral part of the retina to the peripheral part of the sphere of sight, being less distinct, do not become the subject of attention, and are therefore not transformed into visual representations. If, however, with the central part of the sphere of sight conscious images are taken away—if the animal is soul-blind—attention can now fasten only on the images which are seen by the periphery of the retina, the central part being quite vacant in consequence of the operation. In this case, then, visual perceptions in the peripheral parts of the sphere of sight are by attention transformed into representations, whence now conscious images are drawn. If you render an animal soul-blind on one side, it will never of itself draw conscious images from that side, it will see only with the central parts of the sound eye. If now, however, you blindfold the animal on its visual side, and so compel it to look with the peripheral parts of the side operated on, the soul-blindness on this side will vanish. Restoration is consequently a word totally inapplicable here. On the contrary, all that we here find is that cerebral parts are utilised as a repository of conscious images, which by the normal animal are not turned to account simply because it has other parts with more distinct powers of perception to answer its purpose. The circumstance that former observers have always been impressed with the idea of restoration of sensuous activity is to be explained by the fact that the sphere of sight and the sphere of hearing lie only to a small extent on the surface which is more exposed to injury, and therefore, in the case of a simple excision from the cerebrum, they are always only partially affected.—Prof. Zuntz related briefly that last year he had inoculated guinea-pigs with bacillæ of septicæmic rabbits and mice, and that they had all escaped harm. When, however, he repeated these experiments this year, the inoculated guinea-pigs all fell sick, but not from septicæmia, but from peritonitis. When, again, rabbits and mice were inoculated with bacillæ of guinea-pigs who had died of peritonitis, they bred lepticæmia and *vice versâ*. Under the microscope both kinds of bacillæ were seen to behave quite alike.

VIENNA

Academy of Sciences, June 14.—F. Steindachner and L. Doederlein, contributions to knowledge of Japanese fishes (second paper).—E. Hann, on the climate of Bosnia and Herzegovina.—C. Etti, on the history of the tannic acid of oak bark.—M. Neumayr, on the morphology of the valve of bivalves.—L. Teisseyra, contribution to a knowledge of the Cephalopoda fauna of the Jura in the Risan Government (Russia).—Zd. H. Skraup and G. Vortmann, on the derivatives of dipyridine.

June 21.—H. Hammerl, a study on the copper voltameter.—R. Benedikt and M. von Schmidt, notes on halogen derivatives.—K. Hazura, on nitro-sulphoresoreinic acid.—H. Bittner, on *Micropsis veronensis*, a new Echinus of the Upper Italian Eocene.—Contributions to a knowledge of Tertiary Brachiura fauna.—A. Lieben and S. Zeisel, on the constitution of butyrochloral.—K. Natterer, on dichlorocrotonaldehyde.—J. Kachler and F. V. Spitzer, on the action of the isomeric camphor bromides on nitric acid.—Zd. H. Skraup, a sealed paper on the constitution of quinine.—S. Exner, on the defective excitability of the retina by light of abnormal incidence.—J. Woldrich, on the diluvial fauna of Zuzlawitz in Bohemia.

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THURSDAY, OCTOBER 11, 1883

THE METAPHYSICAL FOUNDATIONS OF NATURAL SCIENCE

Kant's Prolegomena and Metaphysical Foundations of Natural Science. Translated, with a Biography and Introduction, by Ernest Belfort Bax. (London: George Bell and Sons, 1883.)

THE pages of NATURE are not the appropriate place for the review of works on general metaphysics. The genius and methods of science are so different from those of philosophy that, as their respective histories have amply shown, these branches of intellectual activity are as a rule best kept asunder. But there is at least one important point of contact which cannot be overlooked. And it is just because in the writings of Kant, and particularly in the second of the two treatises which are translated in this volume, that alleged point of contact was formulated for the first time that his work rightly or wrongly demands notice in these pages. As regards the translation, Mr. Bax has done his work with care. He has undertaken simply to furnish a literal and accurate translation of the "Prolegomena" and "Metaphysische Aufangsgründe," and he has fulfilled his undertaking. We should have been glad could he have seen his way to banish such inelegant and inaccurate renderings of "Vorstellung" and "Anschauung" as "representation" and "intuition," and to substitute for them "idea" and "perception," which, despite their vagueness, are English words of intelligible significance. But no one can fail to find in the translation, as it stands, a faithful and consistent rendering of the original.

In an essay on the relation of philosophy to science contributed to a volume entitled "Essays in Philosophical Criticism," I had recently occasion, in conjunction with my brother, to formulate in some detail what are conceived to be not merely Kant's own criticisms of the subject, but certain definite results obtained by the application of the Kantian analysis of the nature of knowledge to some of the methods of science. I mention this circumstance because that essay has undergone vigorous criticism at the hands of Mr. Romanes in a review which appeared in NATURE of August 23 (p. 386), and because the concise and definite objections taken by him *in limine* to the title of the theory of knowledge to criticise certain of the leading scientific conceptions, form a point of application for a review of Kant's teaching.

In the first place it is necessary to state at the outset what the somewhat increasing number of people who read Kant intelligently think about science. That science has justly dominated the region of knowledge generally is for them a truism, and they repudiate in emphatic language any attempt to speculate by *a priori* reasoning upon matters which fall within the province of observation and experiment. Whenever there occurs a question which is really one of fact in nature, that question they recognise as for science alone. But then they say that it is not the faith but the scepticism of men of science which is too small. They ask men of science to consider their general conceptions—to criticise their categories—a little more than they have been in the habit of doing. They doubt whether such questions as the common one whether the phenomena denoted by the word "life" came into existence at a particular time as the effect or creation of some cause or conditions (whether inorganic or supernatural is irrelevant) are really questions of fact. They profess to be able to show that the dilemmas raised in such cases are the result of the application of conceptions which have really no application, and that such dilemmas have as little foundation as that which arises when, to refer to Mr. Romanes' illustration, we ask whether a piece of mechanism is comical or not comical. It is alleged to be the achievement of Kant to have shown that such questions as we have indicated are irrational and absurd, and that their existence necessitates on the part of men of science the possession of philosophical knowledge. Of this class of questions there may be mentioned by way of illustration the general problems of the commencement or non-commencement of the universe or of life in time, and of the existence of an absolutely First Cause, and the validity of a multitude of assumptions in our inquiries into the facts of nature which pass more or less unquestioned.

In the article already referred to, Mr. Romanes peremptorily refuses to accept the result that it is impossible to regard biological phenomena as the effect of mechanical causes, or, more accurately, to find in experience a case of *abiogenesis*. "It is," he says, "the worst form of dogmatism thus to affirm on grounds of metaphysical speculation alone the antecedent impossibility of any discovery in science, most of all with reference to a matter touching which we are so much in the dark." Now this "demurrer to the relevancy" is an *ignoratio elenchi*. Such a question is for Kant not one of discovery in science at all, but a false issue, which discloses its unintelligible and absurd nature whenever we ask ourselves the preliminary question, what is meant by organisation and mechanism. Let us examine more closely the point made by Mr. Romanes. The living organism is derived from one more simple, and the latter from one yet more simple, the process extending back without an apparent limit. Therefore, says Mr. Romanes, it is unscientific to deny the possibility that there may be a case of organisation so simple that it will be seen to be a mere mechanical arrangement. But the series in like manner tends to reach its limit and the curve to touch the asymptotic line, and yet it is neither unscientific nor unwarrantable *a priori* reasoning to show that a coincidence will never be found in experience. We learn what we have here by defining what is involved in the nature of the series and the limit of the curve. Nobody wishes to deny that organisation and the present state of the world generally may have been attained by a process of evolution from a mass of gaseous vapour. What is denied is that it is the same thing or other than an unintelligible statement, to say that organisation is or may have been evolved out of a mere mechanical arrangement. There is a great distinction between these propositions. Science is a process of abstraction in which attention is concentrated on a certain kind or category of relation to the exclusion of other kinds. For instance, in physical science we look only at those dynamical and statical relations which are expressed in time and space, such as causation and reciprocity. Again, in biology

we have before us the facts of organisation and development. But it is one thing to consider a single set of relations, such as those of causation, to the exclusion of the rest, for the sake of clearness of knowledge, and quite another to say that this particular aspect of the object exclusively constitutes it. Mr. Romanes thinks that biologists do not require any transcendental analytic to inform them that an organism is something more than a mechanism. But he finds it startling to be told that in the investigation of an organism we are to rise above the category of causality, and carry into our inquiry the conception of teleology. Surely the latter proposition is the logical consequence of the former. No one says that the category of causation is not to be used in the investigation of the phenomena of organisation. In anatomy, and in its dynamical correlative physiology, the parts of the organism are constantly treated as independent of each other, and related as cause and effect. But this is an abstract point of view employed for a special purpose—the obtaining of measurements—and is qualified by the recognition of the complete conception of the organs as part of a self-conserving whole or system. This is all that is implied by the unfortunate term "teleology" when used in the theory of knowledge. What Kant professes to show is that this fact of nature cannot be reduced to or expressed in terms of the dynamical and statical relations of time and space. No doubt the laws of matter and energy apply in biology as strictly as elsewhere, but they do not express, much less exhaust, biological phenomena. And therefore we must be careful in biology not to distort those conceptions or hypotheses which are, despite assertions to the contrary, the necessary guides and interpreters of observation and experiments by the exclusive employment of categories which, like causation, neither are drawn from, nor are adequate to, the facts. The subject of the detailed effect of the neglect in this reference of Kant's warning I will not pursue here, as my brother has treated it at some length, with special reference to the objections made by Mr. Romanes, in a paper which will appear elsewhere. It ought to be borne in mind, as illustrating the point of view here emphasised, that Kant himself was one of the first to advance the nebular hypothesis. The truth is that, in speaking of the universe as having presumably originated from a mass of incandescent vapour, Kant, and everybody else, so far from reducing life to mechanism, is really raising mechanism to life. Kant would have told us that in the phenomena of such a developing mass there were potentially present all the relations of the universe as we know it. No doubt the approximate conceptions for the advance of knowledge are at this point the laws of matter and energy. But these do not exhaust the object, and if we have abstracted from the others we have done so in just the same way as we have abstracted from fact that the phenomena are there only for a percipient subject.

Such considerations and the doubts they raise may seem remote. But the number of those is increasing who think that they should be better known to and understood by men of science. It will not do to say that such criticism has no bearing on scientific inquiry until it has been ascertained whether its neglect has not already—even in matters of minute detail—misled and stultified certain phases of such inquiry. Fact and theory are not so very easy to distinguish. With scientific method no one wishes to interfere. But we would subject to closer investigation the question whether what are commonly taken to be the legitimate problems of science are really what they profess to be. It is not to the "Hannibals" of science, but to her Don Quixotes that Kant addresses himself.

R. B. HALDANE

LETTERS TO THE EDITOR

[*The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, or to correspond with the writers of, rejected manuscripts. No notice is taken of anonymous communications.*

[*The Editor urgently requests correspondents to keep their letters as short as possible. The pressure on his space is so great that it is impossible otherwise to insure the appearance even of communications containing interesting and novel facts.*]

The "Transmission Eastwards Round the Globe of Barometric Abnormal Movements"

THE following questions suggest themselves in connection with the above matter:—(1) Is it a fact that atmospheric movements of such small amplitude take the form of waves, and, if so, that the waves have so slow a rate of travel? (2) How is it to be accounted for that the waves travel eastward more slowly than westward? And (3) How can it be explained that they appear at an eastward station with a greater amplitude than at a westward?

With regard to the first question, it may be said that almost absolute proof of the existence of such waves can be brought forward. A recent investigation, the results of which are not yet published, has shown that a barometric wave measuring from maximum to minimum only ·108 inch, which occurred in Western India in 1877–78, was accurately reproduced over the same region three years later, namely, in 1880–81. The wave at the time of its reappearance had all the larger details which it possessed during its original appearance, these details agreeing in many cases to within less than ·001 inch. But whereas the amplitude in 1877–78 was ·108 inch, in 1880–81 it was only ·048 inch. Waves have also been recognised which appear in the summer half of the year at the northern part of Western India and travel southwards, arriving at the southern parts between two and three months after their appearance in the north; and also waves which appear in the winter half of the year at the south and travel northwards. This movement from north to south and from south to north during alternate halves of the year has been traced regularly since 1869; and indeed is so constant that in many cases it has been possible by means of it to calculate quantitatively the average position of the barometer during the next three months.

The second question was answered in my paper which you were good enough to publish in your issues of the 9th and 16th ult. Owing to the upper air currents travelling from equatorial to higher latitudes, and the lower air currents travelling equatorwards, there must be in high latitudes a general movement of the atmosphere eastwards, whereas in tropical and subtropical regions there must be a general movement westwards. This at once explains why in tropical and subtropical regions the atmospheric waves should travel more rapidly westwards than eastwards.

The third question is a difficult one, and the answer not perhaps quite satisfactory. If it were the case that undulations in fluid bodies become heaped up and increased in amplitude when travelling in a direction opposite to that of a current, and are affected in a contrary way when travelling with the current, a satisfactory answer might be furnished.

But an explanation may be sought in a different direction. If the circumstances of any latitude situated a little way from the equator be considered, it will be noticed that two principal air-currents are flowing there—a lower one with a westward component of a certain velocity, and an upper one with an eastward component of a less velocity. Now it may be supposed that these two currents are affected by waves of two kinds, the first being waves common to the two currents, the second being waves which have been generated in the two currents in regions from which they are proceeding. And there are two reasons

why this latter class of waves should affect the barometer more strongly in the case of the current with the eastward component. In the first place that current is proceeding from the tropics, the region in which all great atmospheric movements originate; and in the second place there is a greater mass of matter moving with it than with the other current, there being not only an equal quantity of dry air returning northwards to compensate for that which is flowing southwards, but there being also a considerable quantity of water vapour, which does not return southwards in the form of vapour, but, having been precipitated as rain, returns with the ocean currents. It may not be easy, but I think it is perhaps possible, to demonstrate how this fact should explain the greater amplitude of the eastward than of the westward transmitted waves.

A. N. PEARSON

Meteorological Office, Bombay, September 4

Apparent Disappearance of Jupiter's Satellites

ON the morning of October 15 next Jupiter will appear to be deprived of the satellites usually attending him. This somewhat rare phenomenon has only been observed on four occasions during the present century, as follows:—

May 23, 1802	September 27, 1843
April 15, 1826	August 21, 1867

In 1826 the disappearance of the Jovian moons extended over an interval of 2 hours; in 1843 the interval was thirty-five minutes; in 1867 1 hour 45 minutes; but on October 15 next the phenomenon only endures 19 minutes (*i.e.* from 3h. 56m. to 4h. 15m. a.m.). The second, third, and fourth satellites will be in transit across the disk, while the first will be occulted by the planet. On August 21, 1867, the first, third, and fourth were in transit, while the second was eclipsed, and afterwards occulted. These occasions offer excellent opportunities for comparing the appearance of the satellites while in transit, and for re-detecting the dusky spots which were formerly distinguished upon them by Dawes, Secchi, and others. On August 21, 1867, I observed the phenomenon with a $4\frac{1}{4}$ inch refractor, and noticed that the satellites appeared nearly as dark and distinct as their shadows while projected on the disk of their primary.

There is a remarkable agreement in the intervals separating this rare occurrence. Between the disappearances of May 23, 1802, and April 15, 1826, there is a period of 24 years less 38 days (= 8728 days), and between those of September 27, 1843, and August 21, 1867, 24 years less 37 days (= 8729 days). The other intervals are irregular, there being 17 years 165 days between that of 1826-1843, and 16 years 55 days between that of 1867-1883. If, however, there is a regularly-recurring cycle of nearly 24 years, as the above dates apparently indicate, after every alternate disappearance of these satellites, then we may expect a repetition of the phenomenon on about September 7, 1907.

W. F. DENNING

Bristol, October 6, 1883

The English Viper

IN regard to the English viper, I send a small contribution to the information that Mr. R. Langdon seeks in your issue for August 2 (p. 319). During a residence of more than twenty years on the outskirts of the Forest of Dean, the following facts concerning the adder's bite came more or less under my notice:—

1. A girl was bitten on the thumb, she sucked the bite, and her head, throat, and tongue swelled so much that she nearly died of suffocation and starvation. She was laid up more or less for six months, and folks said that she was never herself again, but became "silly-like," but so far as my memory goes she was but weak minded before the bite.

2. A gamekeeper was bitten on the thick part of the hand. He could hardly get home, and did not leave his bed for three months afterwards.

3. A woman in the Forest was bitten on the thumb, her arm swelled, and became black, but on the application of a herb (which I cannot identify, though she called it "adder's tongue"), the swelling went down at once, and in a day or so no trace of the bite remained.

4. Though the following case did not occur in our neighbourhood, yet as the patient was a family connection, and the details were given me by his mother, I bring it forward. The young man was bitten in the hand, and his arm swelled rapidly to such a size, that the coat sleeve had to be cut open. The youth was ill for many months, and more than a year afterwards had not regained his former mental and physical condition.

5. Cows were often bitten on the legs, but more often on the udder; they never died from the bites.

6. Sheep often died; and lambs, so far as memory serves, did so invariably.

7. A pointer was bitten on the chest. The bite did not bleed, but the dog swelled quickly and could not walk; it was ill for a long time, but did not die.

8. I remember hearing that a little girl had died from the bite of an adder; but I mention the case with little confidence, as it did not come within the limits of my observation.

In 1865 or 1866 adders were more numerous in our neighbourhood than the "oldest inhabitant" had ever known them to be. The farmers were advised to turn their pigs into the fields, and and the result was that wherever the pigs ranged the adders were nearly exterminated. A student of folk-lore would find a wide field in the traditions respecting the adder and its bite. In our neighbourhood the fat of the adder, especially that of the biter, was considered the best antidote for the bite. To roast an adder alive was not only a means of relieving the sufferer, but by making "the varmin squeal" it was said to draw others from their holes, and thus lead to their destruction.

KATHARINE B. CLAYPOLE

THOUGH not precisely in reply to Mr. Langdon's question, yet I add a short postscript to my wife's letter.

In this district we have two venomous snakes, the rattlesnake and the copperhead. The former is now becoming scarce, but the latter is still common. I have never been able to learn that any human being has been killed by the bite of either of these snakes in this neighbourhood. Bites of the rattlesnake are exceedingly rare, but I have known some, and heard of many persons who have been bitten by copperheads.

1. A lady was bitten on the foot at her garden gate; the leg swelled up to the thigh, and was exceedingly painful. She was more or less ill for a week.

2. A boy was bitten on the foot, and the leg swelled and turned black. No remedies were applied for many hours. A poultice of some herb which I have not been able to identify was put on the wound, and in twelve hours more the swelling had gone down, and the boy could walk.

3. In a third case of which I have heard the wound was said to reopen, or at least to become irritable, every year at the date of the bite.

4. A friend of mine had a dog which was bitten by a copperhead. He treated the wound with new milk, but the dog died.

5. In one case of which I have heard a man was bitten by a rattlesnake, but though I do not know the details of the case, the man is still alive.

6. A dog belonging to the friend mentioned above was bitten by a rattlesnake, and treated with new milk. He recovered.

I have heard of and known other cases of snakebite, but similar results followed. The remedies recommended for snakebite are too numerous to mention. Whisky in large doses is the most popular, and it never seems in such cases to produce intoxication. The common remedy—"the fat of the snake that bit you"—is, I suspect, an ingenious device for insuring the destruction of the reptile. It would appear as if the bite of the two snakes which I have mentioned can hardly be as deadly as is commonly supposed. The frequent swelling of the head and tongue appears to me to be caused by sucking the poison from the wound when a sore may have existed in the mouth. Much probably depends on the size and condition of the snake, the time of year, and the place and depth of the bite.

E. W. CLAYPOLE

New Bloomfield, Perry County, Pa., September 3

Solar Halo

I HAD the pleasure of witnessing, this morning, what Mr. Backhouse refers to in the last number of NATURE (p. 515) "as seen on rare occasions—a small portion of an ordinary halo brilliantly coloured."

Looking from a window at 9.40 a.m. towards the south-east, I saw a brilliant patch of light which for a moment I took to be the sun, but which I soon perceived was part of a solar halo, the sun being (roughly speaking) 20° distant in a horizontal line.

The colours were exactly those of the rainbow, especially at

the red end; at the violet the light was so brilliant as to appear almost white. The only clouds at the time were bars of white cirri, and it was across some of these that the halo showed itself. This lasted for eight minutes, and then began to fade as the cirri moved away, but the colours again brightened, and were still visible, even when the sky was apparently clear, although, where the patch of colour remained, very faint cirri could still be perceived behind and through the brightness. At 9.51 the whole had disappeared. The wind at the time was nearly due north. I should like to know whether these solar halos are considered to be produced by ice-crystals in the higher regions. They appear to me quite as prevalent in summer as in winter.

Great Malvern, October 2 E. BROWN

A Remarkable Rainbow

THE phenomenon of supernumerary bows noticed by "L. C." on September 24, has been repeatedly observed and described. Various explanations have been suggested; and "L. C." will probably find what he wants in Archdeacon Pratt's paper in *Phil. Mag.*, 4th series, vol. v. pp. 78-86 (1853).

A. RAMSAY

Meteor

A SPLENDID meteor was seen yesterday (Saturday) evening at about nine o'clock. It passed from the north-east, beneath the Pole star, to the west, where it vanished instantaneously without bursting. The nucleus measured, I should say, at least 5′ of arc in breadth, and was extremely brilliant. A. TAUN

31, Mornington Road, N.W., October 7

A Palæolithic Flake

IT may interest some of your readers to know that I found last week a Palæolithic flake in some gravel at Gray's Inn Lane, where they are now making excavations for sewers. It is a somewhat large, flattish, subtriangular flake of implement-like form, exhibiting a large cone on the plain side towards the butt, and the other side showing several facets; ochreous all over, and somewhat abraded. There is one in the British Museum from this spot, only it is an *implement*, black, lustrous, and spear-shaped, and seems to have come from a higher stratum than the flake before mentioned. Mr. W. G. Smith has an implement from Drury Lane—brought to him by an excavator instructed by him to look for implements at Shacklewell, and while at work at Drury Lane he found one, and, recognising it as an implement, brought it to Mr. Smith. It is subtriangular, worked all over on both sides, blackish indigo, lustrous, and very slightly abraded. These are as yet the only relics of Palæolithic man recorded as found in Central London.

49, Beech Street, E.C. G. F. LAWRENCE

Hop "Condition"

I OBSERVE that it is asserted in a German technical journal that the golden microscopic dust on hops, which English growers call "condition," and in which the finest properties of the hop are supposed to reside, does *not* increase in quantity, as generally it is supposed to do, with the growth of the inflorescence. The quantity on the plants is declared to be as great when the buds are first developed as at maturity. Can any of your readers oblige me with observations or references in point?

H. M. C.

JOACHIM BARRANDE

THE announcement that Barrande has passed away will be received with sincere regret in every quarter of the globe where geology is cultivated. His death severs another of the few remaining links that connect the present generation of workers with the early pioneers of geological science. Born in 1800, he was eventually appointed tutor to the young Duc de Bordeaux. So attached did he become to the royal family of France, that when Charles X. abdicated he voluntarily went into exile, accompanying his young pupil to Prague, which remained his domicile thenceforward to the end of his long life. It was during the early years of his exile that he gave himself to natural history pursuits. In a brief visit to Vienna he came upon a copy of Murchison's "Silurian System," then recently published, and finding some of the fossils therein figured to resemble others which he had himself picked up in Bohemia; he on his return began to look more attentively at the rocks of his neighbourhood. Getting more interested with every excursion, he began to open quarries and employ workmen to search for fossils. In order the more easily to direct their work he laboriously acquired their language. Year after year he continued these researches, devoting to them his time, energy, and fortune. He became the prince of fossil collectors. But at the same time he applied himself with unwearied industry to the scientific study of the fossils and of the rocks containing them. By degrees his labours took shape, and there resulted from them his colossal work, the "Système Silurien de la Bohême," a noble monument of scientific enthusiasm. It was begun as far back as 1852. Since that time no fewer than twenty-two massive quarto volumes of text and plates have been published. Undeterred by the remonstrances of a publisher who would insist on counting the cost and the sale, Barrande was his own publisher, and prosecuted his labour of love down to the end of his life. His numerous separate papers on geological subjects began to appear in 1846, and have been continued to the present time. Living in exile for upwards of half a century, Barrande occasionally visited his native country, and took a keen interest in scientific progress there, but remained an unflinching royalist, refusing to do anything or accept any distinction which might seem to compromise his political principles. He even declined to be nominated a corresponding member of the French Academy. But honours were heaped upon him by the scientific societies of other countries. Due tribute will no doubt be paid to his scientific achievements; for the present we have time only to offer these few lines to the memory of one of the most unwearied and profound students of palæontology, and one of the most upright and honourable of men.

THE SANITARY CONGRESS ON HOUSE SANITATION

A CONSIDERABLE amount of attention was given at the recent Congress of the Sanitary Institute in Glasgow to the question of house construction, and to the evils which are attendant upon the present system under which human habitations are erected both in the metropolis and elsewhere. When it is remembered how large a portion of time the inhabitants of this country are compelled, by reason of climate and otherwise, to spend inside their dwelling houses, it is obvious that the health both of the present and of future generations must be largely dependent on the sanitary condition of those dwellings, and that very earnest consideration should be given, both by experts in matters of building and also by the public themselves, to the sanitary details of house accommodation. And yet it is notorious that houses, which are faulty in almost every particular relating to health, are week by week being run up by hundreds and thousands; that even where money does not enter into consideration the dwelling-rooms of mansions are left without any provision for ventilation whatever; and that both the wealthy and the poor are stricken with disease by reason of the foul air which has been conveyed from the sewers into their homes as the result of arrangements which are, in point of fact, almost always more costly than should have been the more simple appliances which would have prevented the possibility of such an occurrence.

As the law now stands there are certain evils which

cannot be controlled either by any existing statute or under by-laws. Thus, whereas a reasonable width of street may be secured by means of a by-law, there is absolutely no provision to prevent the erection of houses of such a height as effectually to exclude sunlight, and so it comes to pass that windows open, not on to bright, dry, open spaces, but into comparatively narrow thoroughfares which tend to remain damp and imperfectly lighted. Prof. Tyndall's experiments as to the arrestation of infusorial life by solar light should alone suffice to secure for the spaces about our dwellings ample exposure to the rays of the sun, for he has clearly shown that, after infecting certain sterilised infusions and exposing one set where no sun could reach them and another set to the influence of the sun, infusorial life was much more rapidly developed in the former than in the latter; and this notwithstanding the fact that the temperature of the flasks exposed to solar influence was far more favourable to the development of low forms of life than was the case as regards the others. It has also been decided by the law officers of the Crown that the height of rooms cannot be regulated either under any general statute or by means of a by-law. As to this, however, we note that Mr. John Honeyman, a well-known architect, strongly advocated at the Congress the desirability of low ceilings in small houses, alleging that such an arrangement, by inducing economy in construction, facilities for warming, and other incidental advantages, would tend to prevent overcrowding and also add to the comfort of the lower classes. There can be no question that wherever the height of a room is such that the upper portion becomes a mere reservoir for overheated, stagnant, and vitiated air, and whenever adequacy of floor space per head of the occupants is sacrificed on account of an increased cubic space resulting from a high ceiling, then distinct harm results from the loftiness of the apartment; but, due regard being paid to ventilation by means of windows opening nearly up to the ceiling level and other contrivances, a reasonably high apartment has distinct advantages over many of the low ones which are now constructed.

Turning, however, to matters which are well within the control of sanitary authorities, the members of the Congress were unanimous in condemning the present system by which dwelling-houses are now constructed. Thus, instead of covering the ground surface of the sites of new houses with concrete so as to prevent both moisture and effluvia from any neighbouring leaky drain from ascending into the dwelling, the builders round about London and elsewhere either put their brick foundations directly on to the clay or other soil, or else they provide a material which can only be regarded as a make-shift in so far as imperviousness is concerned, and even this is only placed immediately beneath the house walls. Then again, pieces of tarred felt are inserted in the place of adequate damp courses, and so it comes to pass that, within a few months of occupation, the residents are, apart from other evils, exposed to one of the principal predisposing, if not exciting, causes of phthisis. As for drainage, this work can, as soon as completed, be hidden out of sight, and it is notorious how much illness has resulted, and how many lives have been sacrificed, to the want on the part of builders of the most elementary knowledge in connection with the construction and adequate ventilation of house drains.

In dealing with these and other allied subjects, the several speakers paid a tribute of praise to the Model By-laws which have been issued by the Local Government Board, and which in their annotated form fully explain, by means of diagrams and otherwise, how all the various health and other requirements may be most effectually provided. But even where such by-laws have been adopted, we fear they are in many instances not enforced; and evidence was given at the Congress to the effect that the principal offenders are themselves often members of the authorities whose duty it is to see the several provisions carried out. As long as this is the case, subordinate officers can hardly be expected to perform their duties efficiently, and the principal remedies needed are, firstly, by means of congresses, lectures to working men, and such measures, to spread broadcast, and in an easily acquired form, a knowledge as to the elements of house sanitation; and, secondly, a determination on the part of the public to elect as members of local authorities only those who have such knowledge and who will use it for the public benefit.

THE ASTRONOMISCHE GESELLSCHAFT

[FROM OUR VIENNA CORRESPONDENT]

THE meeting of the Astronomische Gesellschaft was held this year on September 14, 15, and 16, in the Academy of Sciences in Vienna. There was a good attendance, and among others present we observed the astronomers Auwers of Berlin, Gould of Cordoba, Pickering of Cambridge, U.S., Elkin of the Cape, Lœwy and Janssen of Paris, Foli of Liége, Gylden of Stockholm, Engstroem of Lund, Oudemans of Utrecht, Foerster of Berlin, Vogel of Potsdam, Gautier, sen. and jun., of Geneva, Thiele and Pechule of Copenhagen, Wagner, Hasselberg, and Dubiago of Pulkova, Bruhns of Leipzig, Wolf and Schönfeld of Bonn, Gruey of Besançon. England was represented by Prof. G. Forbes. The head of the Ministry of Public Instruction in Austria, Dr. Siedler, having welcomed the assembly in the name of the Government, the president, Prof. A. Auwers, briefly addressed the Congress. For the second time, he said, the Congress held its sittings in those halls. The first time they met there they found in this building the old observatory. They now beheld an institution which in magnificence was hardly matched by any other institution in the world and surpassed by none. The President then thanked the Government for their friendly welcome, and the assembly for the large attendance present. The subjects which were the order of the day were then taken up. From the report of President Auwers on the great zone undertaking, it appeared that the observations of all the observatories in connection therewith might be deemed completed, so that next year they would be in a position to enter on the printing of the official catalogue. It was further shown that the preparations for extending this enterprise to the south as far as 23° or thereabout, southern declination, an object which for several years had been in contemplation, were so far advanced that the scheme might now be considered as secured. In the course of the three sittings of the Society a large number of interesting addresses were given and demonstrations made, most of them followed by lively discussions.

Prof. Bruhns spoke on astronomical refractions, and on the formulæ according to which from the observed refraction the law of reduction of temperature in the atmosphere might be determined. Gylden referred to investigations he had made on the subject of the perturbation theory of planets, and to the labours of the Stockholm Observatory towards drawing up tables of planets in accordance with his theory. Prof. Weiss (Vienna) produced the two printed volumes of the annals of the Vienna Observatory, as also the first sheets of his new edition of "The Wonders of the Heavens" by Littrow, and showed drawings of Jupiter and Saturn, executed by help of the 27-inch instrument of the Vienna Observatory, together with drawings of lunar maculæ taken by means of the 12-inch instrument of the same observatory. Photographs of the sun's corona taken in full daylight, sent by Dr. Huggins and laid before the meeting by

Prof. Weiss, were received with much approval. Dr. Elkin reported parallax determinations of southern stars executed by him and Gill at the Cape, especially that of α Centauri, which might be fixed at about ·75 sec., and that of Sirius, which increased to ·4 sec.

Pickering drew attention to photometric investigations carried out at the observatory of Harvard College. Janssen (Meudon) spoke on the observations which had been made in connection with the sun's eclipse of May 6 this year, discussed the photographs of the corona they had taken, and referred to the efforts made by Palisa with a view to discovering an intra-Mercurial planet, efforts which, as was well known, had yielded a negative result. Prof. Foerster gave an interesting account of observations made in the Berlin Observatory, by which he endeavoured to prove that the one ground-pillar of the Berlin Observatory on which investigations had hitherto been conducted had for the last twenty-five years been subjected to angular movements which were connected with the eleven years' period of solar spots. The annual averages of inclinations of the pillar from 1856 to 1881 adhered as closely to Wolf's relative numbers as did the annual averages of the magnetic declination. From these facts Prof. Foerster drew the conclusion that very considerable effects could be traced from the radical changes of the eleven years' solar period. In connection with this communication of Foerster's, B. A. Gould reported how he had made quite similar observations on the sea-coast. Prof. Oppolzer (Vienna) spoke of investigations he had made in the Vienna Observatory with a view to determining the length of the seconds pendulum and the influence of the simultaneous oscillations of the stand. Foli gave an account of his examinations into the daily nutation and precession of the earth and his new tables of precession, and communicated some information regarding the observatory of Liége. Pechule (Copenhagen) sought to refute Stone's assertion that there was a difference of 1½ sec. between the former and the present Julian year, an assertion which had already been declared by Airy to be incorrect. He pointed out where Stone had committed an error in his calculations, and brought forward proof to show that the difference amounted to but four seconds every thousand years. Oudemans (Utrecht) corrected an assertion of Stone's that there was an error of 28 sec. in the reduction from median to sidereal time. Steinheil (Munich) referred to new constructions of telescopes calculated by him, and to the influence of the prism in the case of refracting telescopes on the sharpness of the image, in respect of the achromatism of the images, and to the means by which he counteracted the prejudicial effects in such cases.

On Sept. 15 the members of the Congress visited the Observatory. The astronomers were highly satisfied with the arrangement of the observatory and the system of apparatus. The 27-inch instrument, supplied by Grubb of Dublin, and described in NATURE shortly after its completion, was an especial object of interest. Unfortunately, the sky was clouded, so that it was impossible for the astronomers to carry out the observations they had intended with this powerful instrument. In reference to administrative matters we have also to mention Foerster's report on the conclusions of the International Commission respecting Kiel as an international centre, particularly in regard to the contributions of the respective astronomical institutes. On September 16 a social excursion was made to the neighbouring Kahlenberg, and this event was also made the occasion of the baptism of several newly discovered planets; the planet 234, discovered by Peters, receiving the name of Barbara; the three discovered by Palisa (Vienna) being called (229) Adelinda, (231) Vindobona, (225) Henrietta. It was resolved that the next meeting of the Society should be held at Geneva in 1885.

THE NORWEGIAN CIRCUMPOLAR STATION

IT is with pleasure that I respond to the invitation of NATURE to give an account of our labours here during the last twelve months, and I may, in doing so, state that I have purposely delayed writing these lines, in order to be able to give the result of our researches during a whole year.

The Norwegian Government have contributed their share to the international research of the physical conditions of the Polar regions by the establishment of the observatory here at Bossekop in Alten (Finmarken). The station, which is situated at the bottom of the Alten Fjord in 69° 58′ lat. and 23° 15′ long., commenced its labours on August 1, 1882, which are to be continued until September 1, 1883, in accordance with the programme of the Polar Congress held in St. Petersburg in 1881. The equipment and instruments of the station, as well as its whole organisation, are also in accordance with the principles formulated by the Polar Congresses held in Hamburg in 1879, in Bern in 1880, and in St. Petersburg in 1881. The *personnel* of the station consists of the writer as chief, Doctors C. Krafft, sub-chief, J. Schroeter and F. Hesselberg, observers, and Herr O. Hagen, instrument maker and caretaker.

The obligatory observations embrace astronomical observations, readings every hour of the meteorological and magnetic variations, absolute measurements of the terrestrial current's three components, and studies of the aurora borealis. For the hourly observations the day and night have been divided into four watches of six hours each, which are taken by each one in turn.

In order to effect the astronomical observations, *i.e.* the determination of time and place, a small observatory 25 m. in length, breadth, and height has been erected of deals, the roof and the southern and northern walls of which are provided with shutters to be opened during meridian observations. On a fixed pillar in the centre is placed a universal instrument by Repsold, besides which we possess three box chronometers by Frodsham, Kessels, and Mewes, the last named being regulated by star time, as well as two pocket chronometers by Kessels and Bröcking.

The weather during the winter and certain other circumstances have to some extent affected the astronomical observations, so that for the determination of time only a few meridian passages have been observed; but this circumstance is of no consequence whatever, as the station is independent of local determination of the time for ascertaining the absolute time, viz. the common mean time of Göttingen, which has been adopted at all the Polar stations as the common time, and which we receive from the observatory at Christiania through the telegraph office, about ten minutes distant, twice a week, at 9 a.m. on Sundays and 8 a.m. on Wednesdays, Greenwich time.

We have, however, a few meridian passages and observations of time with corresponding sun altitudes, which may be used for the verification of the longitude of the place. The Polar altitude has been verified by the measuring of circummeridian altitudes of the sun and Polaris. The universal instrument has also been employed for the determination of azimuth for the observations of the aurora borealis and the magnetic declination.

Of magnetical instruments we have a set for the determination of the elements of the terrestrial current, viz. a unifilar magnetometer by Elliott Brothers of London, and a Dover inclinatorium, both verified at Kew. The variation instruments, which are constructed on Lamont's principle by Prof. Mohn, and executed by Herr C. Olsen, optician, of Christiania, consist of a variation instrument, a unifilar apparatus with two fixed deflectors for the observation of the variations of the horizontal intensity, and a unifilar apparatus with vertical bars of soft iron as deflectors, whose magnetic moment varies accord-

ing to the changes in the vertical intensity. We have two sets of these instruments exactly similar in construction, of which one is kept in reserve. All the magnetical instruments are erected in the magnetic observatory in the manner shown in the diagram (Fig. 1). This observatory is divided into three sections, and arranged as follows:—Furthest to the east is the variation chamber, which has, in order to make room for both sets of instruments, been made rather large, viz. 7·5 m. long, 5 m. wide, and 2·8 m. high. It has been constructed partly under the earth's surface, the ground having been hollowed to a depth of about 1 m., where the floor has been laid, and the mould cast up along the outer sides of the hut, which have first been covered with birch bark, and in turn by turf. The roof has first been covered with fireproof paper, and then with turf and mould, which gives to the observatory the appearance of a subterranean chamber. The object of this is, of course, to keep the temperature in the room as constant as possible, which we have in fact fully succeeded in doing, as the diurnal variations have seldom exceeded 5° to 6° C., while averagely the temperature during twenty-four hours has only varied from 2° to 3°. The lowest temperature registered in the chamber during the winter was −3° C. during a high wind, while the highest during the summer was 23° C. Of windows there are none; but lighting is effected by means of four petroleum lamps, which are kept

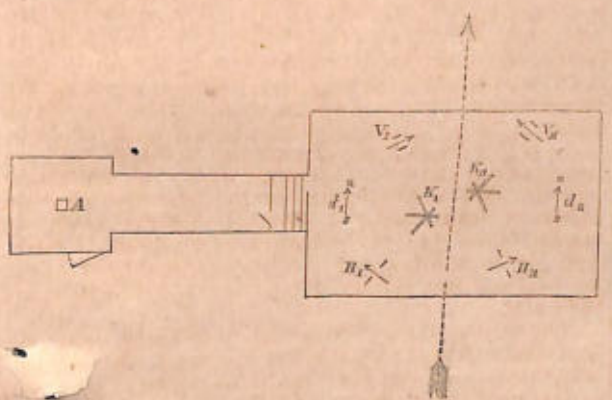

Fig. 1.—Diagram showing the plan of the Magnetic Observatory. d_I d_{II}, variation instruments for the declination; H_I H_{II}, variation instruments for the horizontal intensity; V_I V_{II}, variation instruments for the vertical intensity; K_I, K_{II}, the reading telescopes; A, pillar for absolute measurements; ⟹⟶, magnetic meridian.

burning day and night, and to the faint heat emitted by these I ascribe the circumstance that the average temperature during the winter was several degrees above freezing-point, and this under an open-air temperature of −20° C. From the great variation chamber a small ladder leads through an aperture in the western cross wall up into a narrow corridor 5 m. by 1·5 m., which opens into the chamber for the absolute measurements. This is 2·5 m. in length, width, and height, and from this a door leads out into the open, while it is also provided with a small window in the western wall. In the corridor is a partition with a door, in order to prevent as much as possible any change in the temperature in the variation chamber. The building is constructed of rough deals, while the use of iron has, of course, been carefully avoided. The whole has been joined by means of wooden pegs, and the roof-paper fastened with copper nails. The lamps have been hung on brass wire or placed on wooden tripods; while the hinges of the doors are of brass, and the handles of wood.

In the variation chamber eight pillars have been raised of iron-free bricks and cement. These pillars rest on large slates, which have been laid at a depth of about 7 decimetres below the floor, and run free through openings in the floor. The tops of the pillars have a marble slab attached to them, on which the instruments are placed, viz. one on each of the six pillars, and a reading telescope on each one of the remainder.

The needles in the six instruments are exactly alike in size as well as in magnetic moment. They are made of lamellar watch-spring, separated by three small bits of brass, and are about 9 cm. in length. Above the needle, and parallel with the same, a mirror is affixed, from which the image of the scale (paper on spruce wood), placed perpendicularly on the reading telescope, is reflected in the focus of the telescope. Each scale is one metre in length, but even this comparatively great length has, as regards the intensity instruments, been found insufficient during great perturbation, and we have been compelled to lengthen the scale on the side most exposed by adding an auxiliary scale. The scale is divided into millimetres, the distance between mirror and scale being exactly 1719 mm., making the value of the angle of one part of the scale exactly 1′. The reading telescopes of the two sets are fixed on a common vertical axis, the one for horizontal intensity being highest, the one for declination in the centre, and the one for vertical intensity lowest. This is also the order in which the instruments are read, a reading of all three being easily effected in fifteen to twenty seconds.

The regular magnetic variation observations are, as previously stated, effected every hour, seven readings being taken of each instrument. At fixed terms, viz. on the 1st and the 15th of the month, readings are effected every fifth minute, while, during a certain hour of these two days, the variations of the declination and the horizontal intensity are read every 20th second. Magnetic disturbances, some even of great violence, have during the twelve months been the order of the day here. Thus when perusing our "log," one will hardly find five days in average in each month during which the needle has remained completely at rest throughout twenty-four hours. Little jerks or oscillations have constantly occurred, particularly during the night, when the disturbance has generally been greatest, and it has not been an uncommon occurrence that the readings have fallen out on the auxiliary scale, oftenest, however, as regards the vertical intensity.

The zero of the variation instruments is partly controlled by direct simultaneous observations of both systems, compared once a week, and partly by absolute measurements of the three terrestrial magnetic elements effected several times during the month. The unifilar magnetometer is employed for determining the declination as well as the horizontal intensity, the latter embracing both vibratory motions and deflections with the magnet deflector at two different distances. The effect of the torsion on the position of the declination needle is also determined by deflections in the manner advocated by Lamont in his "Handbuch der Erdmagnetismus," § 91. The inclinometer is provided with four needles, of which three are in use, and during the last half year all three have been used during inclinatory observations, which have given results with a pretty uniform difference. As a matter of course, every reading during absolute measurements has been accompanied by a stringent and simultaneous reading of the corresponding variation instruments.

For the study of the aurora borealis we have employed a theodolite which has been constructed by Prof. Mohn, and finished by Herr C. Olsen. The theodolite has an excentrically attached conic tube, which serves as drop. The small ocular end is closed by a disk in which is a circular hole a little larger than the pupil of the eye. The objective end, which forms the basis of the conus, is completely open, with a cross of thin steel wire suspended therein. The one half of the curved surface of the tube, the ocular part, is a solid brass pipe, while the

other half, the objective part, is constructed in open trellis work, partly in order that the wire cross may easily be seen when a lantern is held at its side, and partly on account of the balance. The horizontal as well as the vertical circle, is provided with noninus, whereby 10′ is read directly and 1′ may easily be ascertained. To the horizontal axis belongs a libella, on which each part represents 1′. A massive base of cast-iron—a vertical column with three projectors at the foot, each one with a foot-screw—gives the instrument an exceedingly solid rest, and keeps the due level for weeks when the instrument is not subjected to gales or other violent exterior influences. Our station possesses two such theodolites, while the Swedes at Spitzbergen have three, the Dutch on board the *Varna* two, and Dr. Sophus Tromholt, at Kautokeino, one.

Auroræ have been seen here during the winter almost every night, and during all weathers, thus, even behind cumulo-stratus clouds, oscillating waves of the aurora borealis have at times been observed. Proper measurements have, however, of course only been effected on clear nights. With Dr. Sophus Tromholt, who has, as the readers of NATURE know, from his communications to this journal, during the winter sojourned at Kautokeino specially for his researches on the aurora borealis, we have arranged to measure at agreed periods the elevation of the aurora in the common plane Kautokeino-Bossekop. We have effected a number of such measurements here, which will, I believe, give important results as regards this phenomenon, when compared with those made by Dr. Tromholt. A closer auxiliary station for parallax measurements was also contemplated here, and to this end I had a pillar raised in an open place for a theodolite, about seven kilometres south of our station, but the want of telephonic connection and assistants, I regret to say, prevented this project from being carried out.

The auroral forms or types which have appeared here have been those generally known, from the grand corona to the modest pulsating little luminous cloud, but as a characteristic feature attending them all I must mention

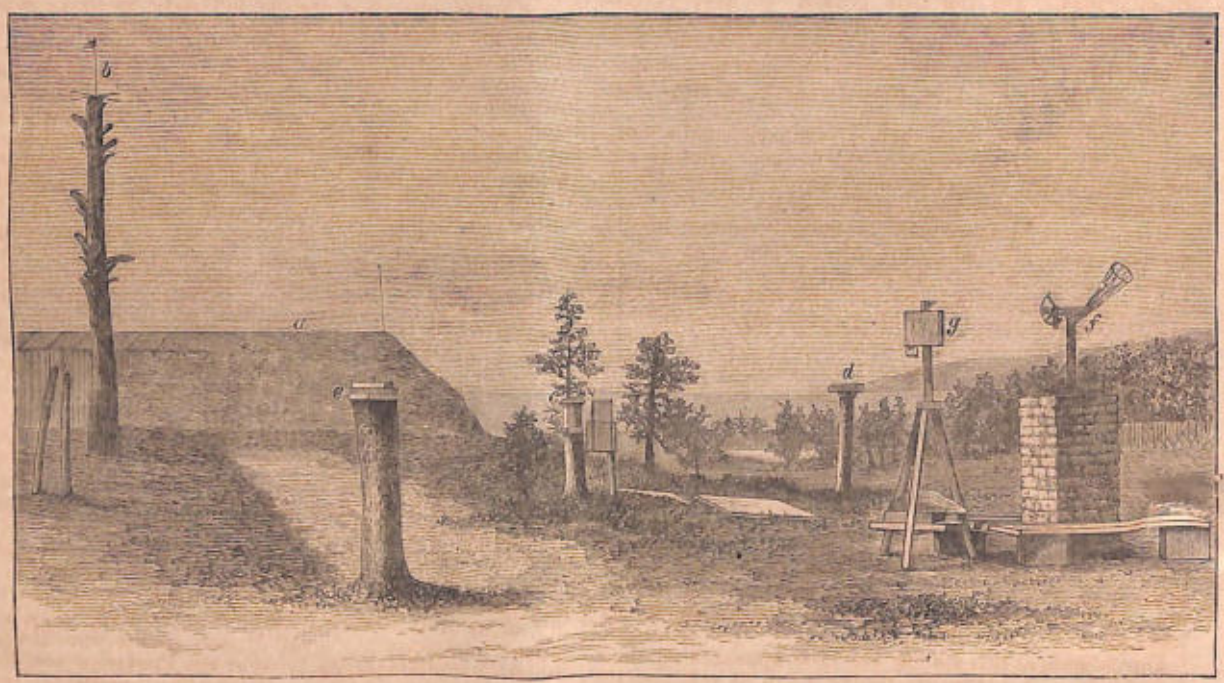

FIG. 2.—The Norwegian Circumpolar Station at Bossekop. *a*, magnetic observatory; *b*, vane; *c*, rain-gauge; *d*, black-ball thermometer; *e*, transit instrument; *f*, auroral theodolite; *g*, instrument for recording the auroral observations.

the absence of stability in the types. Thus only on a few occasions has there been an opportunity of watching the quiet stationary arc, but in general the auroræ have represented wafting draperies and shining streamers with ever-changing position and intensity.

As often as there has been an opportunity, spectroscopic researches have been effected with a Wrede's spectroscope. The well-known yellow-green auroral line has always been observed, and on one occasion also the red, the position of which we succeeded in fixing approximately in the spectroscope.

The meteorological instruments with which we have been furnished are similar to those in use at the meteorological observatory in Christiania. A Kew station-barometer (Adie) is employed at the hourly observations, while a Fortin barometer (Secretan) serves as normal and control barometer. Generally a few times a week both barometers, which hang parallel in the office of the station, are compared. As a reserve instrument we have an aneroid, but this we have fortunately had no need of using.

For the protection of the thermometers we have erected a wooden cage on four poles facing the north, with blinds, a double back wall and a roof, exactly in conformity with Wild's model. In the centre of the cage is the actual thermometer box placed, of sheet iron and with a free circulation for the air, in which is to be found dry and wet thermometers (divided into C° and R°), as well as maximum and minimum ones. All the thermometers, which were manufactured by Aderman of Stockholm, have several times during the winter been examined as to the stability of zero, which has always been found perfectly correct. Besides these a black-ball thermometer has during the summer been erected, and read several times a day. Psychrometer readings have on some occasions been controlled at low temperatures by observations with Allnard's modified form of Regnault's hygrometer (Golaz, Paris), while absolute determinations of moisture

through weighing have been attempted by Dr. Krafft with a chemical weight (Bunge), however without result, caused chiefly by the circumstance that he was unable to give the instrument the proper rest. The observations of the directions of the wind have been made by a weather-cock fixed on the top of a stripped fir tree, the force being registered by Beaufort's scale, and the velocity partly by Mohn's hand thermometer, which are used during the hourly observations, and partly by means of a Robinson anemometer placed on the roof of the dwelling-house, which is read once in twenty-four hours. Further, one of Hageman's anemometers is erected in the office, from which the conductor, made of indiarubber and lead pipes, is carried outside the house and along the flagstaff in such a manner that the absorbing point or tube is situated a couple of centimetres above the knob of the same. The observations with this anemometer have, however, not given so satisfactory results as might have been expected from my experiences in other places. The cause of this is no doubt the circumstance that the instrument used was not a new one, and consequently, perhaps, not very sensitive, while the position was, we found, not the most advantageous. On the bare ground we have placed two rain-gauges—the one square and the other round—with a receiving surface of 225 square cm. each. The rainfall here is very small, averaging only 267 mm. per year, but during the past twelve months it has been rather less.

The measurement of the snowfall we have found almost an impossibility, on account of the frequent gales during the winter, which sweep the snow away as quicksand from one place and deposit large drifts in others.

Every month measurements of the temperature of the sea have been effected, in the Alten Fjord, with one of Negretti and Zambra's deep-sea thermometers. The depth is 100 English fathoms, and the temperature read at every tenth fathom. We have during these researches discovered that from the bottom and 10 to 20 fathoms upwards the temperature keeps constant throughout the year, whereas in the layers above this depth some very interesting variations occur with the seasons.

Last winter here has been milder than we anticipated, the lowest temperature registered being −21°·7 C., which was read by the minimum thermometer at 8 a.m. on December 31, 1882. Under high wind such a temperature is unpleasant enough, and with gales we have several times been favoured. Thus, on October 5 the velocity of the wind under a storm from the north-west was 26 metres per second, and on later occasions the anemometer has not seldom shown a velocity of from 10 to 20 metres per second.

Our labours at this station are now approaching their completion, and it is satisfactory to me to be able to state that no accident has occurred to our instruments, the accuracy of which has been controlled throughout in various manners, and that the scientific researches have been continued during the entire year without a single interruption.

What the ultimate results of our researches during our sojourn here will be it is of course at the present moment an impossibility for me to state, but I feel confident that, when all the materials of research have been collected from the various circumpolar stations and compared, it will be found that the Norwegian station at Bossekop has formed an important link in the chain of international meteorological research around the Pole. AKSEL S. STEEN

Bossekop, Finmarken, Norway, August

A NATIONAL LABORATORY OF MARINE ZOOLOGY

IT is pretty well understood that the Executive Committee of the London International Fisheries Exhibition of 1883 will have a sum of money in hand when all expenses connected with the Exhibition are paid, amounting to some thousands of pounds. The gentlemen who have organised and carried through this very successful enterprise are to be congratulated on the popularity which has attended the Exhibition and on the amount of interest which they have excited in all classes of the community in matters relating to our national fisheries. Not only this, but the Committee deserves hearty thanks for the valuable series of pamphlets on subjects connected with fisheries which it has printed and circulated far and wide. These pamphlets are for the most part reports of lectures delivered by highly competent specialists at the "Conferences" inaugurated by Prof. Huxley under the presidency of the Prince of Wales, and amongst them are such important essays as that of Prof. Hubrecht on oyster culture, of Dr. Day on the food of fishes, of Prof. Brown Goode on the fishery industries of the United States, and of Mr. Duff on the herring fisheries of Scotland.

It is not surprising that at the present moment suggestions should be offered from various sides to the Exhibition Committee with reference to the best use of the surplus funds in its hands. No one will pretend for a moment that the Committee has not the full right to make what use of those funds it may deem most fitting; and the public has every reason to feel confidence that the ultimate decision of the Committee will be made with the intention of doing what is best for the national interests bound up with our fishery industries. At the same time it is a legitimate thing for men of public position and responsibility to place before the Committee suggestions as to useful modes of employing the surplus funds in its hands. Accordingly we note with satisfaction that a number of our leading biologists, whose opinion upon this matter is certainly entitled to very great weight, have placed before the Committee a suggestion for the foundation of a laboratory upon the British coast, which shall be devoted to the study of marine animals and plants in relation to fisheries. A similar proposal has also been independently placed before the Exhibition Committee by the executive of the British Association for the Advancement of Science.

It is a very striking fact that the one point in which all speakers at the Conferences held during the past summer at the Exhibition were agreed was this: that our knowledge of the habits, time, and place of spawning, food, peculiarities of the young, migrations, &c., of the fish which form the basis of British fisheries, is lamentably deficient, and that without further knowledge any legislation or attempts to improve our fisheries by better modes of fishing, or by protection or culture, must be dangerous, and indeed unreasonable. Prof. Brown Goode, the United States Commissioner, declared at the Conference on July 20 that "the spread of actual scientific knowledge concerning fish and fisheries was one of the things which, above all others, would be the most profitable and satisfactory outcome of this Exhibition." At the same Conference Prof. Hubrecht, the Netherlands Commissioner, said that "he endorsed from the bottom of his heart the principle that there must be inquiry, and still further inquiry, before legislation based on scientific and accurate principles could be carried out. They must take as a motto, more knowledge, more science, more zoology." On the same occasion the Duke of Argyll referred to the suggestion which had been submitted to the Conference to the effect that the foundation of a laboratory of marine zoology might well be undertaken by those who had organised and carried out the International Fisheries Exhibition. Speaking with the authority of one well acquainted with the Scotch herring fisheries, as well as with the knowledge of an accomplished naturalist, he stated that in his judgment this suggestion was a most important one, which he hoped would be brought forward in the proper quarter, and that he should give all the help he could in the matter.

The memorandum which we print below briefly sets forth the proposal as now submitted to the Executive Committee of the Fisheries Exhibition. It has been signed by the following naturalists:—Sir John Lubbock, Mr. P. L. Sclater, Prof. Jeffrey Bell, Prof. Michael Foster, Prof. Burdon Sanderson, Prof. Flower, Prof. Allman, Prof. Richard Owen, Dr. G. J. Romanes, Prof. Lankester, Prof. Moseley, Dr. Carpenter, Mr. John Murray, Mr. Thiselton Dyer, Prof. Milnes Marshall, and Mr. Adam Sedgwick. The absence of the names of one or two influential zoologists from this list is explained by their official connection with the Exhibition, which has rendered it undesirable to ask them to commit themselves in reference to a question in the consideration of which they will ultimately have the greatest responsibility and weight.

The memorandum runs as follows:—

Proposal for the Foundation of an Observatory on the British Coast for the Study of Marine Animals and Plants in relation to Fish and Fisheries.

The value to the fish industry of an increased knowledge of the habits and life-history of fishes has been proved by the experience of the American and French Commissions. Without such knowledge we cannot improve our fisheries commercially; with it, there is every probability that a great deal may be done in the way of controlling and extending them. In order to gain accurate knowledge as to the circumstances which affect the life of fishes, and the various mollusks, shell-fishes, corals, and sponges, which are important commercially as well as interesting from the scientific point of view, it is necessary that continuous observations should be made upon their growth from the egg onwards, upon their food and its natural history, as well as upon their enemies and the conditions favouring, or injurious to, their life. Such observations can only be successfully carried out by persons resident on the sea-coast. In order to enable competent observers to spend such time as they can afford for these studies to the greatest advantage, zoological observatories have been established on the sea-coast of foreign countries, but at present there is no such observatory on the British coast. The first observatory of the kind is the "zoological station" established by Dr. Dohrn at Naples, which is frequented by naturalists from all parts of Europe. Its buildings and aquaria represent an expenditure of 20,000*l.*, and its annual expenditure is over 4000*l.* Similar observatories have been established by the Austrian Government at Trieste, and by the French Government at Concarneau, Roscoff, and Villefranche. It has been for some years the desire of English naturalists to establish a zoological observatory on the British coast, which would be in charge of a competent resident superintendent, and fitted with aquaria, laboratories, and apparatus, and possessed of boats and dredging apparatus. Two or three fishermen would be kept in the pay of the observatory. The institution thus organised would be frequented at all times of the year by naturalists desirous of carrying on original investigations relative to the life-history and structure of marine organisms. Accommodation for as many as six such naturalists might be provided. The affairs of the observatory and the granting of permission to make use of its appliances might be intrusted to a small committee, consisting (for example) in the first place of the Warden of the Fishmongers' Company, the professors of zoology, botany, and physiology in the universities of Great Britain, and in the London colleges, and the secretaries of the Linnæan and Zoological Societies of London. Were such an observatory once established, there is every reason to believe that funds could be raised annually for the purpose of extending its operations, and of carrying on special work in it by grants from scientific societies, the universities, and such sources. The obstacle hitherto to the establishment of a British zoological observatory has been the difficulty of obtaining the large sum necessary to launch the institution. It is calculated that 8,000*l.* would be sufficient to secure a site and erect and furnish a suitable building—whilst 500*l.* a year should be secured as a minimum income for the purpose of paying a salary of 250*l.* a year to a resident superintendent, minor salaries to fishermen and attendants, and of meeting the small current expenses. The income of the institution might be materially aided by the payment of a fee (say 5*l.* a month) on the part of those naturalists making use of its resources. The opportunity for securing the 20,000*l.* necessary for the inauguration of such a zoological observatory has presented itself in connection with the International Fisheries Exhibition. Should there be, as there is reason to hope, a large surplus fund in the hands of the Committee of the Exhibition at its close, it is proposed to bring the suggestion of the establishment of a Marine Zoological Observatory before the Committee, and to endeavour to obtain the support of that body for the scheme. It is proposed that a deputation of scientific men should interview the committee of the Fisheries Exhibition, in order to explain the importance of a marine observatory and the close relationship of the work done in such an institution to the interests of our fisheries; and the Committee would then be asked to consider the propriety of handing over the sum of 20,000*l.* (or if possible a larger sum, this being a minimum) to trustees, for the purpose of building and endowing such an observatory, provision being made as to the future government and occupation of the observatory, as above suggested.

NOTES

At the opening of the London Hospital Medical School, Prof. Huxley gave an address on the relations of the State to the medical profession. He considers the present relations on the whole satisfactory, and that it is not desirable that the State should do more than it does to protect the public against incompetent persons and quacks. He thinks that no license should be granted except for the three qualifications, and that the course of study should be extended somewhat backwards, by insisting, instead of the general education test, upon some knowledge of elementary physics, chemistry, and so forth, by the young man desirous of entering upon a course of medical studies. In conclusion, he referred to the want of organisation for the advancement of the science of medicine considered as a pure science.

Prof. Michael Foster gave the introductory address at the School of Pharmacy last week; the subject was "Cramming," and the address will be found reported in full in the *Pharmaceutical Journal* of October 6.

The remains of William Harvey are about to be removed to a new sarcophagus in Hemel Hempstead Church.

An amusing incident is related in our contemporary *L'Électricien*, showing that the knowledge of electrical terminology is yet far from perfect amongst patrons of the latest applications of the science. One of the most eminent and old-established firms who supply incandescent lamps had lately fulfilled an order for a certain number of lamps, specified to be of twenty candle-power at forty-five volts. They received, three days after despatching the goods, the following memorandum:—"We have received your lamps as per invoice, together with the supports, but we were unable to find amongst the goods consigned the forty-five volts invoiced with the lamps . . . "!

As the papers often refer to Chinese telegrams sent to and from Europe in connection with the Franco-Chinese negotiations, it may not be useless to state that a special code of telegraphy has been devised for the use of the Chinese. All the characters of the Chinese language have been numbered, and these numbers are sent by telegraph as secret messages. On arriving in China they are translated into Chinese numbers for the use of Chinese officials.

In carrying out an Act passed by Congress, President Arthur has invited the various countries to send representatives to an International Conference at Washington, the date of which is unfixed, to establish a common prime meridian. The Governments of Austria, Norway, and Sweden have declined, but the two latter approve of the object. Spain is favourable, but has deferred its reply. Belgium is uncertain, but Denmark and Portugal have accepted the invitation conditionally. Switzerland, Venezuela, Mexico, Turkey, Greece, China, Japan, Hawaii, Hayti, Liberia, Holland, Canada, Guatemala, Rou-

mania, Nicaragua, and Honduras have accepted. Replies are expected from Italy, Great Britain, Russia, France, Chili, Brazil, and Germany.

UNIVERSITY COLLEGE, DUNDEE, the munificent gift of Miss Baxter, was duly "inaugurated" on Friday, Prof. Stewart of Cambridge giving an able address on higher education. The college starts with a clear endowment of 100,000*l.*, and a well-selected staff of professors.

THE Photographic Society's Exhibition has been opened at the rooms of the Royal Society of Painters in Water Colours.

WE notice in the *Izvestia* of the Russian Geographical Society an interesting paper by Dr. Woeikof, on the velocity of the wind in Russia. In addition to the important works of MM. Hann and Koeppen, Dr. Woeikof has calculated for fifty Russian and Siberian stations the ratio between the velocity of the wind at 1 p.m. and that in the morning and evening. These calculations have been made in order to show the increase of the force of the wind towards midday and to verify Herr Koeppen's hypothesis as to the dependency of this increase upon the differences of velocities of air in its upper and lower strata, which strata are mixed together by the ascending currents occasioned by the heating of the surface of the soil. The Russian and Siberian stations displaying a great variety of local conditions, M. Woeikof points out the influence of these conditions, but arrives, in their broad features, at the following conclusions:—Throughout Northern and Middle Russia, where the heating of the surface of the soil is very small during the winter, and the ascending current is feeble, the force of the wind increases but slowly as the sun rises above the horizon. The increase is much more during the spring and summer, and at some places the wind at midday blows with a force on an average nearly double what it was in the morning and will be in the evening. In Southern and South-Eastern Russia the increase of the force of the wind during the day is felt even in the winter, owing to the greater heating of the steppes in these lower latitudes. In the Ural region the same increase becomes obvious after February, and the ratio between the forces of the wind at 1 p.m. and at 7 a.m. and 9 p.m. becomes more than 2 to 1 in the summer. In Siberia and Mongolia the relations become more complicated on account of the anticyclones, but the same explanation of the phenomena holds good if the local circumstances be taken into account.

IN his recent work on "Jade and Nephrite Articles in the Dresden Museum," Dr. A. B. Meyer expressed the opinion that there must be other sources of the raw material than those of raw nephrite found in North Germany, Turkestan, New Zealand, and New Caledonia, and of raw jade in Burmah and Montevideo, in order to account for the diffusion of articles wrought from these materials. This view has been so far confirmed that four pieces of raw nephrite of the specific weight of 3·01 have since been found in Suckow, Uckermark, a boulder of the same material in Steiermark, and raw jade in large masses, generally in the form of boulders, in Alaska. He further was of opinion that China could not draw all its nephrite from Turkestan. It had already been shown that the large masses of raw material transported by sea from Burmah to China consisted of jade with the specific weight of nephrite, and Dr. Meyer remarked that by far the largest number of Chinese articles seemed to be of nephrite. Out of the stone hatchets, as they were thought to be, brought by Mr. Anderson from Yunnan, there were but three which had the specific weight of nephrite, and Dr. Meyer conjectured that they were of jade. A piece of the only "indubitable" hatchet out of the three, having been forwarded by Mr. Anderson to Dr. Meyer, was on examination found to be genuine nephrite. The fact is therefore established that genuine nephrite as well as jade exists in the region of Further India, though their exact locality has yet to be discovered.

MESSRS. CROSBY LOCKWOOD AND CO. announce the following new and forthcoming publications:—"British Mining; a Practical Treatise on the Metalliferous Mines and Minerals of the United Kingdom, dealing comprehensively with the theories of Mineral Deposits, the History of Mines, their Practical Working, and the Future Prospects of British Mining Industry," fully illustrated, by Robert Hunt, F.R.S., late Keeper of Mining Records, editor of Ure's "Dictionary of Arts, Manufactures, and Mines, author of "Researches on Light," &c., formerly Professor of Physics, Royal School of Mines; "Earthy and other Minerals and Mining," with numerous illustrations, by D. C. Davies, F.G.S., Mining Engineer, &c., uniform with and forming a companion volume to the same author's "Metalliferous Minerals and Mining"; "Graphic and Analytic Statics in Theory and Comparison, their Practical Application to the Treatment of Stresses in Roofs, Solid Girders, Lattice, Bow-string and Suspension Bridges, Braced Iron Arches and Piers, and other Frameworks, to which is added a chapter on Wind Pressures," by R. Hudson Graham, C.E., containing diagrams and plates to scale, with numerous examples, many taken from existing structures; "A Handbook of the Art of Soap-making, including the Manufacture of Hard and Soft Soaps, Toilet Soaps, Medicated and Special Soaps, Bleaching and Purifying Oils and Fats, Recovery of Glycerine, &c., &c.," with a series of engravings, by Alexander Watt, author of "Electro-Metallurgy Practically Treated," &c.; "The Engineers' and Shipowners' Coal Tables," by Nelson Foley, author of "The Engineer's Office Book of Boiler Construction."

MESSRS. SIEMENS AND HALSKE have brought out an instrument called a torsion galvanometer to be used for large currents. It consists of a magnet suspended between two coils, so as to be affected by both, but to which is attached a torsion spring so arranged that the amount of torsion necessary to bring the needle back to its normal position can easily be determined. These instruments are made in two forms, a vertical and a horizontal form. In the vertical form the needle is suspended by a cocoon silk, and the reading is taken from above; this is the more delicate form. In the horizontal form, which is meant for more practical work, the needle is balanced on knife-edges, and carries at one end a light pointer which passes behind a scale. The amount of torsion required to bring the needle back to zero is indicated by another pointer attached to a handle, and which moves in front of the scale. These instruments can be used either in main circuit or shunt; in the latter case they are often used in conjunction with a resistance box so arranged as to reduce the fall of potential between the terminals of the instrument in a known ratio. It is necessary, however, to use a table of calibrations which are subject to very little change with time.

A COURSE of elementary lectures upon Recent Astronomy and Sidereal Astronomy will be delivered in Gresham College, at six o'clock p.m. on October 16, 17, 18, and 19, by the Rev. Edmund Ledger.

THE President of the Aristotelian Society, Mr. Shadworth H. Hodgson, M.A., LL.D., will open the ensuing session with an address, on Monday evening, October 15, 1883, and the society will then meet fortnightly as usual. The chief work of the session will be a study of Berkeley's "New Theory of Vision" and "Principles of Human Knowledge," and Hume's "Treatise of Human Nature."

THE recent *soirée* of the Chester Society of Natural Science was marked by the publication of a useful programme or descriptive catalogue, which gave to the objects exhibited a teaching value, which may be well imitated, and which forms a permanent reference to those who had the opportunity of being present. The sixty microscopes shown were classified, according to the

subject under the lens, into groups, exemplifying the intimate structure of each of the classes into which animals and plants have been divided, the chief points of structure being briefly described under each head in the "programme," which thus formed a biological text-book of twenty pages with real objects for illustration. This society, founded by Canon Kingsley, is doing exceedingly good work in limiting its operations to the natural history and geology of its own district, scrupulously defined on an ordnance map. The study of local biology is encouraged by the annual grant of 10*l*., known as the Kingsley Memorial Prize, open to any resident within the Society's district; that of next year is offered for the best collection of "Slides of the Freshwater Algæ of the Society's District, omitting the Diatoms." The Kingsley Memorial Medal this year was awarded to Mr. Shrubsole, F.G.S.

THE report on the progress and condition of the Botanic Garden and Government Plantations in South Australia for 1882, by the Director, Dr. Schomburgk, contains the usual amount of information on the introduction and cultivation of useful and ornamental plants. Dr. Schomburgk draws attention to the small rainfall for the year. He says that during 1881 it amounted to 18 192 inches, but during 1882 it only amounted to 15·742 inches, which was 5·469 inches below the general average (21 inches odd) of the previous forty-three years, the only years during which the rainfall was less than that of last year. During May and June severe frosts prevailed. The temperature was on several nights as low as 29° and 30°. These frosts had, of course, a disastrous effect upon plants in the gardens. "The tropical and subtropical trees and shrubs which had scarcely recovered from the frosts of 1881, especially the tropical *Ficus*, constituted the chief bulk of the sufferers; they have suffered materially, and they have been sadly reduced—from 30 feet and 40 feet in height, to 6 feet and 10 feet." As early as the latter end of September some very hot days were experienced, the thermometer showing 96° in the shade, and 123° in the sun, the highest temperature experienced in any former September. During December and January three slight showers of rain alone fell. Notwithstanding these checks to vegetation a considerable amount of work seems to have been done of a varied character. In the matter of useful plants we quote the following paragraph as an example:—"The demand by invalids for medical herbs becomes more frequent, and it is gratifying to be able to supply them. Inquiries are especially made for the following, viz.: the common English broom (*Cytisus scoparius*), of which a decoction is used in dropsy; the leaves of the mullein or shepherd's club (*Verbascum thapsus*), a decoction of the leaves being recommended by some of the American papers as a remedy against consumption; the globular sponge (*Euphorbia pilulifera*), a native of the tropical regions of the New and Old World. It is found growing in Queensland, and a decoction of the plant is said to be used with the best results in asthmatic complaints."

MR. F. S. MOSELEY, F.Z.S., writes to the *Times* to state that a Marmoset (*Hapale jacchus*) in his possession gave birth to two young ones on the 4th inst.; Mr. Moseley supposes this to be the first case of the kind in Europe.

A TELEGRAM received at Paris on Tuesday night from Algiers states that a strong shock of earthquake was felt at Philippeville at half-past one o'clock that morning. The oscillation was in the direction from north to south. At Jammasses the church and barrack walls were cracked; at Stora a house was also damaged.

A CORRESPONDENT residing at Accra, West Coast of Africa, sends some particulars of the recent earthquake at that place:—"It was at 2.30 a.m. on the morning of Sunday, August 12, that several shocks of earthquake were experienced. The evening previous had been cool, with alternate periods of thick, hot air, which rather presaged a thunderstorm, it being the season of the year when tornadoes pass over the coast. On the night in question it was observed that the surf was particularly violent until half an hour prior to the first shock, when the water seemed to subside and become comparatively calm. The first shock was followed by a second and more violent shock, shaking the foundations. In each case the shock was preceded by an explosion resembling in a great degree the sound usually caused by the discharge of a gun from ships lying in the roadstead. Christiansborg Castle, which in 1863 was wrecked by an earthquake at the same time of year, felt the force of the disturbance severely. Several of the castle walls and those of the neighbouring European houses were found to be cracked the next day. The critical phase lasted, as far as could be calculated, from thirty to forty seconds. During the period—2.30 a.m. to 3.30 a.m.—there was a variation of temperature of 3°—viz. from 71° to 74°, and *vice versâ*. In this interval the wind had completely died away, the atmosphere being hot and almost stifling. It was very difficult to trace the direction of the earthquake, but my own opinion is that it travelled from the south-west, and this is somewhat confirmed by the reports since received from that quarter. Small shocks were repeated at intervals of one hour till seven o'clock in the morning, and on two days since the 12th slight tremors have been felt, but not of sufficient power to do much damage. Since the event the weather has become remarkably cool, considering our proximity to the Equator, the average temperatures being, night and morning, 72°, sun 97°, shade 56°."

THE additions to the Zoological Society's Gardens during the past week include a Bubaline Antelope (*Alcelaphus bubalis* ♀), a Domestic Goat (*Capra hircus*) from Algeria, presented by Mr. Robert Pitcairn; a Black Hornbill (*Buceros atratus*) from West Africa, presented by Mr. J. T. Carrington; two Grey Monitors (*Varanus griseus*) from Arabia, presented by Capt. J. S. Sanderson; four Ural Phrynocephales (*Phrynocephalus helioscopus*) from the east coast of the Caspian, presented by Dr. A. Strauch, F.M.Z.S.; twelve European Tree Frogs (*Hyla arborea*), European, presented by Mr. Carl Schorlemmer; a Cape Hyrax (*Hyrax capensis*) from South Africa, a Great Bustard (*Otis tarda*), European, deposited; an Ocelot (*Felis pardalis*), a King Vulture (*Gypagus papa*), a Brazilian Caracara (*Polyborus brasiliensis*), an Anaconda (*Eunectes murinus*), a Common Boa (*Boa constrictor*) from Brazil, purchased; two Mandarin Ducks (*Æx galericulata*), two Cockatoos (*Calopsitta novæ-hollandiæ*), bred in the Gardens.

GEOGRAPHICAL NOTES

A LETTER from Mr. H. M. Stanley, dated July 14 has been published in New York, in which he reports the discovery of a new lake called Mantumba. He has also explored the river marked in the maps as the Ikelembu, but which is really the Ma'undu, and finds it to be a deep, broad, navigable stream. Stanley expresses his increasing surprise at the density of the population in the equatorial portions of the Congo basin, and says if what he has seen may be taken as representing the state of things generally, there is a population in this river basin of forty-nine millions. Extensive commercial openings are offering themselves.

A TELEGRAM from New York, October 9, states that exploring parties who had just descended the Yukon River, in Alaska, say that they travelled down the stream for two thousand miles. They report the river to be one of the largest in the world, discharging 50 per cent. more water than the Mississippi. Its breadth in some places is seven miles.

THE Austrian African explorer, Dr. Steeker, after five years' absence in the service of the German African Society, has just returned home. For the most part he travelled in company with Herr Gerhard Rohlfs, but Steeker has himself discovered about a dozen countries east and south of Abyssinia, which

before him, no European had ever entered. He was imprisoned as a spy by King Melelek, of Shoa, but was eventually released through the intercession of Marquis Antinori. He has brought back with him numerous valuable maps and a large collection of the fauna, flora, minerals, and other objects connected with the regions he explored.

LIEUT. WISSMANN is preparing to set out on a new expedition to the Upper Congo.

THE United States observing party at Point Barrow have returned to Alaska, *en route* for San Franscisco.

THE French war steamer, which was sent out last year with the French scientific mission to Cape Horn, is daily expected with the party, who have spent their winter in this remote part of the world. These observations have been carried on in connection with the Polar observations as organised by the International Conference, and have been made from August, 1882, to August, 1883.

"THE Yearly Report of the Swiss Alpine Club" for 1882, the eighteenth volume of the series, contains many and various contributions towards a fuller knowledge of the Alps. Besides valuable letterpress we are treated to excellent panoramas after original drawings, coloured views, woodcuts, and cartographical sketches.

IN one of a collection of lectures published at Heidelberg, 1883, by the house of Carl Winter, A. von Lasaulx, the well-known geologist, draws an ingenious parallel between Ireland and Sicily, and attempts to explain the backward state of the inhabitants of these two islands and the disorders of which they have been the theatre by the nature of their geological strata, the formation of their coasts and their positions.

THE last number of the *Izvestia* of the Russian Geographical Society, contains, besides minutes of proceedings, two papers by Dr. Woeikof, on the diurnal period of the velocity of the wind in Russia, and on the distribution of heat in the oceans; a paper by Prof. Lenz, on the periodicity of auroras; the annual reports of the western and eastern Siberian branches of the Society; the end of M. Polyakoff's letters from Sakhálin, wherein he describes his journey on boat down the Tym River and on the eastern coast of Sakhalin; and several notes. We notice among these latter a list of forty-two places in Persia, Attak, and Akhal-Tekke, the positions of which were determined by Capt. Gladysheff.

THE EVOLUTIONARY POSITION[1]

I HAVE been requested by the Subjects Committee of the view Congress to place before you a brief statement of some of the advances which have recently been made in natural science, with a view to open a discussion upon their relations, real or supposed, to religious belief. The particular advances which, as I am given to understand, were especially in the minds of the Committee in proposing this question, are those which have resulted in the more or less general adoption by scientific men of the view of the sequence of events which have taken place, and are still taking place, in the universe, to which the term "evolution" is now commonly applied.

All that is embraced by this term, the various realms of nature in which its manifestations are traced, the various shades of meaning attached to it by different persons, would constitute far too large and complex a subject to be treated of in the time to which addresses to this meeting are wisely restricted. I will therefore select for special consideration the only point in the application of the theory upon which I can speak with any practical knowledge; one which is, however, in the eyes of many of very vital interest. It is the one, at all events, which at the present moment attracts most attention; the new ideas upon it being received with enthusiasm by some, and with distrust, if not with abhorrence, by others.

The doctrine of continuity, or of direct relation of an event to some preceding event according to a natural and orderly sequence is now generally recognised in the inorganic world; and although the modern expansion of this doctrine as applied to the living inhabitants of the earth appears to many so startling, and has met with so much opposition, it is, in a more restricted application, a very old and widespread article of scientific as well as of popular faith.

Putting aside, as quite immaterial to the present discussion, the still controverted question of the evidences of the production of the lowest and most rudimentary forms of life from inorganic matter, it may be stated as certain that there is no rational and educated person, whatever his religious beliefs or philosophical views, who is not convinced that every individual animal or plant, sufficiently highly organised to deserve such distinctive appellation, now existing upon the world, has been produced from pre-existing parents by the operation of a series of processes of the order to which the term natural is commonly applied; processes also fundamentally the same throughout the whole range of living beings, however much modified in detail to suit the various manifestations under which those beings are presented to us. We feel absolutely certain, when we see a horse, a bird, a butterfly, or an oak tree, that each was derived from pre-existing parents more or less closely resembling itself. Though we have no direct evidence of the fact in each individual case, the knowledge derived from the combined observations of an overwhelming number of analogous cases is of such a positive character, that we should entirely refuse to credit any one who made the contrary assertion, and should feel satisfied that he had been deluded by some error of observation. We cannot, indeed, conceive of the sudden beginning of any such creatures, either from nothing, from inorganic matter, or even from other animals or plants totally unlike themselves.

To persons whose opportunities of observation of animal and plant life are limited to a comparatively few kinds, existing under comparatively similar circumstances, and which observations moreover only extend over a comparatively limited period of time, it appears that in each kind of animal or plant, such as those just mentioned, individuals of various succeeding generations present a very close resemblance to each other. That they often vary a little cannot escape careful observation, but the deviations from the common characters of the kind to be noticed by persons whose range of vision is thus limited are not striking, and usually appear not to pass beyond certain bounds. Hence arose the common idea, natural enough under such circumstances, but which gradually developed itself, not only into a scientific hypothesis, but even, it would appear, almost into an article of religious belief, that the different kinds or "species," as they are technically called, of animals and plants, had each its separate origin, its fixed limits of variation, and could not under any circumstances become modified or changed into any other form.

This idea became deeply rooted in the human mind, in consequence of the very long period during which it prevailed, the horizon of observation having remained practically stationary from the time man first began to observe and record the phenomena of nature until little more than a century ago, when commenced that sudden expansion of knowledge of the facts of the animal and vegetable world which has been steadily widening ever since. Now it is important to observe that it is strictly *pari passu* with the growth of knowledge of the facts, that the theoretical views of nature have changed, and the older hypothesis of species to which I have referred has gradually given way to a new and different one.

The expansion of the special branches of knowledge affecting our views upon this subject has taken place in many different directions, of which I can here only indicate the most striking.

1. The discovery of enormous numbers of forms of life, the existence of which was entirely unknown a hundred years ago. The increase of knowledge in this respect is something inconceivable to those who have not followed its progress. Not only has the number of well defined species known multiplied prodigiously, but infinite series of gradations between what were formerly supposed to be distinct species are being constantly brought to light. The difficulty of giving any satisfactory definition of what is meant by the term "species" is increasingly felt day by day by practical zoologists, as evidenced by the introduction of such terms as "sub-species," "permanent local variety," &c., into general use, and especially by the wide differences of opinion as to the number or limits of the species included in any given group of animals or plants among naturalists who have made such group their special study.

2. Vast increase in the knowledge of the intimate structure of organic bodies, both as revealed by ordinary dissection and by microscopic examination, a method of investigation only brought to perfection in very recent years. By the knowledge thus acquired has been demonstrated the unity of plan pervading, under diverse modifications, the different members of each

[1] The following address by Prof. Flower, F.R.S., President of the Zoological Society, was given at the recent Church Congress as introductory to a discussion on "Recent Advances in Natural Science in their Relation to the Christian Faith." The address has been revised by the author.

natural group of organisms at one time attributed to "conformity to type," a so-called explanation which explained nothing, but for which a *vera causa* may be found in descent from a common ancestor. Wonderful gradations in the perfection to which different structures have attained in the progress of their adaptation to their respective purposes have also been shown, and of still greater importance and interest, the numerous cases of apparently useless or rudimentary organs in both animals and plants, which were absolutely unaccounted for under the older hypothesis.

3. The comparatively new study of the geographical distribution of living things, which has only become possible since the prosecution of the systematic and scientific explorations of the earth's surface which have distinguished the present century. The results of this branch of inquiry alone have been sufficient to convince many naturalists of the unsoundness of the old view of the distinct origin of species, whether created each in the region of the globe to which it is now confined, or, as many still imagine, all in one spot, from which they have spread themselves unchanged in form, colour, or other essential attributes to their present abodes, however diverse in climate and other environments or conditions of existence.

4. Lastly, though most important of all, must be mentioned the entirely new science of palæontology, opening up worlds of organic life before unknown, also showing infinite gradations of structure, but mainly important as increasing our horizon of observation to an extent not previously dreamt of in the direction of time. Powers of observation formerly limited to the brief space of a few generations are now extended over ages, which the concurrent testimony of various branches of knowledge, of astronomy, cosmogony, and geology, show are immeasurable compared with any periods of which we hitherto had cognisance. We are enabled to trace, and every year, as discovery succeeds discovery, with increasing distinctness, numerous cases of sequences of modification running through groups of animals in successive periods of time, such as the gradual progress in the development and perfection of the antlers of deer, from their entire absence in the earliest known representatives of the type, through the simple conical or bifurcated form, increasing in complexity as time advanced to the magnificent many-branched appendages which adorn the heads of some species of recent stags; such also as the progressive modifications, so often described, beginning in the short-necked, heavy-limbed, many-toed tapir-like animal of the Eocene period, and ending in the graceful, long-necked, light-limbed, single-toed horse of our own age, and numerous others which time will not allow me even to mention.

It would be impossible here to trace the history of the effect of this enormous influx of knowledge upon the doctrine of the separate origin and fixed characters of species; to narrate the scattered efforts of philosophical minds, discontented with the former views, but not yet clearly seeing the light; to describe the slow and struggling growth of the new views, amid difficulties arising from imperfections of knowledge, and the opposition of prejudice, or to apportion to each of those who by their labours have contributed to the final result his exact share in bringing it about. How much, for instance, is due to the work and the writings of our illustrious countryman Darwin? and how much to those who have preceded or followed him? All this forms an episode in the history of the progress of human knowledge which has been abundantly chronicled elsewhere.

The result may, however, be briefly stated to be that the opinion now almost, if not quite, universal among skilled and thoughtful naturalists of all countries, and whatever their beliefs upon other subjects, is that the various forms of life which we see around us, and the existence of which we know from their fossil remains, are the product, not of independent creations, but of descent, with gradual modification from pre-existing forms. In short, the law of the natural descent of individuals, of varieties, races, or breeds (which, being within the limits of the previous powers of observation, was already universally admitted) has been extended to the still greater modifications constituting what we call species, and consequently to the higher groups called genera, families, and orders. The barrier fancied to exist between so-called varieties and so-called species has broken down.

Any one commencing the study of the subject at the present time without prejudice, and carefully investigating the evidence upon which to form his conclusions, bearing in mind that he must look for his proofs, not so much in direct experiments or absolute demonstrations, which from the nature of the case are impossible, but in the convergence of the indications furnished by the interpretations of multitudinous facts of most diverse kinds, must find it extremely difficult to place himself in the position of those who held the older view, so much more reasonable, so much more in accordance with all that we know of the general phenomena of nature, does this new one seem. In fact the *onus probandi* now appears entirely to lie with those who make the assertion that species have been separately created. Where, it may be asked, is the shadow of a scientific proof that the first individual of any species has come into being without pre-existing parents? Has any competent observer at any time witnessed such an occurrence? The apparent advent of a new species in geological history, a common event enough, has certainly been cited as such. As well might the presence of a horse in a field, with no sign of other animals of the same kind near it, be quoted as evidence of the fallacy of the common view of the descent of individuals. Ordinary observation tells us of the numerous causes which may have isolated that horse from its parents and kindred. Geologists know equally well how slight the chances of more than a stray individual or fragment of an individual here and there being first preserved and afterwards discovered to give any indication of the existence of the race. Those who object to the new view complain sometimes of the frequency with which its advocates take refuge, as they call it, in the "imperfection of the geological record." I think, on the contrary, the difficulty is always to allow sufficiently for this imperfection. When we contrast the present knowledge of palæontology with what it was fifty or even ten years ago; when we see by what mere accident, as it were, a railway driven through a new country, a quarry worked for commercial purposes, a city newly fortified, all the most important discoveries of extinct animals have been made, we must be convinced that all arguments drawn from the absence of the required links are utterly valueless. The study of palæontology is as yet in its merest infancy; the wonder is that it has already furnished so much, not so little, corroboration of the doctrine of transmutation of species.

Direct proof is, then, equally absent from both theories. For the old view it may be said that it has been held for a very long time by persons whose knowledge of the facts of nature which bear upon it was extremely limited. On the other hand, the new view is continually receiving more support as that knowledge increases, and furnishes a key to a vast number of otherwise inexplicable facts in every branch of natural history, in geological and geographical distribution, in the habits of animals, in their development and growth, and especially in their structure. Allow me to take one instance from the last named—the anatomy of the whale. How is it possible, upon any other supposition than that it is the descendant of some land animal, with completely developed limbs and teeth, which has become gradually modified to suit an aquatic mode of existence, to explain the presence of the numerous rudimentary, and to their present possessors absolutely useless, structures found in its body. Amongst others, a complete set of teeth, existing only in embryonic life, entirely disappearing even before birth, and rudimentary hind legs, with their various bones, joints, and muscles, of which no trace is seen externally. It may be asserted that the whale was originally created so, as it was asserted, and long maintained, that fossil shells and bones were originally created as such in the rocks in which they are found. It took more than two centuries of continuous and most acrimonious discussion to convince the world, especially the theological world, that these were the actual remains of animals which had once lived in a former period of the earth's history. Their evidence is now, however, universally admitted as supplying knowledge of the changed conditions of the surface of the earth, and with equal clearness do these rudimentary organs, hidden in the secret recesses of the whale's body, furnish, to those who inquire, indications that the animal has passed through phases of existence unlike those in which we now see it.

I do not for a moment assert that the new view explains everything that we students of nature are longing to know, or that we do not everywhere meet with obscure problems and perplexing difficulties, facts that we cannot account for, and breaks in the chain of evidence. As to the details and mode of operation of the secondary laws by which variation and modification have been brought about, we are far from being in accord. Happy for us that it is so, or our work would be at an end. I only maintain that the transmutation view removes more difficulties, requires fewer assumptions, and presents so much more consistency with observed facts than that which it seeks to supersede, and is, therefore, so generally accepted, that there is no

afore probability of its being abandoned, and the old doctrine of the fixity of species revived, than that we should revert to the old astronomical theories which placed the earth in the centre of the universe, and limited the date of its creation to six ordinary days.

The question of the fixity or the transmutation of species is a purely scientific one, only to be discussed and decided on scientific grounds. To the naturalist, it is clearly one of extreme importance, as it gives him for the first time a key to the interpretation of the phenomena with which he has to deal. It may seem to many that a question like this is entirely beside the business of a Church Congress, as it is one with which only those expert in the ways of scientific investigation, and deeply imbued with knowledge of scientific facts, could be called upon to deal. This would certainly have been my view, if it had not been that some who, from their capacities and education, should have been onlookers in such a controversy, awaiting the issues of the conflict while the lists are being fought out by the trained knights, have rushed into the fray, and by their unskilful interposition have only confused the issues, casting about dust instead of light. In the hope of clearing away some of this dust the present discussion has been decided upon.

It is self-evident that a solid advance of any branch of knowledge must, in some way or other, and to a greater or less degree, influence many others, even those not directly connected with it, and therefore the rapid simultaneous strides of so many branches of knowledge as may be embraced under the term of "Recent Advances in Natural Science," will be very likely to have some bearing upon theological beliefs. Whether in the direction of expanding, improving, purifying, elevating, or in the direction of contracting, hardening, or destroying, depends not upon those engaged in contributing to the advance of science, but upon those whose special duty it is to show the bearing of these advances upon hitherto received theological dogmas. The scientific questions themselves may well be left to experts. If the new doctrines are not true, there are plenty of keen critics among men of science ready to sift the sound from the unsound. Error in scientific subjects has its day, but it is certain not long to survive the ordeal, yearly increasing in severity, to which it is subjected by those devoted to its cultivation. On the other hand, the advances of truth, though they may be retarded, will never be stopped by the opposition of those who are incompetent by the nature of their education to deal with the evidence on which it rests. There is no position so fraught with danger to religion as that which binds it up essentially with this or that scientific doctrine, with which it must either stand or fall. The history of the reception of the greatest discoveries in astronomy and geology, the passionate clinging to the exploded pseudo-scientific views on those subjects supposed to be bound up with rellgious faith, the fierce denunciations of the advocates of the then new, but now universally accepted, ideas, are well-worn subjects, and would not be alluded to but for the repetition, almost literal repetion in some cases, of that reception which has been accorded to the new views of biology.

Ought not the history of those discoveries and the controversies to which they gave rise to be both a warning and an encouragement? Those who hoped and those who feared that faith would be destroyed by them have been equally mistaken; and is not probable that the same result will follow the great biological discoveries and controversies of the present day?

In stating thus briefly what is the issue of these discoveries, as generally understood and accepted by men of science, I have done all that I promised, and must leave in far more competent hands the part of the subject especially appropriate for discussion at this meeting. I may, however, perhaps be allowed to put a few plain and simple considerations before you, which may have some bearing upon the subject, and which have no pretensions to novelty, though, being often lost sight of, their repetition may do no harm.

I said at the commencement of this paper that it has long been admitted by all educated persons, whatever their religious faith may be, that that very universal but still most wonderful process, the commencement and gradual development of a new individual of whatever living form, whether plant, animal, or man, takes place according to definite and regularly acting laws, without miraculous interposition. Further than this, I believe that every one will admit that the production of the various races or breeds of domestic animals is brought about by similar means. We do not think it necessary to call in any special intervention of creative power to produce a short-horned race of cattle, or to account for the difference between a bulldog and a greyhound, a Dorking and a Cochin China fowl. The gradual modifications by which these races were produced, having taken place under our own eyes as it were, we are satisfied that they are the consequence of what we call natural laws, modified and directed in these particular cases by man's agency. We have even gone further, having long admitted, without the slightest fear of producing a collision with religious faith, that variation has taken place among animals in a wild state, producing local races of more or less stable and permanent character, and brought about by the influence of food, climate, and other surrounding circumstances.

The evidences of the Divine government of the world, and of the Christian faith, have been sufficient for us, notwithstanding our knowledge that the individual was created according to law, and that the race or variety was also created according to law. In what way then can they be affected by the knowledge that the somewhat greater modifications, which we call species, were also created according to law? The difficulties, which to some minds seem insuperable, remain exactly as they were; the proofs, which to others are so convincing, are entirely unaffected by this widening of scientific knowledge.

Even to what is to many the supreme difficulty of all, the origin of man, the same considerations are applicable. Believe everything you will about man in his highest intellectual and moral development, about the nature, origin, existence, and destiny of the human soul—you have long been able to reconcile all this with the knowledge of his individual material origin according to law, in no whit different in principle from that of the beasts of the field, passing through all the phases they go through, and existing long before possessing, except potentially, any of the special attributes of humanity. At what exact period and by what means the great transformation takes place no one can tell. If the most Godlike of men have passed through the stages which physiologists recognise in human development without prejudice to the noblest, highest, most divine part of their nature, why should not the race of mankind, as a whole, have had a similar origin, followed by similar progress and development, equally without prejudice to its present condition and future destiny? Can it be of real consequence at the present time, either to our faith or our practice, whether the first man had such an extremely lowly beginning as the dust of the earth, in the literal sense of the words, or whether he was formed through the intervention of various progressive stages of animal life?

The reign of order and law in the government of the world has been so far admitted that all these questions have really become questions of a little more or a little less order and law. Science may well be left to work out the details as it may. It has thrown some light, little enough at present, but ever increasing, and for which we should all be thankful, upon the processes or methods by which the world in which we dwell has been brought into its present condition. The wonder and mystery of creation remains as wonderful and mysterious as before. Of the origin of the whole, science tells us nothing. It is still as impossible as ever to conceive that such a world, governed by laws, the operations of which have led to such mighty results, and are attended by such future promise, could have originated without the intervention of some power external to itself. If the succession of small miracles, formerly supposed to regulate the operations of nature, no longer satisfies us, have we not substituted for them one of immeasurable greatness and grandeur?

A GREEN SUN IN INDIA

WE have received the following communications on this phenomenon. At the same time we may refer to a passage in one of Mr. Norman Lockyer's papers on "Physical Science for Artists," in which he speaks of the marked effects of aqueous vapour in the atmosphere on the character of the sun's light. He states that he asked Dr. Schuster to test his theory while in India. "Theory," he states, "had led me to expect that with the enormous thickness of air available there, absorption at the red end of the spectrum by aqueous vapour would be seen as well as the absorption at the blue, which is so common with us. Seeing the sun a vivid green through the steam of the little paddle-boat on Windermere first led me to inquire into the possibility of aqueous vapour following the same law as that which I think we may now accept in the cases of the vapours of metals. As in these experiments with vapours absorption of the red end alone was seen, as well as absorption at the blue end alone, the

assumption that these two absorptions existed in aqueous vapour at once accounted for the green sun." In the sequel it will be found that Dr. Schuster's observations quite confirmed Mr. Lockyer's theory.

BY my friend Major A. T. Fraser, R.E., I have just been favoured with a copy, which I now inclose to you, of a Madras paper, dated September 12, giving not only the frightened comments of a dozen different, unpractised observers on the *green* sun, seen morning and evening over the south-east of India during the two or three previous days, but also the spectroscopic explanation thereof by Rev. Prof. Michie Smith, which is so good that you may perhaps think well to introduce it into your columns.

The case too is further worth notice here, as an example of the occasional powers of the rain-band spectroscope over and above the wet and dry bulb thermometers, to tell us what is in the upper air now and will visit us soon below. For on those days when the greenness of the sun was undoubtedly due to being seen through strata of atmosphere inordinately charged with watery vapour (much as I set forth in vol. xiv. of "Edinburgh Astronomical Observations," was the case so eminently at Palermo in 1872), the air in contact with the dwellings of man was dry.

It has been so too for a considerable time, as testified by Mr. Pogson at the Madras Observatory, both by his daily hygrometric observations, and by his record of rainfall for the year being behind the usual quantity by about a third of the whole. From this circumstance apparently, "some of the learned old men," but knowing nothing of spectroscopy, in that locality, needlessly afflicted themselves and their neighbours also, by proclaiming that the *green* sun, in place of being a sign of good times coming, "was a bad omen for the country, and would bring a famine this year."

But though there was still a drought at Madras, the same paper involuntarily reports that abundant rain had begun to fall further away to the south and west, or to the extent, at Travancore, of 5·91 inches, and at Malabar of 10·14 inches, in one week.

C. PIAZZI SMYTH

15, Royal Terrace, Edinburgh, October 9

WE have just been having the curious phenomenon of a greenish colour in the light of the sun. Letters to the Madras papers show that the same thing has been noticed in many other parts of Southern India. It is new to me, and to every one else who has seen it, so far as I have heard. The native astronomers say that there is a planet wholly absorbed in the sun, and that if it leaves the sun a green light will appear. Or, according to others, if Venus comes in contact with the sun, which, according to their calendars, is the case now, a green light will be seen. Both agree, however, in portending evil to the inhabitants of this planet; consequently there has been no little curiosity and speculation awakened by this singular appearance, and more or less of uneasiness in the minds of the ignorant and superstitious natives. As I am principal of the High School in this place, and teacher in a small way of science, they apply to me for the scientific solution of the mystery; but, farther than a mere conjecture, I have to confess myself quite as much in the dark as the rest.

Doubtless others of your correspondents have noticed the same thing, and my description may be superfluous; yet I venture to give it, as it may at least corroborate the statements of other observers.

My attention was first called to the matter by one of my teachers about four o'clock on the afternoon of September 10, but I learn that the same thing was noticed elsewhere the day before. At the time of which I speak I noticed that the light from the sun shining into the room through an open western door threw a curious pale blue colour on the floor. I also noticed that it had something of the effect upon colours that is commonly seen in coloured lights. On looking out I saw that the sun, which was somewhat dimmed by a haze, had a decidedly greenish-blue tinge. The same thing was observed on the 11th and 12th, both morning and evening; but my observations were confined to the evenings. About four o'clock (at least I did not notice it earlier) an indistinct bluish tinge appeared in the light. This gradually passed into a greenish colour, and this in turn became tinged with yellow as the sun approached the horizon. As the sun sank, bands of smoky haze drifted across its disk. After the sun was down, bright yellow, orange, and red appeared in the west, a very deep red remaining for more than an hour after sunset; whereas under ordinary conditions all traces of colour leave the sky in this latitude within half an hour after the sun disappears. At night the moon, just past the first quarter was surrounded by a pale greenish halo some thirty degrees in breadth.

After sunset I observed a peculiar appearance in the haze which covered the sky. It was not of sufficient density to be at all visible, except where it reflected the direct rays of the sun. There it had a singular mottled appearance, with a smoky look along the borders of the denser portions, suggesting clouds of smoke or dust in the upper regions of the atmosphere.

Of course the question which every one is asking now is, What caused the green light? very few, so far as I have learned, having noticed anything else. The succession of colours which I have mentioned, occurring exactly in the order of the solar spectrum, would seem to indicate beyond a doubt the presence of some highly refracting substance in the atmosphere which resolved the sun's rays into primary colours and gave us in succession, according to the angle of the sun to the horizon, blue, green, yellow, orange, and red, the two latter only appearing as reflected from the under surface of the haze. On the evening of the 13th the sun appeared to be perfectly clear, but after it was below the horizon the western sky was seen to be covered with a smoky haze of a singular appearance, which became brilliantly illuminated with yellow, orange, and red in the order I have mentioned, counting upward from the horizon. These sank one after the other, leaving at last an arc of brilliant red along the west, the inner portion of the segment contained by the arc being composed of orange. This disappeared in turn, and the whole western sky became yellow again without any distinct outlines, and this gradually deepened into red, which remained for an hour or more after sunset. The latter phenomenon was not unlike an ordinary sunset, except in brightness and duration.

But what could the refracting medium be? The air itself has refracting power, and so have the minute particles of moisture or ice which constitute the ordinary hazy clouds in the upper regions of the atmosphere; but it would be difficult to say why the effects which I have described should not be of more frequent occurrence if produced by either or both of these causes, since they are always present in a greater or less degree, and especially as there was apparently nothing unusual in the state of the weather at the time. Neither would clouds of smoke alone produce such effects as I have mentioned. In my native place in the United States, where vast tracts of prairie, and often of woodland, are burned over every autumn, a smoky haze is a common thing at that season of the year. Sometimes for days together the haze is so dense as almost to hide the sun, yet I never heard of any other effect upon the light than this obscuring of it, while the sunsets were especially dull and colourless. Nor do I see how these phenomena could be referred to unusual electrical conditions, for in that case they should be more common, as electrical storms are by no means unusual. I have been led, therefore, to wonder if the phenomena may not be the result of some fine transparent or semi-transparent dust particles in the upper regions of the atmosphere, which form the singular looking haze, and refract the light in the manner I have described, and whether the whole may not be traceable to the recent volcanic eruptions in Java.

According to the telegrams, the city of Batavia was darkened for thirty-six hours by clouds of dust from the volcano. True, we are a long distance from Java here, Ongole being in latitude 15° 30′ N., and longitude 80° 6′ E. But it is well known that the smoke and ashes from volcanoes are often carried to immense distances, and in this case, if acted upon by the trade winds, they would be carried away to the westward, and rising with the upward currents might enter the return trades, and so be swept over Southern India in a north easterly direction—the direction of our prevailing winds at this season of the year. However, I only venture this solution of the problem as a timid conjecture, the truth or falsity of which I have no means of demonstrating.

Will not some of the readers of NATURE who are better informed in regard to such matters kindly give me their opinions of the phenomena? I should be glad also to know if such effects upon the light as I have described have ever been noticed as the result of the smoke or dust or gases emitted by volcanoes.

Another thing which awakened about as much curiosity and speculation in the minds of the natives as the coloured light was the large spot now crossing the sun's disk. Ordinarily the atmosphere is so clear that even at sunset the sun cannot be

viewed with the naked eye; but, being obscured as it was by the haze, the spot was distinctly visible to all.

Ongole, India, September 14 W. R. MANLEY

[Mr. Manley sends us several letters from the *Madras Mail* on the phenomenon; from these we give the following extract, dated September 10:—]

A. T. M. writes:—"Unlike his usual custom the sun rose this morning clothed as it were in bright blue colour, rendering the whole horizon and all beneath it of the same hue. The pure, colourless river water looked as if it was just let out of an indigo vat. Even the green fields with grass and trees about looked blue. Our whitewashed house also had a temporary change of colour. This phenomenon lasted from 6 to 10 a.m."

The same phenomenon seems to have been observed in Trinidad on the afternoon of Sunday, September 2. Mr. J. Arnold, writing to the *Times*, gives the following extract from a correspondent's letter from Port of Spain:—

"We have been having very curious weather; last Sunday, about five o'clock, the sun looked like a blue globe, and with the aid of a small telescope I saw plainly three dark spots on it. After dark we thought there was a fire in the town from the bright redness of the heavens." Mr. Arnold adds: "All my correspondents agree as to the blue colour, and several seem to have noticed the spots. This occurrence, which was held to foretell bad weather, took place three days before the cyclone that swept Martinique."

THE JAVA ERUPTION

THE following details concerning this catastrophe have been sent by Lloyd's agents at Batavia, under date of Sept. 1:—

"The past week is memorable as having witnessed one of the most disastrous and severe volcanic eruptions ever known in the Malay Archipelago. Krakatoa has again been the origin of the disturbance. On Sunday last, about 4 p.m., a series of detonations were heard proceeding apparently from the south-west. Towards night these grew louder, till in the early morning the reports and concussions were simply deafening, not to say alarming. When day broke the atmosphere to the west had a sulphurous and lurid appearance, and a thin layer of fine white ash covered the ground. Towards 9 a.m. the reports died away, but about an hour later dark clouds quite obscured the sky and the sun. A heavy rain of ashes, sulphur, and dust commenced to fall, and at 11 a.m. this town was in pitch darkness and business totally suspended. About twelve o'clock (midday) a large wave about seventeen feet in height swept in from the sea, causing many prows and small craft to be driven ashore, but doing but little damage to the shipping in harbour. This being the dry monsoon, the rivers are low at present. The wave, however, drove an immense volume of water up our rivers, which suddenly rose so high that the banks at the river mouth were flooded and many small crafts stranded. Happily the wave subsided again suddenly, leaving the rivers almost dry, and about one o'clock the rain of ashes subsided and the atmosphere grew lighter. Shortly after 2 p.m., however, another wave, larger than the first, came rolling in from the sea. A few native fishermen were drowned by this wave, and two Europeans at Onrust also lost their lives. At Tandjong Priok the *Princess Wilhelmina* was within an ace of stranding, while some small crafts and prows were cast high up on land. No further damage, however, occurred in Batavia. The eruption, however, so far as we can learn, has had most fatal and disastrous effects all along the south-west coast of Java, and also on the south coast of Sumatra. We shall not probably be in possession of full particulars for some days yet, as telegraph lines are damaged and roads destroyed, but so far we can give the following particulars. The Island of Krakatoa, the summit of which peak was 2600 feet above water level, has totally disappeared below the sea, and the neighbouring Island of Dwaisindeweg is split in five parts. Sixteen new volcanic islands have been formed between Krakatoa and Sibesie, and the sea bottom in the Straits of Sunda has completely changed. In fact the Admiral Commanding-in-Chief has issued a circular stating that till new soundings have been taken the navigation of the Straits of Sunda is likely to be extremely dangerous. Anjer and lighthouse and the other lights of south-west Java have all been destroyed. The subsidences and upheavals we have alluded to caused a large wave about 100 feet in height to sweep down on the south-west coast of Java and south of Sumatra. This wave swept inland for a great distance, thereby doing great injury both to life and property. We are here only twelve miles away from one of the points on which the wave spent its fury. The whole coastline to the south-west has changed its configuration. The inhabitants of the Island of Onrust were only saved from the flood which swept over the island by taking refuge on board two steamers. At Merak Government establishment the inhabitants took refuge on the knoll, 50 feet high, but were all swept off and drowned, with the exception of one European and two Malays, who were saved. Mauk and Kramat, west side of Batavia Roads, have been laid waste, and about 300 lives lost. In Tjeringin only one house has been left standing. Both the native and European officials have perished. A rain of mud also fell at the above place, which is situated opposite to where Krakatoa Island once lay. Anjer seems to have been completely destroyed. Lloyd's sub-agent there wires from Serang: 'All gone. Plenty lives lost.' The dry dock at Amsterdam Island was carried away by the waves, but has since been found stranded in Middleberg Island. The Padang steamer, which left here on Sunday, returned next day to Anjer, only to find the place in ruins. The captain reports that his vessel was in great danger, owing to the eruption from Krakatoa. On his arrival at Telok Betong, his first port of call, the place was found completely destroyed. We understand that it has been submerged, but are not yet in possession of full particulars. We hear that on Monday the whole of West Java, as far as Banding, was shrouded in darkness and covered by ash rains. A telegram just in informs us that the explosions from Krakatoa were heard at Deli (Sumatra), which place is opposite Penang. The Government here, we understand, in the interest of shipping, are sending out steamers to cruise at either end of the Straits of Sunda, to warn vessels to observe caution while passing the Straits, as charts are no longer reliable. According to latest telegram from Serang we learn that in the residence of Tjeringin alone 10,000 lives were calculated to be lost. The Padang steamer just in reports that it is impossible to approach to the place where Telok Betong once was situated, owing to the sea being filled with pumice stone and mud. In some parts of Sumatra Straits the pumice stone is seven to eight feet deep."

THE BRITISH ASSOCIATION

SECTION C—GEOLOGY

On some Fossil Fish Remains found in the Upper Beds of the Yoredale Series at Leyburn, in Yorkshire, by James W. Davis, F.G.S.—The red limestone forms the upper part of the main limestone of Phillips, being separated from it by only one foot of shale or plate. It is about 100 feet below the millstone grits, the intermediate beds being composed of grits and shales with one bed of limestone about 16 or 18 feet thick. A peculiar aggregation of fish remains has been discovered in the red beds by Mr. Wm. Horne of Leyburn. They comprise nearly forty species, the majority of which are peculiar to the beds; others like *Cladodus* and *Petalodus* are common to the Mountain Limestone, and do not appear to differ either in size or otherwise from those of the lower massive limestone. The representatives of the genera *Psamodus*, *Cochliodus*, and *Polyrhizodus*, which are found abundantly in the lower limestone, and are of great size and importance, are in this locality comparatively small and rare, and appear to indicate that the fishes they represent were gradually becoming extinct. Their representatives are not known to occur in the superimposed Millstone Grits either in this locality or any other. There are in addition species of *Megalichthys* and *Pleurodus*, which are characteristic of the coal measures. The presence of so varied a fauna naturally leads to the inference that the circumstances under which they existed were not those usually characteristic of the aggregation of limestones, but rather indicate a shallow or shore deposit with occasional influxes of fresh water. *Megalichthys* and *Pleurodus* are fishes which in the coal measures probably lived in fresh or brackish water; and though they may have been adapted to exist in marine conditions, the occurrence of beds of sand and shale intercalated with the thin limestones of the Yoredales evidently shows the proximity of land, and it is probable that they were carried to their present position by rivers, and there deposited with the marine forms with which they are associated. The supposition that the water was brackish may account for the small size of some of the genera already mentioned and their final extinction in the grits and shales which succeed the limestone. The great fishes whose remains are found in the lower lime-

stone, represented by *Ctenacanthus*, *Orthacanthus*, and others, are absent, the only species hitherto found being those of the curious *Cladacanthus* and *Phytonemus*.

On the Occurrence of the Remains of Labyrinthodonts in the Yoredale Rocks of Wensleydale, by James W. Davis, F.S.A., F.G.S.—Some bones of the leg of a Labyrinthodont were discovered by Mr. Horne and described by Prof. L. C. Miall in the *Quarterly Journal of the Geological Society*, vol. xxx. p. 775. They were found in a dark-coloured flagrock above the Harmby Quarry, which also extends with an easterly dip to the Harmby railway cutting. The same flagrock is also found behind Leyburn and the Shawl, and in that locality it has been extensively quarried. In addition to the leg-bones already mentioned, others have been found in the same flagrock, but separated by considerable distances, so that it is not probable that they belonged to the same Labyrinthodont. In the railway cutting a portion of a cranium was found. It is 1·9 inch in length and 1·4 in breadth. A number of sutures, not very well defined, seem to indicate that the bone constituted the back part of the skull. The third specimen was found in the quarries beyond the Shawl north-west of Leyburn, and exhibits casts of the jaws of another Labyrinthodont. Each ramus is about three inches in length; they have been disturbed and displaced. The external surface of the jaws was ornamented with a reticulated arrangement of tubercles, an impression of which is preserved in the specimen. Along the margin of the impression of the alveolar portion of one of the rami there is a series of impressions which appear to have been caused by small pointed teeth.

Section across the Trias recently exposed by a Railway Excavation in Liverpool, by G. H. Morton, F.G.S.—During the last eight years a very important section of the Triassic strata has been exposed in Liverpool, by excavations for widening the line of the London and North-Western Railway Company. The section presents a solid mass of sandstone on both sides of the new railway cutting from Lime Street Station to Edge Hill Station, a distance of 2300 yards from east to west. The height of the rock on each side varies. The strata exposed belong to the Keuper and Bunter formations. The Pebble Beds of the Bunter crop out for 914 yards along the east of the cutting, but do not contain any marl partings, and not a single pebble of any kind has been noticed. Only two faults occur along the whole length of the Pebble Beds exposed, and they are of very little importance. The subdivision ends at Smithdown Lane, where there is a fault with a downthrow to the west, which brings in the upper mottled sandstone, the highest member of the Bunter formation, where it is not represented on the map of the Geological Survey, or the fault recorded. The Upper Mottled is a fine-grained, soft, bright red sandstone with grey streaks, and as it readily crumbles into sand is never hard enough for building purposes. It crops out to the west from Smithdown Lane to University College, when a fault throws down the strata about 600 feet and brings in the Keuper sandstone, which is 400 feet thick, and interstratified with thin beds of marl. The highest beds of the Keuper are at the College; lower strata containing the beds of marl crop out from beneath, and are thrown down to the west by faults three times in succession, when the basement beds crop up in Lime Street Station. The section shows that all the faults throw down the strata to the west and bring in higher beds in that direction. It also shows the exact position of the fault between the Bunter and Keuper formations, which was not known before. The position of the Keuper, as a wedge-shaped mass of sandstone, with the Bunter formation faulted against it on the east and west, is of great local interest, and it is easy to understand how the succession of the strata has not been satisfactorily explained before in the absence of any such a continuous section as that described. The remarkable absence of faults in the pebble-beds has an important bearing on the construction of the Mersey Tunnel, which will have to be carried through these beds along its entire length. The section shows that while faults are numerous in the Keuper sandstone, which was frequently fractured during subsidence into a depression, the pebble-beds are very little faulted. A few days ago, when under the Mersey, I did not find a single fault either in the tunnel or in the heading beneath.

Recent Opinions on the Loess Deposits of the Valley of the Rhine as Evidence of a "Great Post-Glacial Flood," by Mark Stirrup, F.G.S., adversely criticises recent opinions of Mr. H. H. Howorth, F.S.A., as to the mammoth in several of the superficial deposits proving a "great Post-Glacial flood." The facts connected with the loess deposits of the Rhine Valley are not consistent with the interpretation given to them by Mr. Howorth, nor is the assumption that the materials of the loess were derived from volcanic mud-streams borne out by the evidence. The author considers Mr. Howorth has failed to prove his postulate that not only the extinction of the mammoth but the existence of several superficial or Post-Glacial deposits were due "to a sudden catastrophe involving a great diluvial movement which extended over the larger part of the northern hemisphere, and accompanied by an equally sudden and violent change of climate," and the author considers the whole of the evidence adduced by Mr. Howorth as unsound and inconclusive. He regards Mr. Howorth's attempt to resuscitate some of the obsolete doctrines of Cuvier and Buckland as a retrograde movement in the history of geology.

Master Divisions of the Tertiary Period, by Prof. Boyd Dawkins.—The classification of the Tertiary rocks sketched out some fifty years ago and since then altered in no important degree is out of harmony with our present knowledge, and the definitions of the series of events which took place in it has been greatly modified by the process of discovery in various parts of the world. The terms Eocene, Miocene, and Pliocene no longer express the idea of percentages of living species of fossil mollusca upon which they were founded, and Post-Tertiary, Quaternary, and Recent are founded on the assumed existence of a great break comparable to that separating the Secondary from the Primary or Tertiary periods which is now known not to exist. The author proposed a classification of the Tertiary period in Europe, by an appeal to the land mammalia, and since that time his definition has been found to apply equally well to the Tertiaries of Asia and the Americas and to the late Tertiaries of Australia. He stated that the forms of life in the rocks have changed at a very variable rate, and in direct proportion to their complexity of organisation, the lower and simpler having an enormous range, while the higher and more complex have a much narrower range and are more easily affected by the change in their environment.

On a Boulder from the Chloritic Marl of Ashwell, Herts, by H. G. Fordham.—Boulders found in these marls, in the so-called coprolite workings in Cambridgeshire and the neighbouring counties, are usually little more than pebbles. The boulder now described measures $12 \times 9\frac{1}{2} \times 5\frac{1}{2}$ inches. It is somewhat triangular in general form, and is much rounded and worn. The material, according to Prof. Bonney, is a quartz-felsite. The author attributes its origin to its being brought to its present position by floating ice.

Preliminary Note on the Further Discovery of Vertebrate Footprints in the Penrith Sandstone, by G. V. Smith.—The specimens were obtained from a quarry opened out by the Settle and Carlisle Railway, situated on the slope of the hill, north of the highway from Penrith to Alston, and about three and a half miles from Penrith, the sandstone is strongly current bedded, and is largely used for building purposes; these sandstones are older than the magnesian limestone. The impressions indicate several distinct forms of vertebrates.

On a Supposed Case of Metamorphism in an Alpine Rock of Carboniferous Age, by Prof. T. G. Bonney, M.A., F.R.S.—At the base of the Carboniferous series in some parts of the Western Alps is a conglomerate called the *Poudingue de Val Orsine*, the matrix of which abounds in mica, and is supposed by some geologists to exhibit true foliation. In the Alps there is always an abrupt transition from the comparatively unmetamorphosed rocks of known geological age to the true schists and gneisses of unknown but certainly far greater antiquity, and nothing short of the clearest proof would justify us in considering any of these crystallised foliated rocks as altered Devonian or Silurian, even though the latter term be used in its most extended sense.

On the Geological Age of the North Atlantic Ocean, by Prof. Edward Hull, LL.D., F.R.S., &c., Director of the Geological Survey of Ireland.—In this paper the author made use of three leading formations as factors in his inquiry, viz. the Archæan (or Laurentian), the Silurian (chiefly the Lower Silurian), and the Carboniferous. He considers that throughout the Archæan, or Laurentian, the Lower Silurian, and the Carboniferous epochs, the regions of North America, on the one hand, and of the British Isles and Western Europe were submerged, while a large part of the North Atlantic area existed as dry land, from the waste of which these great formations had been built up; and he urged that if such were the case, the doctrine of the permanency of oceans and continents, as tested by the case of the North Atlantic, falls to the ground.

Dyas versus Permian, by Rev. A. Irving, B.Sc., F.A.,

F.G.S.—This subject is brought forward for discussion both as having a special local interest, and on account of the international importance of the subject in view of the Berlin Congress next year, and the progress of the geological map of Europe. The author, referring to previous papers in the *Geological Magazine* during the year 1882, in which strong reasons were given for abandoning the threefold division of the so-called Permian system, and to the discussions raised in the same periodical, maintains that the "Permian system" of Murchison, which represents the group of strata as marked by three stages, is inapplicable to the English rocks of Post-Carboniferous age. The term "Permian" has only a local and subordinate value, and scarcely applies even to the whole Russian area in which these strata are developed. He considers that the application of the "Permian system," as propounded by Murchison, to the Post-Carboniferous rocks of Central Europe is no longer tenable, any more than is its application to the British series, as the author has shown elsewhere.

On the Coloration of some Sands, and the Cementation of Siliceous Sandstones. By the Rev. A. Irving, B.A.—In the first part of this paper attention is drawn to the occurrence of certain green-coloured sands which are frequently met with below the peaty layers, at the heads of the small valleys, in the Upper Bagshot sands. The local and exceptional nature of these green deposits, and their relation to the decomposing vegetal matter which has overlain them for a long period of time, suggest the connection of the green colour with the decomposition of vegetation. Chemical analysis of these sands shows that the green colour is in no way connected with any of the ordinary green minerals which enter into the formation of rocks, but reveals the *organic* origin of the colouring matter. In the second part of the paper attention is drawn to some recent investigations by the author of the origin of the siliceous cementing material of the sarsen stones.

Note on the Nagel Flue of the Rigi and Rossberg. By Prof. T. G. Bonney, M.A., F.R.S.—The author called attention to the following points in regard to the conglomerate of these mountains:—(1) That the pebbles were not seldom indented by mutual pressure; (2) that the pebbles in this district consisted mainly of grits and limestones from the Secondary and perhaps early Tertiary series of the Alps, with a variable amount of a reddish granite (of whose locality he was ignorant). He considers there was a close analogy between the Bunter conglomerate and the nagel flue, the former also resembling the British Old Red Sandstone, and a part of the Calciferous sandstone series in Scotland. As these three were admittedly freshwater deposits, he argued that the Bunter series (the parts of which had some resemblance to the ordinary molasse) should be reckoned among the true fluviatile or fluvio-lacustrine deposits.

Notes on Geological Sections within Forty Miles' Radius of Southport. By C. E. De Rance, F.G.S.—The sections in Silurian works of the Lake District and North Wales within the radius are described, also those in the Carboniferous limestone, coal measures, Permian, and the Triassic rocks, especially the Keuper sandstones and worls around Southport. The sections in the glacial drift of West Lancashire and Cheshire are mentioned, and the sequence and character of the overlying post-glacial beds. Southport is built upon blown sand resting on peat, which is 79 feet below the surface at the sea-coast, rising inland to the surface; the whole series rests on the Keuper marls, which have been bored into to a depth of 187 yards at the Palace Hotel, Birkdale, without finding the base. Fragments of gypsum and pseudomorphous crystals of salt occurred in the boring. The section in the Mersey tunnel, now in course of erection, was alluded to.

On the Pre-Cambrian Igneous Rocks of St. David's, by Prof. J. F. Blake, M.A., F.G.S.—The rocks below the Cambrian conglomerate have been described by Dr. Hicks as bedded rocks belonging to three distinct periods. The same rocks have been recently asserted by Dr. Geikie to be partly Cambrian and partly intrusive. The author contends that they are Pre-Cambrian in age, but form a very complete volcanic series, which may well be designated the Dimetian. The basis of the series is the Dimetian granite, serving as the core. This is surrounded by the more acid rocks, as the quartz-felsites and the felspar porphyries (the so-called Arvonian), and the more outlying portions consist of very varying materials, chiefly rough ashes or agglomerate breccias—on the east side finely bedded "halleflintas," and on the north side many basic lava flows. These are the so-called "Pebidian." The arrangement of these rocks shows the characteristic irregularity of volcanic rocks, and though many portions are bedded, they have no dominant strike over the whole district. The Cambrian series commencing with the conglomerates is quite independent and hangs together as a whole. In no case can a continuous passage be proved from the one series to the other; the junction is in most cases a faulted one, and at the places where this is not so, the conglomerate lies on different beds of the volcanic series.

On a Coral Atoll on the Shore Line at Arvigland, near Dumfries, Scotland, by James Thomson, describes a band of Carboniferous limestone, with corals of several genera, which form seventeen coral reefs, extending through a depth of 400 feet of strata.

On the Former Physical Condition of Glendale, Northumberland, by G. P. Hughes, describes the River Till, as once filling this valley, and forming a lake, on the site of which occurs peat, forest beds, grey clays, with *Bos urus*, *Cervus megaceros*, and red stag, and gravels, resting on boulder clay.

Additional Notes on Anthracosaurus Edgei, by W. H. Baily, describes a large Sauro-Batrachian from the lower coal measures, Jarrow Colliery, near Castlecomer, co. Kilkenny.

On Basalt apparently overlying Post-Glacial Beds, co. Antrim, by W. T. Knowles, describes a mass of basalt twenty yards in length, lying on sands and gravels; probably is a glacial erratic.

On the Geological Relatives and Mode of Preservation of Eozoon Canadense, by Principal Dawson.—The oldest known formation in Canada is the Ottawa gneiss, or fundamental gneiss, a mass of great but unknown thickness and of vast area, consisting entirely of orthoclase gneiss imperfectly bedded, and destitute of limestones, quartzites, or other rocks, which might be supposed to indicate the presence of land surfaces and ordinary aqueous deposition. It constitutes the Lower Laurentian of Logan, and may be regarded either as a portion of the earth's original crust, or as a deposit thereon by aqueo-igneous agency, and without any evidence of derivative deposits. Succeeding it is a formation of very different character, though still belonging to the Lower Laurentian of Logan. It may be named the Glenville series, and includes beds of limestone, quartzite, tin ore, graphitic and hornblendic schists, with local beds of pebbles; it is in one of these great limestones that Eozoon occurs. The Grenville series give distinct evidence of ordinary atmospheric erosion of the older rocks, and of ordinary aqueous as well as organic deposition. The author hopes to exhibit specimens, now in the McGill University, to the Association.

On the Topography and Geology of the Troad, by T. S. Diller.—The Liparites are older than the Andesites, rocks that are probably pre-Cambrian from the base of the older sedimentary rocks, which are much altered and often highly crystalline. The more sedimentary rocks are also partially crystalline; they are less important in determining the physical geography. Positions of streams have varied much, but the coast-line has probably changed little since the days of Troy. Mount Ida is an anticlinal with a very short axis, and is almost a dome, the summit of which has been denuded.

SECTION D—Biology

Department of Zoology and Botany

On the Origin and Development of the Rhinoceros Group, by Messrs. Scott and Osborne.—The very extensive series of Tertiary lake deposits in the north-western United States have afforded these gentlemen material for some generalisations on this subject. Their conclusions are as follows:—That from the Rhinoceros group of the Middle Eocene there diverge three distinct lines, one represented by the forms still living in the Old World, the other two exclusively American and extinct. The first of these lines is continued into the Upper Eocene formation by the genus Amynodon. In this form the rhinocerotic features of the skull are slightly more marked; the lower canines are somewhat more procumbent and have caused the atrophy of the lower incisors. The digits are four in the manus and three in the pes. In the Lower Miocene follows the genus Aceratherium, which, retaining the number of digits found in Amynodon and many lophiodont skeletal characters, is yet an unmistakable rhinoceros. From Aceratherium, again, we get two diverging lines, one belonging to the Old World, the other to the New. These authors think that very probably Aceratherium originated in America, and migrated to Asia in early Miocene times. In the Old World it gave rise to the horned series of genera, probably beginning, as suggested by Cope, with

Ceratorhinus. In America are found a number of large rhinoceroses in the Loup Fork deposits of the River Platte, which are variously designated as Uppermost Miocene and Oldest Pliocene. These have left no successors unless *R. inenius* of Le Gros should turn out to be an Aphelops. In brief, the rhinoceros line branched off from the Lophiodontidæ in America during the Middle Eocene, in early Miocene times the genus Aceratherium migrated to the Old World, and there gave rise to the horned genera, which still live there, as well as the larger species which became extinct in the Post-Pliocene. The second line mentioned is represented by the curious genus Diceratherium. The third line is that of Hyracodon, small hornless animals of the Miocene. This retains the full set of incisors and canines in both jaws, but with rhinoceros-like premolars and molars. Many lophidont characters are still retained.

The Polymorphism of Alcyonaria, by Prof. Marshall.—The author directed attention to the occurrence of tentaculato-zooids in two members of the group Pennatulidæ—the first the variety of *Pennatula phosphorea*, known as aculeata, and the second a new species of Umbellula, *U. gracilis*, obtained in the Faroe Channel during the *Triton* dredging expedition in 1882. In the first case the tentacles, which vary from one to five in number, are fused together to form a conical spine strengthened by very stout calcareous spicules, and projecting a considerable distance beyond the mouth. In the case of *U. gracilis* the tentacle is single, and differs from that of all other pennatulid zooids in presenting a fringe of pinnules along each side identical with those of the typical polyps. The morphological importance of this unitentacular condition was discussed at some length, the single tentacle being shown to have constant anatomical relations and to correspond to the single tentacle present in the young embryos of *Actinia mesembryanthemum*. In conclusion, arguments were adduced against Prof. Kölliker's statement that Umbellula is one of the more primitive genera of Pennatulidæ.

The Differences between the Males and Females of the Pearly Nautilus, by Mr. A. G. Bourne, B.Sc.—The author bases his observations upon the dissection of two specimens, male and female respectively—both adult and well preserved—of *N. pompilius* obtained by Prof. Lankester for the museum at University College, and a specimen of *N. macromphalus* placed in his hands for examination by Prof. Hubrecht, of Utrecht University. The author regards the tentacular lobes as homologous with the arms of a Dibranch, while the tentacles probably represent the suckers, this view, which has already gained considerable ground, receiving very strong support from the hectocotylised condition which the author describes. Eight tentacular lobes may be recognised, four internal, two superior, and two inferior, the latter two being fused together, and four external, the two superior being fused to form the "hood," and the two inferior completing the external ring. In the male four tentacles of the left superior internal lobe become hectocotylised, while the corresponding four upon the opposite side exhibit an exactly similar modified condition, though in a very slight degree, forming a most interesting example of a "rudimentary organ." In the male the inferior internal lobes are present in a very much reduced condition.

Budding in Polyzoa, by Prof. Haddon.—This author asserted that according to most observers the buds in ectoproctous Polyzoa are derived solely from the endocyst, or according to Joliet, from the endosarc (funicular tissue). It is possible that a combination of these views may be the more correct, since the development of the bud itself appears to prove that several distinct tissues are implicated, and that as a matter of fact all the three embryological layers are concerned in this process.

On a Young Specimen of the Grey Seal (H. gryphus) from Boscastle, Cornwall, by Prof. Lankester.—Prof. Lankester had the good fortune to find a specimen of this seal at the above place about a fortnight ago. He carried it about a quarter of a mile to a more sheltered place, but found it in the original place the next morning. As the specimen was not more than twenty-four hours old, was very weak, and could not swim, it is very probable that the mother had carried it during the night. The animal was taken and fed on milk; he was sent to the Zoological Gardens, and when last heard of was doing well. Mr. Cordeaux said it was extremely interesting that this specimen had been found, as previously it had not been seen so far south. Prof. Moseley remarked that the dislike of young seals to the water had probably some connection with their descent from ancestors which inhabited the land quite as much as the water.

On Wool Plugs and Fertilised Fluid, by Mr. Duncan Matthews.—This paper describes in detail a series of experiments undertaken with the object of testing the filtering action of cotton wool plugs upon the atmosphere, and the consequent possibility of permanently preserving fluids sterilised in flasks plugged with wool. The author found, after a long series of experiments, that sprayed water carrying germs could pass through wool plugs as well as between it and the glass, when an inward current was produced by the cooling of the flask. He therefore sees no reason why air should not in the same manner carry germs through or alongside the wool. As an experimental fact, he found this to be so in a very large percentage of his experiments. All the experiments related to one kind of bacterium, the hay-bacillus.

The President then introduced the next four papers, which all related to various phases of the germ-theory, by a few remarks on bacteria. Micrococcus, bacillus, spirœchœte, spirillum, and leptothrix were briefly spoken of, and the terms saprogenous, cromogenous, and pathogenous explained; the first of these papers was then read.

On the Germ Theory of Disease from a Natural History Point of View, by Dr. Carpenter.—Dr. Carpenter stated that many of the existing genera and species of animals and plants were altogether uncertain, that as fresh knowledge was gained, so it was found necessary to modify our accepted views; this especially holds good with genera which have great power of adapting themselves to various circumstances, and which consequently produce numerous variations. This power of modification, the author stated, was much more marked in the lower than in the higher forms of either kingdom, and was especially found in bacteria. The author then cited the case of the germ producing smallpox, in which he stated the germ had undergone such a modification, that whereas two centuries ago the disease was very severe, and known as "black-pox," it now existed only as a mild disease. During the last siege of Paris, however, the conditions were such that the germ reverted to its original form, and produced the same severe disease as two centuries ago. Many facts were brought forward to confirm this view.

On some Cell Contents in Coffee and other Plants, by Marshall Ward.—The author has for some time past been engaged in researches among the fungi, particularly those which attack living plants; and his attention was necessarily directed to cell contents of the host plants; among others the cells of *Coffea*, *Cinchona*, *Pavetta*, and *Canthium*, and one or two cryptogams have received special attention. The present paper refers particularly to one class of bodies found in the cells of the cultivated species of *Coffea*—*C. arabica*, *C. liberica*, &c. Certain fatty bodies, mixed with proteids, found in the endosperm, are traced into the embryo and seedling, and their reactions and changes noticed. In the leaves, cortex, and other soft parts of the mature plant are found "fat-bodies," under circumstances which compel the author to conclude that they are the result of constructive activity, and not products of destructive metabolism. These "fat-bodies" consist of varying mixtures of fats and other substances, probably, in part, proteid, and show considerable similarity to the fatty masses of the endosperm. Details are given of their reactions and changes, and the author believes that they represent temporary stores, to be worked up further in the construction of higher bodies.

On the Closed Condition of the Seed-Vessel in Angiosperms, by Alexander S. Wilson, M.A., B.Sc.—Flowering plants may be divided into two classes, according as their seeds are contained within a closed seed vessel, or are exposed without any such covering. The former, having their seeds included in a pod or pistil, are called Angiosperms or cover-seeded; and the latter, on account of their naked seeds, Gymnosperms. The Angiosperms, which form by far the more important division, embrace most of the common plants which make up the bulk of our flora, and are universally regarded as the more highly organised of the two. Corresponding to the lower degree of organisation, Gymnosperms (yew, cypress, fir, &c.) appear earlier in the geological strata, and are largely represented in a fossil state. The pod of an Angiosperm, such as that of a wall-flower, is composed of metamorphosed leaves termed carpels. In nearly every instance these leaves are so united as to form a completely closed case enveloping the young seeds. At first sight it would seem as if the presence of such a covering were a disadvantage, for before the young seeds or ovules can develop to maturity they require to be fertilised. The process of fertilisation is effected by the agency of pollen dust, which is brought to the flower either by the wind or by insects visiting the flower in search of honey. Now in the case of Gymnosperms, where the seeds are exposed uncovered, this pollen dust,

if blown by the wind, simply alights on the surface of the seed and fertilises it directly. In plants with covered seeds, on the other hand, the pollen cannot gain direct access to the ovules, but can only fall on the surface of the envelope formed by the carpellary leaves. This covering has to be penetrated before fertilisation of the seeds can be effected. For this purpose several adaptations of tissues, modifications of structures, and changes in the position of the ovules are rendered necessary, all of which might easily be dispensed with were the seeds exposed as they are in Gymnosperms. It can hardly be supposed that all this specialisation, whereby the process of fertilisation so simply performed in Gymnosperms becomes complicated by being broken up into numerous subsidiary processes, should be called into play unless some very important end were to be attained by the presence of a completely closed pistil. What then is the *rôle* of the pistil? The young seeds are the most vital parts of the vegetable organism. Composed of delicate cells, containing much nitrogen and phosphorus, they may be said to constitute the chemical and physiological wealth of the plant. On this account they must be carefully guarded from any external influence that would degrade their chemical constitution or lead to a misappropriation of the nutritious matters they contain. Now it is well known that the leaves and stems of nearly all plants are subject to the attacks of parasitic fungi. The spores of these parasites germinate on the leaves of the plant on which they alight, and appropriate its juices to their own use, as, for example, in the case of the fungus which occasions the potato disease. All kinds of moulds, putrefaction, and fermentation are in like manner produced by the development of spores falling from the atmosphere which have found a favourable soil for their growth. Now a more suitable pabulum or nidus for the growth of mould germs can hardly be imagined than that which would be afforded by the immature ovules, seeing that in them is collected a large amount of easily assimilable matter destined for the nutrition of the embryonic plant. There can be little doubt then that the disadvantages which the pistil brings with it, and the higher organisation thereby entailed, are more than compensated for by the security which it gives against the entrance of fungus spores. The pea pod is in fact the counterpart of the hermetically sealed or stoppered flasks, in which Tyndal and Pasteur performed their well known experiments on the preservation of organic fluids against putrefactive changes. These observers found that it was possible to preserve beef tea or other organic infusion for any length of time, provided no air was admitted to the flask, or if care were taken to filter the air from all organic germs by passing it through cotton wool, &c., before allowing it to have access to the infusion. The pistil of a flower then may be regarded as analogous to the flask in these experiments. The loose cellular substance of the style, and the acid secretion on the stigma, may in like manner serve to filter the air before it reaches the ovules contained within the ovary. At any rate the air must pass through the substance of the carpels before it can reach the ovules.[1] When this fact is viewed in connection with the experiments of Van Tieghem, which show how difficult it is to effect the direct fertilisation of ovules with pollen, owing to the constant appearance of microscopic fungi, a new light is thrown on a vast number of vegetable and animal structures. The same principle operates not only among phanerogams, but even among the cryptogams; nor could a principle of such general application in the vegetable world have failed to play an important part in the animal kingdom. It is remarkable then to find that within the cup of the commonest wild flower we have the results of recent scientific research anticipated, the benefits of the antiseptic system as completely secured as by modern surgery, and a parallel between nature and art which agrees even to the minutest detail.

Protoplasmic Continuity in the Florideæ, by Thomas Hick, B.A., B.Sc.—The author has made an extensive series of observations on a large number of species belonging to the more important genera of Florideæ, with special reference to the question of protoplasmic continuity. He finds in all the species examined that there is such a continuity, and that of the clearest and most definite character. In the simpler filamentous types, such as *Petrocelis cruenta* and *Callithamnion Rothii*, the protoplasm of each cell is united with the protoplasm of contiguous cells by means of a fine protoplasmic thread. This obtains throughout the whole plant. In the more complex types, such as *Callithamnion roseum*, *C. arbuscula*, and *C. tetragonum*, the arrangements for continuity are of a more elaborate character. The contents of the axial cells are not only united with one another, but also with those of the cortical cells, however numerous these may be. The cortical cells also display continuity *inter se*. *Ptilota elegans* is a most instructive form, as here the connective threads may be easily traced from the tips of the ultimate branchlets to the base of the stipes of the frond. As the threads become older, they increase in thickness, thus showing that they are not merely temporary or effete structures. On the stouter connecting cords a sort of ring or collar is developed at about the middle point, and over this is stretched, *in some cases*, a delicate diaphragm. The behaviour of both ring and diaphragm when treated with microchemical reagents, is similar to that of the ordinary protoplasm.

On Peripatus, by Adam Sedgwick.—Mr. Sedgwick showed living specimens of this animal, and briefly described them.

Some newly-discovered Localities of the Rare Slug Testacella haliotoidea, by E. J. Lowe, F.R.S.—This rare and hitherto extremely local nest-eating slug has recently been found in various places in Monmouthshire and South Wales. Shirecester Hall, Shirenewton Village, Tatton Court, Hardwick, Chepstow, Cardiff, and various other places, were mentioned as producing more or less abundant quantities of this interesting creature.

Department of Anatomy and Physiology

On the Relations of Protoplasm and Cell-wall in the Vegetable Cell, by F. O. Bower.—After tracing the history of this subject, it was concluded that it has now been demonstrated with as much certainty as is possible by the use of microchemical and staining reagents, that in certain cases, the number of which is now constantly being increased, there is a direct connection between the protoplasmic bodies on opposite sides of cell-walls, and that this connection is established by means of fine strings of protoplasm which, in the cases observed, run nearly transversely through the walls. The question remains whether this is the *only* mode of permeation of the cell-wall by protoplasm. The author could not accept it as proved as yet that any further permeation of the cell-wall by protoplasm, as a reticulum or otherwise, really exists, but he brought forward certain grounds for regarding such a permeation as possible or even probable, taking into account chiefly those phenomena observed in *free cell-walls*, in order thereby to avoid any confusion with connecting strings, such as those already proved to exist:—1. The strings already observed vary greatly in thickness, from the well marked to the indistinguishable; thus we have evidence of the existence of strings which would probably not have been recognised were it not for comparison with other examples. Further, it has been shown, in the author's paper on plasmolysis, that protoplasm may be drawn out into strings so fine as to defy definition even by high powers of the microscope; thus there can be no objection on the ground of the small size of the hypothetical strings or reticulum. 2. Those cases in which a perforation of cell-walls has been demonstrated are those very cases in which a most efficient physiological connection is required. There is no reason why a less obvious permeation should be denied where the requirements are less, but by no means absent. 3. There is *a priori* probability of some form of permeation of cell-wall by protoplasm if Strasburger's account of the growth of cell-walls be correct. 4. A strong argument in favour of such general permeation of walls by protoplasm is found in the existence of important chemical changes in the substance of certain cell-walls *at points at a considerable distance from the main protoplasmic body*, *e.g.* formation of cuticular substance, wax, &c., which differ fundamentally from cellulose, are insoluble in water, and are apparently formed *in the wall itself*. The tendency of recent observations is to show more and more clearly how close the connection of protoplasm with the important chemical changes in the plant is; thus it appears probable that protoplasm is present in some form or other in the cell-wall. Reasons were also given for thinking that the exposure to air is not an important factor in the above changes. These and other considerations show that though this permeation of the wall cannot be accepted as proved as yet in any one case, still the subject deserves more close attention than it has yet received, while it may be expected that the application of new methods may produce definite results bearing on this very important question.

On the Occurrence of Chlorophyll in Animals, by C. A. MacMunn, M.D., F.C.S.—The difficulties attending the recog-

[1] This view of the function of the carpels is corroborated by the fact observed in the case of Reseda, the carpels of which open soon after fertilisation. After dry weather an accumulation of sand and dust frequently takes place within the ovary of Reseda.

nition of chlorophyll in animals was first referred to, and the writer stated that he had based his conclusions as to the identity of animal and vegetable chlorophyll on the fact that the wave-lengths of the centres of the bands of the same solutions of animal and vegetable chlorophyll are the same, and that the wave-lengths of the centres of the bands are the same when the same reagent is added to the respective solutions. Without committing himself to accepting the views of Kraus or Sorby, he applied the term chlorophyll to that colouring matter, or mixture of colouring matters, which can be extracted out of green leaves, such as those of *Primula*, by means of alcohol or alcohol and ether. The colouring matter, to which the writer has given the name "enterochlorophyll" (*Proc. Roy. Soc.* 226, 1883), and which can be extracted from the liver or other appendage of the enteron of invertebrates, was shown to be probably produced by, and in, the body of the animal, and for certain reasons (detailed at length) not food chlorophyll. The absence of parasitic algæ in sections of the livers of certain mollusks which yield enterochlorophyll shows that this pigment cannot be due to their presence. The writer further showed that Pocklington's observations, published in the *Pharmaceutical Journal* (1873), on the presence of chlorophyll in the wing-cases of Cantharides beetles, could be verified, and he had succeeded not only in verifying the presence of the principal chlorophyll band in the ethereal, chloroformic, and alcoholic solutions of the wing-cases, but the changes produced in the spectra of these solutions on the addition of certain reagents showed the presence of a body indistinguishable from vegetable chlorophyll. Hence Leydig's conclusion as to the presence of that colouring matter in insects was proved to be correct. However, in the case of green larvæ the mere occurrence of a band in red when a strong light is concentrated on the integument may be merely due to the presence of food chlorophyll in the intestine, for, on squeezing out the contents of the latter, the green colour and the band both disappear. The function of chlorophyll was then referred to: it was shown that it could hardly be of much use in respiration, as oxidising and reducing agents do not affect it; that for protective purposes or in mimicry a body of less complex chemical composition might answer equally well, except that the eyes of some invertebrates may be more susceptible to rays of light of a certain wave-length than our own, especially as Sir J. Lubbock has shown that ants perceive the ultra-violet rays of the spectrum which are invisible to us. It may possibly be the persistence of a pigment which was once useful in a remote ancestor in some cases, perhaps at a time when the atmosphere contained much more carbon dioxide than at present. Or again, it may be of use in absorbing the chemically active rays of the spectrum when occurring on the surface of an animal, especially as Zimiriazeff had shown that Langley's observations with the bolometer have proved that the point of maximum energy of the solar spectrum corresponds with the principal chlorophyll band between B and C. In the case of enterochlorophyll this colouring matter may be of use in furnishing material for the construction of other colouring matters, especially as this body and hæmochromogen exist side by side in the bile of some mollusks; and in the bile of the sheep and ox a body exists which fluoresces red and resembles chlorophyll closely, but possesses at the same time some properties which show that it is a hæmoglobin derivative, as proved by the writer (*Proc. Roy. Soc.* No. 208, 1880, and *loc. cit.*). The conclusions which had been arrived at gave support to the view which Prof. Lankester had maintained, namely, that chlorophyll may occur quite independently of the presence of parasitic algæ, as in *Spongilla* and *Hydra*, and that it is in some cases produced synthetically by and in the bodies of animals.

On the Intercellular Connection of Protoplasts, by Prof. W. Hillhouse.—In this paper the author gives the results of a large number of observations to prove the intercellular connection of protoplasm. Out of twenty-two plants examined, these connections were only found in the cortical tissue of *Ilex aquifolium* and *Æsculus hippocastanum*, the pulvinus of *Prunus laurocerasus*, and the winter bud pith of *Acer pseudoplatanus*; he, however, points out that these connections are easily broken in preparation, and that a single connection between a number of cells would be sufficient to produce a perfect unity of action. His conclusions are:—1. That protoplasmic threads connecting neighbouring protoplasts are present in such widely different and diffused structures as sieve-tubes, cortical parenchyma, leaf-pulvinus, pith of resting leaf-bud, and endosperm of seeds. 2. That in the contraction of the protoplast in natural plasmolysis these threads would normally remain unbroken. 3. That they *may* serve to transmit impulses from one cell to another, acting in this way somewhat like a nervous system. 4. That besides the perforating threads, equally widely spread and much more numerous, are threads which attach the protoplast to the cell-wall, whether at the base of pits or otherwise, and that these threads are often opposite each other. 5. That the closing membrane separating two threads often shows differentiation, which suggests permeability, if not "sieve perforation." 6. That in the contraction of the protoplast in natural plasmolysis these threads would naturally be unbroken. 7. That these threads may, when in extension, act upon the cell-wall and put it in a state of slight positive tension. 8. That the presence of minute perforations communicating from cavity to cavity of living cells *would* not, and when communicating with the intercellular spaces *need* not, be a hindrance to the turgipotence of the cells.

On the Continuity of Protoplasm through the Walls of Vegetable Cells, by Walter Gardiner.—The author, after briefly reviewing the work which has already been done in this department, goes on to describe his own experiments with Mimosa, Robinia, Dionæa, and other sensitive plants, and with thickened endosperms in general. In all organs of movement examined, the freely pitted parenchymatous cells were found to communicate with one another by means of delicate protoplasmic threads, which perforate the closing membranes of the pits. The author remarks that the existence of a communication between adjacent cells appears to be very wide, if not of universal occurrence. His own observations, extending over a series of fifteen species of palms and representatives of some thirteen orders, were all found to bear out the above researches, as in all cases definite and well pronounced continuity existed.

On the Muscular Movements that are associated with certain Complex Motions, by R. J. Anderson, M.A., M.D.—When a muscle contracts, one extremity or both extremities may move. When one extremity moves whilst the other is fixed, the fibre may describe a plane surface, as when the moving end lies in a right line or a cone, as when the moving extremity lies in the circumference of a circle or other plane curve. If the fibre lie in the plane of the circle, the cone will be reduced to a plane. Where both extremities move, the fibre may describe a plane, or a cylinder, or a ruled surface of a high order. It frequently happens that when one extremity of a fibre is fixed the other extremity moves in a circle, which itself experiences a movement of translation. The moving point then describes a trochoid, examples in pronator teres and pectoralis major. Muscle fibre may describe curves of a complex nature, although the muscles themselves form a simple surface, as in the two muscles already cited.

SECTION G—MECHANICAL SCIENCE

A Comparison of Morecambe Bay, Barrow-in-Furness, North Lancashire, West Cumberland, &c., in 1836 and 1883, by Hyde Clarke.—The writer gave an account of his plans and surveys in 1836 for forming a through line of railway from Lancaster, through Furness and West Cumberland, across the Solway to Dumfries, and thence to Glasgow, by the course now adopted by the Glasgow and South-Western Railway. The chief feature was the passage and embankment of the large estuaries called Morecambe Bay. The history of this undertaking was given, with details of the plans of Messrs. Hyde Clarke, George Stevenson, Hayne, Rastrick, &c., and the works carried out by Mr. James Brunlees. The plans of the Warton Land Company were described. The effect of the undertaking in the development of Barrow or Foudrey and the iron manufacture of Furness was illustrated. There were still 40,000 acres to be reclaimed, and capable of becoming good agricultural ground. If reclaimed it would enable a railway to be carried across the bottom of the Bay. There was now a population of 50,000 in Barrow, and although there had been great depression there were elements which pointed to a probable increase of from 100,000 to 200,000 persons.

The Term "Stability," as used in the Literature of Naval Architecture, by Prof. Osborne Reynolds.—The author explained that the origin of the paper had been the report and discussion which had taken place in regard to the lamentable disaster which happened to the *Daphne*. Stability meant a state of being able to maintain a particular position against any forces which tend to upset; or another way of expressing the same thing was a state of ability to maintain a position after being disturbed and allowed to go free to recover itself again. It appeared from

the report of Sir E. J. Reed on the *Daphne* disaster, and the discussion which resulted, that naval architects were using the term stability both in its proper sense, as meaning a tendency to hold a particular position, and also as meaning a tendency to change position in a particular direction. The writer of the paper proceeded to urge the desirability of using two terms, the one to express the greatest angle of disturbance from which a vessel would return to her normal position, and to limit the quantitative meaning of the term "stability" to the measure of that angle, using the term "stiffness" to express the moment of the upsetting forces necessary to produce any particular angle of disturbance. The adoption of that system, which was consistent and definite, would prevent the confusion into which it appeared naval architects had fallen, and it would then be seen that what were ill-called curves of stability would be well-called curves of stiffness.

On the Construction and Working of Alpine Railways, by J. B. Fell, C.E.—There are three Alpine railways in existence at the present time—the Mont Cenis and St. Gothard Railways, which have been made with long summit tunnels and with ordinary gradients, and the Brenner Railway, that has been made with similar gradients but without a long tunnel. The important question has now arisen, and has been taken into serious consideration by the Governments and local authorities interested, as to how far it may be possible to make other trans-Alpine railways, some of which are urgently needed, at a cost that would render them financially practicable; and to accomplish this object it has been proposed to effect a reduction of one-half or more of the cost, by carrying these railways over the mountain passes by means of steep gradients and the use of the centre rail system, as it was adopted on the Mont Cenis Railway. Upon these improved summit railways the same weight and number of trains could be run that are now running on the Mont Cenis Tunnel Railway, and with the protection of avalanche galleries and covered ways the regularity of the service would be maintained at all seasons of the year. The extra cost of working expenses caused by working over a higher level than that of a tunnel line would, if capitalised and added to the cost of construction, still leave a clear net saving of more than one-half in the cost of construction as compared with the cost of a tunnel railway. The result of the experiences of the last twenty-five years seems to point to the conclusion that a method of constructing Alpine railways with long, non-paying tunnels is a thing of the past. The future belongs to the best system that can be devised for overcoming the difficulties of trans-Alpine railways rather by adding to the powers of the locomotive engine and by other mechanical appliances for reducing the cost of traction on steep inclines, which methods are capable of indefinite improvement, than by burying in gigantic tunnels enormous sums of unproductive capital that, when once expended, are irrecoverably lost.

The Euphrates Valley Railway as an Alternative Route to India, by J. B. Fell.—The author described the proposed route, and gave the total cost as 8,500,000*l*. He stated that, when not only its commercial but also its strategical and political advantages were taken into account, it must be admitted that the Euphrates Valley Railway certainly has the prospect of being one of the most successful enterprises in the world. Canon Tristram detailed his experience in the Tigris and Euphrates valleys, and stated that he believed the former to be the preferable route.

On Injector Hydrants, by J. H. Greathead.—This paper described the method proposed for the author for meeting the serious increase of fires in the metropolis. A separate system of water supply at very high pressure would be laid under the footway with hydrants at short distances apart. The high pressure water would be used in conjunction with the ordinary water supply in the mains, and jets of water would thus be enabled to be raised to sufficient heights without the aid of fire-engines. The paper was illustrated by numerous diagrams, and elicited an interesting discussion, generally favourable to the author's views.

Nest Gearing, by Prof. Fleeming Jenkin.—This paper contained an account of a new friction gearing, the chief novelty being in the mode of obtaining any required amount of pressure between the wheels which roll upon each other. As many as thirty-two modifications have already suggested themselves, and the opinions expressed in the discussion were unanimously in favour of the invention as being a very valuable one.

Electric Launches, by A. Reckenzaun.—The paper commenced with a description of the launch *Electricity*, which made her first trip in September, 1882. The *Electricity* is 25 feet long, with a 5 feet beam, and draws 21 inches forward and 30 inches aft. Her speed is 8·3 miles per hour with ten passengers on board. Forty-five Sellon-Volckmar accumulators stored under the seats and decks forward and aft supplied the current to two Siemens D_3 Series dynamos placed side by side on the floor of the boat, with their axes parallel to the propeller shaft. A Carliss-Browne two bladed propeller of 20 inches diameter and 3 feet pitch was employed in these first experiments; straps and pulleys were resorted to in order to reduce the speed of the screw to 350 revolutions, whilst the motors revolved at 950 revolutions per minute. The two motors were coupled in parallel circuit, whereas the cells formed one series. Each machine had its own switch and ammeter, and the starboard machine could be stopped mechanically by means of a friction clutch on the countershaft. Both machines were tested with a Prony brake, and they gave 1·86 horse-power on the brake at 950 revolutions, consuming a current of 21 amperes and 100 volts. At 694 revolutions, 100 volts and 33·25 amperes, the brake horse-power rose to 2·78. With 47 cells on board, the current used by both motors running together was 46 amperes, and the propeller made 360 revolutions; when disconnecting one of the motors the current passing through the other was 33 amperes, and the speed of the propeller shaft fell to 250. Messrs. Siemens' dynamos lend themselves very readily to the purposes under consideration; the height of a D_3 machine is only 10 inches, length 28 inches, and width 23 inches. The two machines weigh together 632 lbs., countershaft, supports, and pulleys 180 lbs., total for the driving apparatus 812 lbs.

Electric Launches, by J. Clark.—This paper contained a very brief account of advances in this subject.

The Fire Risks of Electric Lighting, by Killingworth Hedges.—The author first drew attention to the great difference between the electric currents which have been in constant use for telegraphic purposes and those which are to be supplied by the undertakers under the Electric Lighting Act. The latter can only be said to be free from danger when the heat generated by the current is utilised in its right place, and not developed in the conductors or wires which lead the electricity to the incandescent lamps. The Fire Risk Committee have already issued rules for guidance of users of electric light; these can hardly be said to embrace all the salient points of the new subject, which can only be arrived at after years of practical work. The necessity of proper regulations has already been recognised by the insurance offices, both in the United States and Germany, and some of their special rules are given in this paper. The conductors must be properly proportioned for the current they have to carry; whatever resistance there is in the conductor will cause a corresponding development of heat, which will vary with the amount of electricity passing, and inversely as the sectional area. As the temperature in Dr. Matthiessen's experiments upon the subject was not increased over 100° C., the author has made some further experiments—heating the wires by the electric current from a secondary battery to within a few degrees of their melting-point. Various materials were tried—the wires and foils having such sectional area, and so arranged that, on the current being increased by 20 per cent., they were immediately fused. The total length of each experiment was twenty-four hours, during which time the current passing through varied slightly. The results of the experiments were then given.

SCIENTIFIC SERIALS

Archives of the Physical and Natural Sciences, Geneva, September 13.—Verification of some atomic weights (second memoir); zinc and magnesium, by M. C. Marignac. The atomic weight of zinc, fixed by Erdmann at 65·05 and by Favre and Jacquelain raised to 66, is approximately determined at 65·33, a figure which further analysis may show to be slightly too low. For magnesium, calculated by MM. Marchand and Scheerer at 24 and by others at 24·5, the number 24·37 results from the author's fresh experiments.—Essay on the protistology of Sardinia, with a description of some new or little-known lower animal organisms, by Prof. Corrado Parona. In the fresh and marine waters of Sardinia the presence is determined of as many as 228 species belonging to the families of Bacteria—Monera, Flagellata, Lobosa, Diatomea, Heliozoa, Ciliata, Acineta, and Catallacta. The paper is accompanied by seven illustrations.—Memoir on earthquakes and volcanoes (continued), by Prof. F. Cordenons. In this second and concluding part the

author expounds his own views, and argues against the generally accepted theory that underground disturbances of all sorts have their source, not in the upper but in the lowest regions of the earth's crust.—On a case of commensalism between a fish (*Caranx melampygus*) and a medusa (*Crambessa palmipes*), with two illustrations, by M. Godefroy Lunel. In this instance the fish appears as the parasite or guest of the medusa, taking up its abode in one of its cavities, which it enters and leaves at pleasure without apparent injury to the gelatinous substance of the sea-nettle. This circumstance, which has been fully verified, seems to throw a new light on the relations of a species of *Schedophilus* to the medusa, on which it is supposed to feed, and has accordingly, by Prof. Cocco, been named *Schedophilus medusophagus*. One of these is described by Günther in the *Transactions of the London Zoological Society*, October, 1882.—Meteorological observations with tables of temperature and barometric pressure made at the Observatory of Geneva and on the Great Saint Bernard during the month of August.

Rivista Scientifico-Industriale e Giornale del Naturalista, July 15 and 31.—On the measurement of altitudes by means of the barometer, by S. Paolo Busin.—Further remarks on a new experiment in electrolysis, by Prof. Eugenio Semmola.—On the comparative electric resistance of fixed and vibrating metal wires, by Prof. Angelo Emo.—An essay on some new applications of the hyperbolic functions to pseudo-spherical surfaces, with a description of Gronau's tables for all kinds of trigonometrical functions of cyclic and hyperbolic sectors, by Prof. Angelo Forti.—On the language of birds, by Prof. Luigi Paolucci.

SOCIETIES AND ACADEMIES

LONDON

Entomological Society, October 3.—Mr. R. McLachlan, F.R.S., vice-president, in the chair.—Two new members were elected.—Mr. F. P. Pascoe exhibited several interesting British *Hemiptera*, and Mr. T. Wood exhibited a supposed new British species of *Malthodes*.—Mr. W. F. Kirby (on behalf of M. Wailly, who was present as a visitor) exhibited a large box of bred specimens of various *Saturniidæ*, &c., and some living larvæ of *Telea Polyphemus*, and *Hyperchiria Io*.—Mr. Billups exhibited specimens of the celery fly (*Tephritis onopordinis*), and a small larva of *Meloe* (?).—Dr. D. Sharp communicated some proposed alterations of names in the genus *Batrisus*.—Mr. W. F. Kirby read notes on the Diptera of New Zealand, supplementary to Prof. Hutton's list of 1881.

SYDNEY

Royal Society of New South Wales, July 4.—The Hon. J. Smith, C.M.G., M.D., president, in the chair.—Ten new members were elected and sixty-three donations received. The following papers were read:—By the Rev. J. E. Tenison-Woods, F.G.S., &c, on the Waianamatta shales.—By R. Etheridge, jun., further remarks on Australian Strophalosiæ; and description of a new species of Aucella from the Cretaceous rocks of North-East Australia.—Prof. Liversidge, F.R.S., &c., exhibited specimens of tin ore; he explained that most of the tin worked in this colony was alluvial tin, though occasionally thin veins of crystallised tin had been met with. Those shown, however, were from a vein which had already proved to be of a width of ten feet, and the full width had not yet been reached. The tin, as could be seen, was disseminated through the felspar, and the specimen, which came from the Stannifer Bischoff Mine in New England, closely resembled the ore found in the St. Agnes Mine, in Cornwall, England.

August 1.—The Hon. J. Smith, C.M.G., M.D., president, in the chair.—Three new members were elected, and sixty-seven donations received. The following paper was read:—On plants used by the natives of North Queensland, &c., for food and medicine, by E. Palmer.—Mr. J. Trevor Jones, City Engineer, exhibited and explained the MacGeorge test, an instrument for determining the deviation in diamond drill bores.

PARIS

Academy of Sciences, October 1.—M. Blanchard, president, in the chair.—On the slow upheavals and subsidences of the ground, by M. Faye. In reply to M. Issel of Genoa, the author revives the old theories of Élie de Beaumont, Cordier, and many others, and argues that the progressive cooling of the earth's crust goes on at a more rapid rate under water than on dry land. There is nothing hypothetic in this view, which might have been deduced from the thermometric soundings taken fifty years ago by the *Venus* in deep seas, and repeated with similar results in recent times. It follows that the solidified crust is much thicker under the oceans than on the continents. Hence also the liquid mass in the interior of the globe is subjected to far greater pressure under the seas than on the main land; and as this excess of pressure is diffused more or less rapidly in every direction, the less dense continental crust must yield to the pressure exercised on it from within. It is thus being everywhere continually upheaved, while the submarine crust, becoming denser and denser, is slowly subsiding.—Note on the recent attempts made by M. Delauney and others to foretell seismic disturbances, by M. Daubrée. The author concludes that the hitherto collected statistical data are insufficient to justify any theorising for the present on the future recurrence of earthquakes.—Separation of gallium (continued); separation from tantalic acid, by M. Lecoq de Boisbaudran.—Researches on the encephaloid cancer, by M. C. Sappey.—On the destruction and utilisation of the carcasses of animals dying of contagious diseases, and especially of charbon, by M. Aimé Girard.—Observations made at the Observatory of Marseilles, by M. Coggia.—On the calculus of perturbations, by M. A. de Gasparis.—On the approximate evaluation of integers, by M. Stieltjes.—On the interpretation of some phenomena of the solar spectra, by M. L. Thollon.—On the transport and distribution of electric force; experiments made at Grenoble by M. Marcel Deprez, by M. Boulanger.—On the presence of arsenic in certain wines in the absence of all foreign colouring matter, by M. A. Barthélemy.—Quantitative analysis of the chloroform in the blood of an animal treated with this anæsthetic, by MM. Gréhant and Quinquaud.—Researches on parasitic infusoria, with an account of fifteen new species of protozoa, by M. G. Kunstler.—On the marine lamprey, by M. L. Ferry.—On the caterpillar that feeds on the citron blossom, by M. Laugier.—On the position of a fœtus found in a *Pontoporia Blainvillei*, by M. H. P. Gervais.—On a meteor observed at Evreux on the night of September 23, by M. H. Dubus.

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THURSDAY, NOVEMBER 22, 1883

THE GERMAN FISHERIES COMMISSION

Vierter Bericht der Commission zur wissenschaftlichen Untersuchung der deutschen Meere für Jahre 1877-1881. II. Abtheilung. (Berlin: Paul Parez, 1883)

THIS portion of the Fourth Report of what might perhaps be called the German Fisheries Commission is a folio volume of considerable thickness, consisting exclusively of three elaborate scientific memoirs, each of which is stamped with the thoroughness so characteristic of German work. The first, by Dr. Adolf Engler, deals with the marine fungi of Kiel Bay, the second, by Dr. R. Möbius and Fr. Heincke, with the fish fauna of the Baltic, and the last contains an account of the properties and history of the eggs of certain fishes, by Dr. von Hensen.

The second, which we shall first consider, is the most important and the largest—extending to nearly 100 pages—and consists of an elegant and concise description of all the species of fish hitherto found in the Baltic. As the work is founded on observations extending over twenty years, made with the advantages of constant residence on the Baltic shore and of control over the collections in the Kiel Museum, the list is as valuable as it is complete. This makes the absence of some forms we should naturally have expected all the more remarkable: we have especially noticed the absence of Myxine, but perhaps to those better acquainted with the distribution of this interesting form its absence will not be a matter of surprise.

The descriptions are preceded by an introduction which explains in a very lucid manner the principal points of fish organisation and their relative importance in identification. This is followed by a simple classificatory catalogue of the fishes described. In this catalogue all Teleostei are divided into Physostomi and Physoclisti. It is satisfactory to find the great fundamental characters which divide the Teleostei insisted upon, but there seems no objection to retaining the criterion of the fin rays for the Physoclisti, especially as this criterion brings out the affinity between Gadidæ and Pleuronectidæ.

The concise and elegant descriptions are supplemented by a useful fin formula which makes comparison easy. The food and habits of the fish are mentioned, the spawning habits being especially described, and each account is accompanied by a simple but extremely well executed woodcut, in which all the characteristic features are definitely indicated in outline. The object stated in the preface, to make identification practicable to laymen, has been certainly attained.

In the account of the herring considerable space is given to the discussion of the differences between the two races which the labours of the Commission have shown to exist in the Baltic. Perhaps before long it will be ascertained whether the same differences exist between the spring and autumn herring of the North Sea.

The last portion of this memoir consists of general considerations on the fish fauna of the Baltic. The authors find that this sea may be divided into three regions, each characterised by a distinct fish fauna, of which the Western receives the greatest number of occasional visitors from the North Sea. They conclude that the Baltic was once in open communication with the Arctic Ocean, and that some of the species of fish which entered at that time remain now as inhabitants of the Gulfs of Bothnia and Finland. This portion of the work is illustrated by an interesting map. Appended to the whole is a table of the spawning periods of the fishes constantly inhabiting the Bay of Kiel, and also an index of the Latin names of the fishes described, and another of their German, Danish, and Swedish synomyms.

Dr. von Hensen reports at length on the researches made by him during four years on the eggs of the plaice, flounder, and cod.

Agassiz described the eggs of the plaice as floating at the surface, while the Swedish naturalist, Malm, affirmed that they slowly and gradually sink. The first eggs that Dr. Hensen obtained from a ripe female plaice gradually sank. This being a question of the relation between the specific gravity of the eggs and of the salt water, Hensen carried out a series of investigations into the specific gravity of the different eggs and their natural condition when deposited by the fish. By an elaborate process of measurement and calculation he arrived at the specific gravity of the ripe eggs before extrusion, and ascertained the limit of specific gravity and the salt percentage in the water which determines whether the eggs of the cod and plaice shall float or sink. He found that cod's eggs floated in water which contained more than 1·85 per cent. of salt; and plaice eggs, when the percentage was above 1·78. These correspond to a specific gravity of 10145 and 10136 respectively, at 17°·5 C. He found from the observations of the Commission that the water in the Bay of Kiel has very often a specific gravity less than these. Thus there is an exception even to the statemen that cod's eggs float. As will be seen, they always float in the open ocean. It was found that the specific gravity of the eggs before extrusion was somewhat greater, and their volume somewhat less than in the fertilised eggs which had been in sea water, and further that the eggs swell somewhat by the absorption of water without salt.

The author next calculated, from the number of female fish taken on a given fishing-ground and the average number of eggs contained in each, the average number of eggs in the sea corresponding to a square metre of surface, and then made careful continuous nettings of the eggs to find if the actual number coincided. He fished the bottom, and the surface, and vertically. Eggs of the plaice and flounder were frequently taken at the bottom. He found the eggs pretty evenly scattered, and often obtained them in the proportion of 30-80 per square metre of surface. He then discusses what proportion of eggs are likely to be destroyed by their various enemies. This is the first attempt which has been made to estimate the actual number of eggs of fishes hatched in a particular area. The whole paper bears evidence of the most profound and careful work.

The memoir which stands first in the book gives an interesting account of the areas of sea-bottom in the Bay of Kiel known as "weisser" or "todter Grund." They are called "dead" by the fishermen because no fish are found on them, a fact probably due to the presence of

sulphuretted hydrogen. The white felting which gives the name "white" is formed by threads of different species of Beggiatoa, a thread-like fungus classed with the Schizomycetes by Zopf and others who have stated that bacteria forms constitute a stage of their life-cycle. Thus *Monas Okenii*, *Bacterium sulphuratum*, *Clathrocystis rosea-persicina*, and *Beggiatoa rosea-persicina* have all been described as stages of a single life-history. Dr. Engler is extremely cautious on this point, and limits himself to what he has seen. He does not agree with Warming that *Monas Müllerí*, which occurs with the Beggiatoæ, is the young stage of one of them; although he has observed one species sending off motile spherical spores. Two new genera of thread-shaped fungi are described which were found on a *Gammarus locusta* living on the white bottom. The paper is illustrated by a number of admirably executed drawings.

Thus the volume forms a very considerable contribution to the accurate scientific knowledge of the Baltic, for the attainment of which the Commission was instituted. Like all the other work published by the Commission, it exemplifies in the most convincing manner the truth that, to obtain light on marine problems, what is required is not a mass of evidence from people all equally without knowledge on the subject, but continued and elaborate research.

MASCART AND JOUBERT'S "ELECTRICITY AND MAGNETISM"

Electricity and Magnetism. By E. Mascart and J. Joubert. Translated by E. Atkinson. Vol. I. (London: Thos. de la Rue and Co., 1883.)

WE took occasion some time ago to draw the attention of the readers of NATURE to the "Leçons sur l'Électricité et le Magnétisme," by Professors Mascart and Joubert; we have now to thank Prof. Atkinson for an English translation of this valuable work. This is not the place to inquire into the necessity for an English translation of *any French* scientific work, not to speak of one which makes such demands on the culture of its readers as this does. It is enough for us to know that the publishers and translator consider the number of semi-educated Englishmen sufficiently great to justify their venture; it is our part to speak to the merits of the work and the manner of the translation.

The alterations in the matter of the book are so slight as to call for no remark. Our first duty therefore reduces itself to a simple iteration of our high opinion of its value as a scientific manual. At the present time the public is well supplied with scientific instructors. The good intentions of all of them need not be doubted; but the inactivity or modesty of some and the incompetency of others have brought it about that there are large gaps in our repertory of science text-books either not filled at all or filled very unworthily. It would not be accurate to say that vol. i. of the treatise of MM. Mascart and Joubert fills the greatest of these gaps in the department of electricity and magnetism; nevertheless it fills a place not at present wholly occupied by any English text-book of merit. It has the misfortune, no doubt, of overlapping to a large extent the great work of Maxwell; but we believe that the tyro in the mathematical theories of electricity and magnetism will find it of the greatest advantage to use Mascart and Joubert as companion and commentary to Maxwell's volumes. In all that relates to fundamental points and general theory Maxwell should be studied, even where he is hardest to follow, because his work was written, not to evade, but to meet, difficulties. On the other hand, Mascart and Joubert will be found invaluable in matters of detail. We know of no text-book in any language that contains such an abundance of elementary illustrations of electrical and magnetic theory, all arranged with an elegance peculiarly French.

The English version now before us is neatly printed and solidly got up. The translation on the whole is very well done. It would be easy to pick out small inaccuracies here and there, particularly in the early chapter. For some of these the translator is not altogether to blame; for the introductory part of the work seems to us to be less clear and carefully written than the following chapters, where the authors enter more into detail; and in that part of the book the translation leaves little to be desired. We noticed very few misprints, but one calls for correction: the name of van Troostwyk's collaborateur in the decomposition of water by the voltaic current was Deimann and not Diemann. No doubt this mistake occurs in the original; but the individual in question, though perhaps not widely known, yet deserved better than to be made quite unrecognisable. This brings to mind the only complaint of any gravity we have to bring against the editor of the English translation. Why did he not do something to remedy the one serious defect of MM. Mascart and Joubert's text-book, viz. the want of sufficient references to original sources of information? It must be remembered that the scientific student who goes the length of MM. Mascart and Joubert's leading strings is expected one day to walk alone; and some indication should be given him of the paths that lead to farther knowledge. A defect of the kind might be overlooked in a school primer, written to enable the oppressed schoolmaster to screw a Government grant on the minimum qualification from some reluctant inspector, but is to be deplored in a work of the present pretensions.

Instead however of complaining farther of what MM. Mascart, Joubert, and Atkinson *have not* done (perhaps had not the leisure to do) for us, it will be more fitting to conclude by thanking them heartily for what they *have* done, and done so well. G. C.

OUR BOOK SHELF

Energy in Nature. By William Lant Carpenter, B.A. B.Sc. (London, Paris, and New York: Cassell and Co.)

THIS book is, with some additions, the substance of a course of six lectures on the Forces of Nature, and their mutual relations, delivered under the auspices of the Gilchrist Educational Trust.

It is of the greatest importance that the general body of the people, and more especially the intelligent artisan class, should become acquainted with the leading principles of the science of energy. The series of lectures delivered with this object represents one of the best sustained efforts to bring this great subject before the minds of this class of the people, and in collecting together and publishing these lectures the author has done a work which must be regarded as a scientific boon to the artisan.

In one respect this task has presented difficulties of a peculiar nature, due to the fact that our country has taken a leading part in developing the principles of energy—this science has in fact grown here, and the terminology has grown with it. At the present moment there is no man of science who speaks of the forces when he means the energies of nature, but there is a lagging behind in this respect amongst the body of the people, to whom the word force is a familiar one, and the word energy, in a scientific sense, very much the reverse. Accordingly one of the first duties of the author has been to define the exact relations between force and energy in a way suitable to his audience—a task which he has successfully achieved.

While in respect of importance the science of energy holds a paramount place, it is also a subject which lends itself admirably to the mode of treatment adopted by the author of this volume. Probably no subject is more difficult of conception on general principles merely, and without reference to the actualities of life. The philosopher in his study may have but a vague conception of these general laws, and his assent to the definition of work may be purely intellectual. Perhaps he may never have witnessed a well marked case of the transmutation of energy, nor may he have the consciousness that he himself is frequently the subject of such transmutations. The artisan is, however, in a totally different position. After a day's hard toil he is well able to realise in a very vivid manner the meaning of the word *work*. To spend his personal physical energy, and to recruit it by food, are operations in which he is constantly and consciously engaged. Hence it follows that a theory which borrows all these facts as illustrations of its truth appeals to the artisan in a much more emphatic way than it does to the mere student of science. To use the scientific terminology, the latter may have more *kinetic* intellectuality than the former, but the artisan is in a *position of advantage* which enables him to grasp the truths of the science. A book, therefore, which, like the present, abounds in good illustrations and in clear and simple statements, carrying practical applications, is one peculiarly fitted to a class better qualified by education and experience to perceive the concrete than to appreciate abstract general principles.

B. S.

Journal of the Royal Agricultural Society. Second Series, Part II. Vol. XIX. October, 1883. Price 6*s*. (London: John Murray.)

THE current number of the *Journal of the Royal Agricultural Society* has just reached us. It fully maintains the reputation so justly earned by previous numbers, and contains papers on many topics of present interest to agriculturists. Among the principal of these may be mentioned "The Progress of Fruit-Farming," by Mr. Whitehead, of Barming House, Kent, himself largely interested in this business. The continued reports upon Prize Farms are worthy of attention as showing what is being done on the best farms in various districts. A report on sheep-feeding experiments conducted at Woburn by Dr. Voelcker in his capacity of chemist to the Society, and a report on wheat mildew, by Mr. W. C. Little, of Stag's Holl, form the chief attractions to practical farmers. Among the more purely scientific or speculative contents may be mentioned a contribution from Rothamsted, by Sir John Lawes and his able coadjutor, Dr. Gilbert, upon the composition of drainage water collected at Rothamsted, and a valuable paper upon nitrogen as nitric acid in the soils and subsoils of certain fields on the same estate. The remainder of the volume is chiefly occupied with useful official matter, such as the Weather Report; the Botanical Report, by Mr. Carruthers; and Reports on Live Stock, Implements, &c., exhibited at York. A touching tribute is paid to the memory of a late president of the Society, the late Lord Vernon, by Mr. Wells, himself an ex-president. Perhaps the most striking and instructive paper is that by Mr. Thomas Bell upon the Yorkshire Prize Competition, containing a full report of the Tuyers Wood and East Park Farms, occupied by Mr. Turnbull. In these days, when dairying is justly attracting very special attention, it is highly interesting to receive sound information as to the methods used on thoroughly well-managed farms. A daily record of the milk yielded by each cow in a dairy containing 100 animals in milk is in itself highly useful, and worthy of imitation. It is impossible in a short notice like the present to open up the various topics dealt with. It has ever been the wise policy of the "Royal Agriculturist" to fill its pages with contributions from specialists upon their own specialities. There is no padding or superfluous discursiveness, and sometimes to the uninitiated there may appear to be a want of that introductory and explanatory matter which entices on the general reader. As a record of agricultural research and progress, the journal holds a high position, which the number just issued fully maintains.

J. W.

LETTERS TO THE EDITOR

[*The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, or to correspond with the writers of, rejected manuscripts. No notice is taken of anonymous communications.*

[*The Editor urgently requests correspondents to keep their letters as short as possible. The pressure on his space is so great that it is impossible otherwise to insure the appearance even of communications containing interesting and novel facts.*]

On Chepstow Railway Bridge, with General Remarks suggested by that Structure

IN a letter to NATURE of some months past, suggested by a special subject of engineering, I pointed out the necessity of clearly understanding the effects of endwise pressure on metallic columns, in respect of its tendency to cause springing or buckling of the columns. I remarked that there is a total want of experiments on the subject (Mr. Hodgkinson's observations, made on a very small scale, being excepted), and I gave some details of a theory by which the effective arrangement of such experiments might perhaps be facilitated. I have lately observed in an engineering work a failure of a different class arising from endwise pressure, of a kind which I had not anticipated, and which appears to be perhaps more dangerous than even the buckling to which I had called attention.

In the neighbourhood of Chepstow, the River Wye is crossed by a railway bridge of a single span. The four corners of the bridge are supported by iron tubular vertical, columns of considerable length. One of these columns (on the Monmouthshire side of the river, and on the lower side of the bridge as regards the course of the river) is split, with several important longitudinal fissures. To avert the present destruction of the bridge, strong iron hoops have been placed surrounding this tube, drawn tight by screws and nuts, exhibiting a somewhat unsightly appearance.

For clear understanding of this state, the reader may figure to himself a cask or barrel, set on its end, and loaded on the top till its staves burst outwards; then he must conceive a hoop to be placed round the body of the cask, and drawn till the edges of the staves are wholly or nearly in contact.

I do not doubt that this column is now safe. But there are other columns supporting the bridge which are exposed to the same dangers: the bridge is heavy, the loads from the Taff and the Tawe are not light, and the jar of ponderous locomotives may try every original weak point or may create new ones; and I think it would be well provisionally to encircle the other supporting columns in the same way as the one which has failed.

A symmetrical system of rings, with some attention to simple elegance, would remove the offensive effect produced by the bent bars of mere blacksmith's work which now surround a single column.

But it is not specially to the state of the Chepstow Bridge that I wish to call the attention of the public. It is to the total want of practical knowledge as to the enduring power of metals, with which this bridge was built, and with which other such bridges must at present be built. We are totally without experiment on the danger of springing or buckling, and on the danger of bursting (now, I believe, for the first time brought forward). And we might perhaps consider such experiments as well falling within the province of those organised bodies whose union is based on the promotion of the most important determinations in civil engineering.

The Institution of Civil Engineers (with which body I have a much-valued honorary connection) has lately departed in some measure from the strict subject of engineering to which its attention had been successfully given for so many years. I venture to suggest that this body might well take up the conduct of experiments bearing on engineering. The examination of the effects of force in mere crushing of external surfaces has been admirably prosecuted by American engineers. But the examination of bending and bursting, as the effects of end-pressure, is still open to the engineers of Britain. The funds of the Institution appear to be amply sufficient for such purposes, and the undertaking of them would undoubtedly be considered as honourable to the body.

G. B. AIRY

The White House, Greenwich, November 17

Physiology in Oxford

A PARAGRAPH appeared in the *Spectator* of Saturday, the 10th inst., on the Oxford memorial concerning the University Physiological Laboratory. That part of it which affects Magdalen College appears to me to rest upon erroneous information, and is certainly calculated to spread an entirely false and misleading impression of the attitude of this College in the matter, and of the University in general.

If you will allow me to quote the paragraph, and at the same time give you the actual facts, I think you will easily form an opinion on the real state of the case.

The paragraph states that the signatures were received "from members in Oxford and its suburbs, and the rest from a circle of about fifteen miles round."

The fact is that the signatures are not drawn exclusively from either the smaller or even the larger area, one of the so-called Magdalen signatures being that of a member of the Hereford Cathedral choir.

The paragraph goes on to say:—"We are told that Magdalen men have signed it more numerously than any other College but one, and, in proportion to the size of the College, more numerously than any. Now, as Prof. Burdon Sanderson is *ex officio* a Fellow of Magdalen, and as Magdalen has for years past had a physiological laboratory of its own, this popularity of the memorial among Magdalen men is highly significant."

On this I have to remark that the signatures are representative neither of the governing body of the College, nor of its resident members.

The governing body of the College consists of the President and twenty-four Fellows; of these twenty-five *three alone have signed the memorial.* The resident members, as shown by the list of congregation, number twenty-two; of these twenty-two *only six* have signed.

Finally, as regards the last paragraph, it is true that Magdalen College has for years past had a physiological laboratory of its own, and it is further true that the University teaching of physiology has been carried on there, previous to the advent of Dr. Burdon Sanderson, for years past under a Government licence with the full and express consent of the whole governing body of the College, a fact which is indeed significant, but hardly in the way in which the *Spectator* appears to have been informed.

EDWARD CHAPMAN

Magdalen College, Oxford, November 15

Green Sunlight

MR. G. H. HOPKINS' observation that the parting ray at sunset is sometimes brilliant emerald-green brings to my memory a somewhat similar experience. On September 13, 1865, watching on the summit of the Rigi for sunrise, I caught the very first possible glimpse of the sun's disk as, on a very clear morning, he emerged from behind the sharply-defined outline of a distant mountain. The very first rays, although necessarily proceeding from the comparatively obscure limb of the sun, were dazzlingly brilliant, and of a superb emerald green colour. But almost instantly, as more of the sun appeared and his light grew sensibly more intense, the green passed away or was merged in the yellowish white of ordinary sunlight.

In my case I do not doubt the phenomenon was purely subjective, for before sunrise the sky was all lit up of a magnificent crimson hue. Every one must have noted how the moon when surrounded with bright crimson clouds looks more or less decidedly green.

A very striking effect of this sort, like the others an example of the well-known visual phenomenon of "accidental colours," may be artificially obtained, any time the moon shines, by burning an ordinary "blue" signal light. After my eye had been intensely excited by such a light close at hand, I have seen the moon, near or at its full, of a deep plum colour, by which I mean the colour of the bloom on a black plum or on a well coloured Hamburg grape. Or, in place of these, the *violet* of my friend Prof. Piazzi Smyth's exquisite chart of colours in his "Madeira Spectroscopic," or the *bleu violet* of Chevreul's chromatic circle. I recommend the experiment as easy of performance and exceedingly beautiful in its effects. Possibly a small blue light would suffice. But, on the occasion to which I have referred, certainly not less than thirty ounces of nitre, ten of sulphur, and five of black antimony sulphide were employed. These, mixed in fine powder, may be burned in a case about six inches high and four in diameter; of course in the open air, and where no mischief may accrue from an intensely hot and voluminous flame.

In a communication made to the Royal Society of Edinburgh in 1852 (*Trans.* vol. xx. pp. 445–471), I adduced evidence to prove that a continuous thin layer surrounds the sun's photosphere, of which upturned portions form the red protuberances seen at total solar eclipses; and I then showed that if the well known darkening of the sun's limb be due to absorption in his atmosphere, it can only be caused by such a *thin* envelope. The existence of this envelope, the sun's chromosphere, is now fully established. If, from the red colour of its upper portions, we may infer the resultant tint emitted by the whole to be red, then, by a well known law, the discolouration of the sun's limb due to its absorption should be of a greenish hue. But such an effect would necessarily be but slight, and could not explain the brilliant green witnessed on the Rigi. Nor do I recollect any instance where the first emerging rays of the photosphere at the end of a total eclipse have been observed to be green.

WILLIAM SWAN

Ardchapel, Dumbartonshire, November 8

A LETTER from Barinas, Venezuela, states that on September 2, from daylight until noon, and from 3 p.m. to sundown, the sun appeared like a globe of burnished silver. Between noon and three o'clock it was of a bluish-green colour. This appearance in the western hemisphere seems to dispose of the suggestion of the Java eruptions as the cause of green suns in India.

HYDE CLARKE

Mangrove as a Destructive Agent

As I have never seen the mangrove mentioned but as a conservative or productive agent as regards geological change, it may be interesting to readers of NATURE to hear of its acting in a contrary direction.

In several parts of eastern tropical Africa, where the shores are mostly of upraised coral limestone, I have noticed the effect of mangrove in eating away this rock, but nowhere have I seen it so well marked as in the Island of Aldabra, some two hundred miles to the north-west of Madagascar, and which I surveyed in 1878.

Aldabra is an upraised atoll about twenty-two miles long, and presents low cliffs of about fifteen to twenty feet of solid coral rock to the sea and also to the lagoon, which is, at low water, nearly dry

The mangrove has established itself on the edges of the lagoon, doubtless from seed transported by the currents, and, in all places where it has done so, tortuous creeks or little gorges run back into the coral, filled with mangrove trees (standing in deep mud of the adhesive and fœtid nature so characteristic of mangrove swamps), which stretch out their roots to the coral walls around them, and, as it seemed indubitably to me, in some way decompose the softer parts and eat their way in. The island is riddled with these creeks, always filled with mangrove, and opening into the lagoon.

The outer face of the island is of course being slowly undermined by the sea at high water, presenting overhanging cliffs impossible to scale, and the island is wearing away from that cause also, but the destruction from the mangrove is much more important, and at no very distant period, as it seemed to me, the upraised island will be again reduced to its original level as an ordinary atoll.

It would be interesting to know how long the mangrove has been there, for as Aldabra is one of the two oceanic groups in which the giant tortoises still exist indigenous, it must have been in its present condition of upraised atoll, I imagine, for a long period. It could never have been much larger in diameter, from the soundings round it, but the mangrove may have greatly increased the size of the lagoon by steady working at the inner rim of the islands, the actual area of which is now but small, from their narrowness.

I may mention that the island is covered with low, tangled scrub, which has managed to find foothold and sustenance on the rock, for there is but little or no soil, and the top of the rock is everywhere cut up by sub-aërial action into the sharp, honeycombed, and jagged surface which upraised coral in the tropics, uncovered by grasses, soil, &c., always wears into, and which, by the way, makes it extremely difficult to walk over, a difficulty much increased in this instance by these mangrove channels, as well as the tough nature of the matted, thorny bushes. A walk in Aldabra is the most aggravating and slowest piece of locomotion I have ever engaged in: and nothing short of the patience, perseverance, and general disregard of time of the tortoise tribe can make it an agreeable residence. Some of my negro sailors were sent into the bush to hunt for tortoises, and after three days' search brought back one, which is now in the Gardens of the Zoological Society; but they returned nearly as guiltless of artificial clothing as their captive.

W. J. L. WHARTON

H.M.S. *Sylvia*, Monte Video, October 10

The "Cloud-Glow" of November 9

THE beautiful after-glow of Friday, the 9th instant, was most interesting as seen from the west side of Hampstead Hill, where its best development was made more effective by a frame of dark cumulus, with a fringe of dusky green tint, carried up from the sunset quarter by a westerly breeze, rather rolled up like a curtain, exhibiting the richly-coloured scene behind as it was withdrawn. I estimated the altitude of the upper edge of the glow at about 30°; but at Freshwater, Isle of Wight, it has been described as extending nearly to the zenith. There would be no difficulty in calculating approximately the height of the cirrus—as desired by Mr. Russell—if it could be assumed that the reflection was from the same matter in both cases, which is improbable.

J. J. WALKER

Waking Impressions

A CURIOUS case I have just read in a recent number of NATURE recalls a somewhat similar experience of my own, rather earlier in date. I awoke in the middle of a story told by an internal voice—a voice felt, not heard. I listened with curiosity and interest, as totally unprepared for what was coming as if the narrator had been Gladstone or Ruskin. I believe when I awoke I had a dim recollection of what had gone before, but I strove afterwards in vain to recall it. All I know of the history of the mysterious lady is the following fragment: "She had many admirers, but she gave the preference to Tom, because he promised to marry her in the West Indian fashion. He drew her three times through a hoop, once standing, once sitting, once lying, which signified that he would never desert her in youth, maturity, or old age."

I have not the least idea who "she" was. I know no one I call Tom except an old schoolfellow long married, and, to the best of my belief, I never heard of such a custom in the West Indies or elsewhere. Once since I have waked in the middle of a dream which went on, but it was a dream of a very commonplace character.

WILLIAM RADFORD

Sidmouth

Barytes from Chirbury

I AM indebted to Mr. Yelland of Wotherton for sending me some fine examples of the crystals described by Mr. Miers in NATURE, vol xxix. p. 29, and am collecting several particulars respecting their occurrence. Some time ago I commenced a determination of the faces, but my work has been interrupted.

The characteristic plane E is mentioned by Carl Urba (Groth, *Zeitschrift für Crystallographie*, v. 433, 1881) as occurring on barytes crystals from Swoszawice in Galizien. In a measurement I made last year to determine this plane on one of the Wotherton specimens I obtained E E′ as 39° 59′, and, using Miller's distance for *b d* leads to the symbol 412, and by calculation the distance *a* E as 26° 2′. Carl Urba gives its calculated distance as 26° 4′, and measured distance as 25° 58′.

C. J. WOODWARD

Birmingham and Midland Institute, Birmingham, Nov. 10

"Salt Rain and Dew"

LOOKING over the "School Geography" of Dr. Clyde (Edinburgh, 1870), I find, on page 32, in the paragraph headed "Russian Lakes," the following remarkable statement:—"In the south-east region, not only the lakes, *but the very rain and dew likewise are salt*, a phenomenon common to all the shores of the Caspian and Sea of Aral" (the italics are mine). Will some one of your readers kindly refer me to the traveller's tale in which this myth originated.

HARRY N. DRAPER

Esterel, Temple Road, Dublin, November 17

AN INDIAN WEATHER FORECAST

THE period of drought in Upper India, which happily came to an end in the latter part of August, was not entirely unforeseen, as will be shown by the following extracts from the Government *Gazette*; and the facts will probably be not without interest to meteorologists in Europe and elsewhere.

Extract from the "Gazette of India" of June 2, 1883

"That the unusually dry weather now prevailing over the North-Western Himalaya, and that which, though less abnormal, characterises the whole of North-Western India at the present time, is an effect of the unusual accumulation of snow, is a conclusion justified by the experience of the last few years; and were it not that the snow is rapidly decreasing under the unobstructed radiation of the sun, there might be some reason, judging from the present limited experience, to anticipate some retardation of the rains of the Upper Provinces, and possibly even in Western India generally. But, on the other hand, the fact that, during the months of April and May, the atmospheric pressure over the greater part of the country has been below the normal average of the season, is one which, arguing from the same experience, portends favourably for the timely influx of the monsoon. In Bengal it may be said that the present prospects are wholly favourable.

(Signed) "HENRY F. BLANFORD,
Meteorological Reporter to the
Government of India

"Simla, May 18, 1883"

"Since the above was written, there has been heavy rain for many days on the outer hills, and more or less on the plains of the Punjab, and apparently a very heavy fall of snow on the higher ranges. At the present time, as seen from Simla, the latter are white with snow, down to a level of about 11,000 or 12,000 feet. And some 500 feet of the top of the Chor (11,982 feet) is also covered with a snow-cap. If, therefore, the mountains of Lalwul, Spiti, and

other more distant ranges have shared this fall, if it is as extensive as it is apparently heavy on the visible ranges, and if the views which the experience of recent years seems to justify, viz. that an unusual extent and thickness of snow on the Himalaya is productive of dry north-west and west winds in North-Western India, are valid, we must be prepared for a long spell of dry weather and a retarded rainfall in the Upper Provinces. The present season will serve as a test of the validity of the above view.

(Signed) "HENRY F. BLANFORD,
Meteorological Reporter to the
Government of India

"Simla, May 31, 1883"

Information was subsequently received to the effect that the heavy snow of the winter months as well as that which fell at the end of May was restricted to the outer range. In the interior of Lalwul and Spiti and in the Pangi valley the snowfall was very deficient. Nevertheless the May fall on the outer range seems to have sufficed to produce the effect predicted.

Extracts from a Memorandum on the Chief Weather Characteristics of the Month of June, 1883, in India, in the "Gazette of India"

"In Bengal, after some weeks of close cloudy weather, with occasional showers, the monsoon rains were ushered in on June 13, with a little cyclonic storm, formed apparently on the coast of the Sunderbuns. From the coast on the three following days this storm passed inland, on a north-west course, bringing heavy rain in its track, as far west as Behar, and a moderate fall up to Allahabad; beyond which, for a time, the rains did not advance. . . . At Bombay it blew strongly on the 11th, 12th, and 13th, but not from the monsoon quarter; and afterwards the wind fell light, and so continued till the 24th, when the monsoon set in steadily. But the rainfall has been light throughout the month, and, at its close, was six inches short of the normal average. On the 26th or 27th a second cyclone was formed at the head of the Bay of Bengal, causing heavy rain around the coasts, and especially those of Orissa and Ganjam; then, travelling westward, the centre reached Cuttack on June 30; Seoni on July 1; Indore on the 2nd; and lay between Kurrachee and Rajkot on the 3rd. It caused very heavy rain in Gujerat, flooding the rivers, and interrupting railway communication between Bombay and Baroda.

"In the North-Western Provinces, with the exception already mentioned, the rains did not set in before the 26th, but throughout the month the wind was, in general, easterly, and occasional thunderstorms occurred. In the Punjab also, the first rain fell between the 26th and 29th, but in the eastern half of the province the prevailing high temperature was mitigated by an occasional dust-storm. . . .

"In Lower Bengal rain of importance fell on twenty-two days. The total fall of the month was five inches in excess. . . .

"In Rajputana, Sind, &c., the number of days on which rain fell was only four, and the average total was less by three-quarters of an inch than even the small amount which generally falls in this region in the month of June. . . .

"From the above it appears that, over a large tract of country, the monsoon so far has been weak. On May 28 it was reported to have burst at Cochin; and between that date and June 5 it appears to have spread along that coast as far north as Goa. In Bombay itself the weather has been showery, but there have been no very heavy falls of rain. On the Bengal side, on the contrary, the south and south-west winds have brought up even more than the normal amount of rain, and the weather at the head of the Bay has been somewhat exceptionally rough

In Northern India the monsoon current has been much delayed, and in parts of the North-Western Provinces and the Punjab continuous rain has hardly yet set in.

(Signed) "W. L. DALLAS,
Assistant Meteorological Reporter
to the Government of India"

Extracts from a Memorandum on the Chief Weather Characteristics of July, 1883, in India, in the "Gazette of India"

"Except in the North-Western and at a few Central stations, the rainfall of the month shows on the whole comparatively little departure from the average.

"After the disappearance of the storm noticed in the June summary, which passed from the Bay of Bengal across India, &c., . . . there occurred a general rise of the barometer, a corresponding decrease in the humidity of the atmosphere, and a cessation of the rainfall, over a large tract of country for two or three days. On the 5th or 6th, however, rain recommenced generally and continued for some time. In the eastern half of the North-Western Provinces, Assam, Bengal, Burmah, and the south of the peninsula, it fell more or less on every day, till the close of the month, but over Western and North-Western India the fall ceased about the 19th, and from that date till the end of the month a decided break in the rains occurred, and fine weather set in.

"On the plains of the Punjab there were only eleven wet days; the break in the rains, which commenced on the 19th, being very decided in this province. In consequence the amount of rain for the month, and, except in the Indus valley, the total since June 1, was several inches below the average. . . .

"The weather in the western half of the North-Western Provinces was similar to that experienced in the Punjab, but in the eastern half it was wetter, the number of rainy days being nineteen. In the Meerut division five inches less than the average amount fell during the month; while at Lucknow eight inches and at Allahabad one and a half inches more than the average was registered. . . .

"In Lower Bengal and parts of Behar the rainfall was several inches above the July average; while in Purneah, Patna, and Orissa it was deficient. The average number of wet days was twenty-six, and no break in the rains of any consequence occurred within these provinces. . . .

"In Rajputana the rainfall was about the average amount, and occurred on thirteen days; scarcely any fell after the 17th. . . .

(Signed) "W. L. DALLAS,
Assistant Meteorological Reporter
to the Government of India"

Extract from a Memorandum of the Chief Weather Characteristics of August, 1883, in the "Gazette of India"

"The month just elapsed was one of very deficient rainfall throughout India, except in the provinces of Madras, Berar, and Assam. The break in the rains, which during the latter half of July was very general in North-Western and parts of Central India, became even more pronounced throughout that region during the first three weeks of the month under review; and extended, though in a modified degree, to Behar and a large part of Bombay. The drought was apparently at its height, both as regards extent and intensity, during the second week in August. . . . On the 19th, however, a change commenced. The air became slowly damper over the Central and North-Western Provinces, and the sky more cloudy; and very gradually these changes spread, till at the close of the month rain had extended to the Punjab, Rajputana, and Gujerat; in Rajputana and a large part of the Punjab and the North-Western Provinces it was only on the last

two days of the month that rain began to fall, and even then in small amounts. . . .

(Signed) "W. L. DALLAS,
Assistant Meteorological Reporter
to the Government of India"

The above extracts speak for themselves. The results do not accord precisely with the terms of the prediction, inasmuch as the rains, instead of being simply retarded, penetrated for about a fortnight to the Upper Provinces, and then gave place to the dry north-west winds, which are characteristic of periods of drought. But there is no reason to regard the snows as inactive during this rainy interval. At Simla this rainy period was one of frequent thunderstorms and on more than one occasion of hail,[1] and in fine intervals the existence overhead of the ominous north-west wind was established by the steady drift of the higher clouds (*cirro-cumulus*, &c.). The outflow of dense air from the snow-fields was therefore active, although it was only at a later period that it descended to the level of the lower hills; and then, chiefly as the result of diurnal convection, to the plains of North-Western India.

The full discussion of the evidence for the dependence of dry winds on the snowfall will be undertaken elsewhere. It must not, however, be supposed that the Himalayan snows are to be regarded as the *sole* cause of drought. Causes of wider incidence are sometimes in operation. Thus, in 1876 and 1877, an unusually high atmospheric pressure prevailed over nearly the whole of Asia and Australia. Whether there was any unusual accumulation of snow on the vast mountain tracts of Central Asia or over the northern plains in those years would be an interesting subject of inquiry were the means of information forthcoming. H. F. B.

NORDENSKJÖLD'S GREENLAND EXPEDITION[2]

III.

WE give a few extracts from Baron Nordenskjöld's concluding letters on his journey down the west coast of Greenland and his visit to the east coast :—

At Ivigtut a visit was made to a valley which, on account of its copious flora, has been named Grönnedal (Green valley), and another to the spot where the inland ice falls into the Arsukfjord. In the former place Dr. Nathorst found, in a kind of syenite, a blue mineral which seems to be sodalite. This discovery is chiefly remarkable from the circumstance that this mineral is also found in the vicinity of the small kryolite deposit at the Ilmen mountain in the Ural, which seems to indicate that a kind of relation exists between these two minerals, both strong in natron, which circumstance may be of service to the geologist in search of kryolite. From the excursion to Grönnedal Herr Kolthoff brought with him some rare butterflies and other insects, while of the botanical finds there were splendid specimens in bloom of *Linnæa borealis*, which is quite plentiful about Ivigtut. It has not before been known to exist in Greenland. The zoologists found only three kinds of land mollusks, viz. a physa, a vitrina, and a helix, which were all few in number. The entomological harvest consisted of a few beetles, butterflies, and insects of other kinds.

On their way to Julianehaab, as they steamed down the narrow fjord in pitch darkness and a perfect calm, "we saw suddenly behind the vessel on the surface of the sea a broad but clearly defined band of light. It shone with a steady, yellowish light, somewhat like that of phosphorescent elements, while, in spite of the speed maintained, viz. four to six knots, the band came nearer and nearer. When it reached the ship it seemed as if we were steaming through a sea of fire or molten metal. After a while the light travelled beyond the vessel, and we saw it at last disappear on the horizon. Unfortunately I had not an opportunity of examining it with the spectroscope. It was beyond doubt of a different nature to the bluish-white phosphorescent light, which throughout its appearance was seen distinctly in our wake, and as the light was perfectly steady it cannot have been caused by the phosphorescence from a passing shoal of fish. A shoal of fish would have occasioned some stir in the sea, but in this case the surface was calm throughout, while phosphorescence from the same would have been bluish in character, not yellow as this was. The Esquimaux stated that a glacier river in the vicinity shed a thin layer of brackish clay-water over the surface of the fjord, and fancied that this circumstance was in some way or another connected with this grand phenomenon, which they themselves had never before witnessed. There was at the time no aurora visible, the sky being covered with clouds. The cause of this remarkable phenomenon, which made the *Sophia* seem to steam through a sea of fire for fully fifteen minutes, I have been unable to ascertain; maybe it was a phenomenon such as this which made Lig-Lodin, of the Greenland Saga, relate to King Harald Sigurdson that he had once sailed over a spot where the sea was on fire."

At Fredriksdal Nordenskjöld engaged two Esquimaux to act as pilots in the sounds on the east coast, north of Cape Farewell. One of them stated that remains of buildings, which were not built by the Esquimaux, are to be found in nearly every great fjord on the east coast, particularly in the large ones of Umanak, Ekaleumiut, and Igdluluarsiut. Entire walls do not remain standing, but though low they are extensive. The largest ruin is said to exist at Igdluluarsiut. A fine kind of soft stone is to be found on an island south of Umanak, from which pots were made to three feet in diameter. This mineral deposit is of special interest in reference to the ethnography of Greenland, as the Umanak fjord is situated in lat. 63°. This name is, however, a common one for places among the natives. Ivar Baardsen, in his famous description of Greenland, states that a soft stone was found on Renö, outside the Einafjord, from which the largest vessels were made. Cannot the mineral deposit at Umanak be identical with this? These statements, as well as others received from the "Eastlanders," and the remarkable Norse characteristics possessed by the same, which the missionary Hans Egede pointed out long ago, seem to Baron Nordenskjöld to refute the theory now mostly advanced as to the Norse colonies, viz. that they were situated on the south-west coast of Greenland.

In spite of predictions of failure and even disaster before he left Europe, Nordenskjöld decided to attempt to land on the east coast, south of the Arctic circle. After some difficulty they succeeded in anchoring in the Kangerlutsiok Bay, but on account of the state of the ice they had to stand to sea again, and steamed along the ice-belt lining the coast, in order to find an opening by which the shore might be reached. The fauna of the sea here was very poor, and they only saw in two days one whale, a few seals, and a very small number of sea birds. The abundant fauna of the coasts of Spitzbergen and Novaya Zemlya is thus entirely wanting on the east coast of Greenland. The cause of this may be the great depth of the sea right up to the shore, which prevents the animals from fetching their food from the bottom; perhaps also the war of extirpation which the natives seem to have carried on for years has also contributed thereto. The auk and the *Uria grylle* are, however, said to breed in large numbers on the rocks off Cape Farewell. The Esquimaux pilot stated that he had been told by old people that they could remember the *Alka impennis* having been found here. The natives called it Isaro-

[1] These accompaniments are characteristic of the spring rainfall both on the hills and the plains, not of the monsoon rains, and indicate demonstrably in most cases the existence of a dry upper current.

[2] Continued from p. 42.

kitsok. Only a little distance out to sea they found a warm current—rising to 6° C.—coming from the south. The drift-ice was what Arctic skippers call "knatteris," *i.e.* little bits, viz. remains of large floes after the influence of the summer heat and the Gulf Stream. Very few icebergs were seen, and they appear to be far more numerous on the west coast. As it was now late in the season, and the coals were nearly done, Nordenskjöld had reluctantly to renounce the plan of reaching the fjords where the greatest ruins are said to exist, and, instead, attempt to reach the south shore by Cape Dan, a promontory which, if the Einafjord was situated at Umanak or Ekaleumiut, should be the Herjolf's Naze of the Sagas. "On the 4th, when off the Cape, we met the ice twenty miles from the coast, which was, however, passable, as it consisted mostly of large, loose floes only a few feet above water, while nearer the shore it again became heavier. Beyond this we saw an ice-free channel three to four miles wide. The sea was as smooth as a pond, and a boat could easily reach the shore. The mountains ran mostly into the sea with almost perpendicular declivities, without any grass-covered underland. Opposite us we saw a small bay, into which I steamed, in order to take the sun; but finding both the depth and the bottom unsuitable for anchoring, we only landed for a few hours, while some of the crew went on the hills above to look for a better harbour. The staff returned on board with a rich harvest from the steep slopes, the flora of which was copious beyond expectation. The sailors reporting a harbour near, I steamed thereto and cast anchor. It was a beautiful fjord, with several arms, which was only connected with the sea through a small opening, and was well sheltered. It was the first harbour on the east coast south of the Polar circle, in which a vessel had anchored for several centuries.[1] It was named 'King Oscar's Harbour.' If Cape Dan is the old Herjolf's Naze, this harbour is the "Sand" described by Ivar Baardsen, 'much frequented by the Norwegians and traders.' That the Norwegians had once been here was demonstrated by walls of loose stones erected on the mountains above the harbour, which had, no doubt, served as landmarks for finding the almost hidden opening of the fjord. We found, besides, some stone ruins of a smaller house, identical with those found on the west coast. These ruins are, of course, not extensive enough to demonstrate that here was situated one of the 'Bygder' (parishes) of Greenland, but they may certainly serve as sign posts for future explorers of the east coast. As soon as at anchor we went on shore, and spread in all directions in order to examine the neighbourhood. King Oscar's Harbour is surrounded by soft, close, grass slopes and flourishing shrubs. The fauna appeared to me more copious and the grass less mixed with moss than on the west coast in the same latitude. In one of the valleys a river flowed, the shores of which consisted of loose sand without any covering of grass. Here were found traces of the Esquimaux. Some of the footprints were days old, but others were so fresh that the moist sand had not had time to dry. Most probably they had taken flight on seeing the steamer forcing the barrier which had hitherto formed their shelter. We found plenty of remains of them in the shape of huts, graves, fox-pits, &c. The naturalists gathered here a quantity of fresh materials of the fauna and flora of East Greenland, among which I may specially mention the well-known *Potentilla anserina*, which is found so often near the Norse ruins in West Greenland, and which may, for that reason, be a sign of the Norse colonisation of East Greenland. We found traces of reindeer, but none of the musk-ox; neither did we see any bears or walruses, and only a few seals. Our whole bag was two ptarmigans.

[1] North of the Polar circle the east coast of Greenland is in many places easily accessible.

That the Esquimaux had decamped was very annoying, as they could no doubt have given some valuable information relating to this part of Greenland and the tribes which inhabit it."

After reconnoitring the coast still further, Baron Nordenskjöld decided that his best course was to return at once to Reikjavik. Before doing so, however, some hours were spent in dredging and in hydrographical research, as well as in photographing some of the coast scenery.

"Having thus given an account of the work of my expedition, I have to point out that we have been the first to penetrate into the heart of Greenland, and that our journey has resulted in learning something about this continent, the natural conditions of which may probably give us a clue to the true condition of Scandinavia during the Glacial period, the study of which is therefore of such great importance to the geology of North Europe. Besides this, valuable scientific data have been collected during my voyage along the east coast of the composition of the ice-belt which bars the way *from the east* to the southern part of Greenland, while many errors as to the state of the east coast of Greenland have been corrected. In addition to these objects one more has been attained, viz. the anchoring of a vessel by the shore of East Greenland, an achievement attempted in vain for centuries. If thus the work of the numerous expeditions despatched since the sixteenth century by sea to the part of Greenland lying opposite or south of Iceland to the part where the Norse Österbygd was or was not situated, it will be found that not one of them succeeded in reaching the coast.

"A few words more in conclusion as to the purely scientific results of the expedition. During the voyage of the *Sophia* along the coast of Greenland from Cape Dan past Cape Farewell to Cape York, and further from Cape York around Cape Farewell to Ingolf's Mountain, hydrographical researches and dredgings were effected whenever time and weather would permit. These labours were conducted by Herr Hamberg and Dr. Forsstrand. In addition, Herr Hamberg effected a number of analyses of sea water, and the gases contained therein, from various depths, while he brings home a series of the most carefully effected measurements of the temperature of the sea, which demonstrate that the *cold current* running along the east coast is, both in width and depth, very insignificant, and rests *even near the shore* upon one of warm water produced by the Gulf Stream. Davis Sound and Baffin's Bay, on the other hand, are filled with cold or very slightly warmed water *to the bottom*. Contrary, therefore, to the general belief, *the west coast of Greenland is washed by cold water, while a greatly heated current coming from the south runs along the east coast a distance of* 40′ *to* 50′ *only from the shore*. This current must exercise a great influence on the climate of the east coast, which may be more moist, but, I believe, not colder than that of the west coast.

"The dredgings have yielded Dr. Forsstrand a fine harvest of marine animals, &c., of which I may mention gigantic sponges from great depths in Denmark Sound (between Iceland and Greenland). The dredgings on the east coast were, however, greatly impeded through causes detailed above, and by the circumstance that the bottom consists mainly of huge boulders, which tore the net. Of the animal species existing on land or in fresh water, Herr Kolthoff has collected rich fresh materials of the Greenland fauna. Especially will the variety of insects collected be of great instructive value to science. On account of the limited accommodation on board, and from the circumstance that the flora of Greenland is well known through Danish and Swedish specialists, I took no botanist with me. But even in this field new materials have been gathered through the zeal given to such researches by Dr. Nathorst and Dr. Berlin whenever time permitted. The collections of microscopical plants

which have been made, the true place of existence of which is the ice and the snow, must particularly be of great value. They are besides of additional interest to the expedition, as they belong to a new branch of science which has in the first instance been created by Swedish *savants*. The collections, perhaps, of most value to science have, however, been made by Dr. Nathorst from the North-West Greenland so-called basalt formation, which is remarkable for the quantity of fossil plants contained in the clay, sand, and tuff strata there. Of course some very fine palæontological collections have been brought from these parts before, especially by the Swedish expedition of 1870, and by some Danish ones under Dr. K. Steenstrup; but it is the first time that a palæontologist has visited this spot, and I am, in consequence, convinced that the objects gathered by Dr. Nathorst, when scientifically treated, will yield many new data on the copious flora which once covered the ice-laden regions round the Pole.

"Finally, the expedition has brought home some splendid specimens of the remarkable minerals found at the well known deposits at Kangerdluarsuk and Ivigtut, while I have on the inland ice collected, as previously stated, a great many samples of the dust found on the ice, and which I have named kryokonite. I hope, when this has been exhaustively analysed, to be able to furnish fresh proofs in support of the theory that this deposit is, at all events partly, of cosmic origin, and thereby contribute further materials to the theory of the formation of the earth. Dr. Nathorst was, as previously stated, prevented by the ice from reaching Cape York and examining the blocks of ironstone lying there, but their existence has been corroborated beyond doubt by the Esquimaux in the neighbourhood. Here the expedition obtained some valuable ethnographical objects, and it learnt a fact from the natives which may be of considerable importance as to the question of the wanderings of the tribes around the Pole, viz. that four 'Russian Esquimaux' had come to Wolstenholme Sound. They said they were the last survivors of a tribe which had left their place of habitation by the Behring Strait (or the northern shore of Asia?) in search of a new place of settlement, and who had at last reached Smith's Sound. These are the results of my expedition to Greenland in the *Sophia*. The scientific collections made will be distributed among the museums of my country."

A. E. NORDENSKJÖLD

THE ROTHAMSTED GRASS EXPERIMENTS[1]

THERE is at Rothamsted nothing which will more impress the visitor than the seven acres of meadow land in the Park, the many years' experiments upon which with different manures constitute the subject of the above-named memoir. The twenty parallel plots into which the area is divided appeal at once and forcibly to the eye by the obvious differences in their herbage. A plot here with rich green grasses waving luxuriantly upon it; another, on which the yellow meadow vetchling apparently constitutes the leading feature; a third, irregular, patchy, and much afflicted with the sorrel-dock; and yet another, on which, at the time of our visit (August), the white-flowered umbels of the earth-nut put everything else in the shade,—these and the like appearances convince with an eloquence which the pen is powerless to imitate.

The land in Rothamsted Park has probably been laid down with grass for some centuries. No fresh seed has been artificially sown within the last fifty years certainly, nor is there record of any having been sown since the grass was first laid down. The experiments commenced in 1856, at which time the herbage appeared to be of uniform character. With few exceptions the same description of manure has been applied year after year to the same plot; and two plots, the third and twelfth, have been continuously unmanured. For the first nineteen years the first crop only was cut and carried away, and the second crop was usually fed off by sheep who were receiving at the time no other food. Of recent years it has been more and more the practice to make the second crop also into hay, and it is intended to adhere to this plan in future, weather permitting.

The produce of every plot is weighed as hay, and the result calculated per acre. Taking the average of the first twenty years, the unmanured plots, 3 and 12, gave the lowest yields of all, 21¼ and 24 cwt. respectively. Next above these is plot 5, manured with ammonia salts[1] at the rate of 400 lbs. per acre per annum, the yield giving an annual average of 26¼ cwt. per acre. The highest average recorded, 62½ cwt. per acre, resulted from a mixed manure, containing 500 lbs. sulphate of potash, 100 lbs. sulphate of soda, 100 lbs. sulphate of magnesia, 3½ cwt. superphosphate of lime, 600 lbs. ammonia salts, and 400 lbs. silicate of soda,—a tremendous dressing, by the way. The average yields on the other plots, each one of which received different manurial treatment from that of the others, range themselves between these extremes.

But the mere quantitative estimation of the results was a comparatively simple task to that of making a qualitative examination of each crop. The proximate analysis was into the three classes of gramineous herbage, leguminous herbage, and miscellaneous herbage, the last-named containing all plants not referable to the Gramineæ or the Leguminosæ; and even this task would not be a very difficult one. But when it is stated that in certain seasons a complete botanical analysis was made, whereby each species of plant was separated from all the others, then the irksomeness of the work will be appreciated. For the details of these analyses we must refer to the memoir itself, but the following is worth reproducing. "To quote an extreme case in illustration of the difference in the character of the herbage, and of the difference in the degree of difficulty of separation accordingly, it may be mentioned that whilst a sample of 20 lbs. from one plot in 1872 only occupied from four to five days in botanical analysis, a sample of equal weight from another plot in the same year occupied thirty days."

The total number of different species of plants that have been detected on the plots is 89; of these, 20 are grasses, 10 are leguminous, and the remaining 59 belong to miscellaneous orders. The 89 species comprise 59 dicotyledons, 26 monocotyledons, and 4 cryptogams, 3 of which are mosses (Hypnum); they are arranged under 63 genera and 22 orders. Of the miscellaneous plants there are 13 species of Compositæ, 6 of Rosaceæ, 5 each of Ranunculaceæ and Umbelliferæ, 3 each of Labiatæ, Polygonaceæ, Liliaceæ, Caryophylleæ, Scrophulariaceæ, and Musci, 2 each of Rubiaceæ and Plantagineæ, and 1 each of Cruciferæ, Hypericineæ, Dipsaceæ, Primulaceæ, Orchidaceæ, Juncaceæ, Cyperaceæ, and Filices. Six genera only were represented by more than one species; these were Ranunculus, 5 species, Rumex 3, and Potentilla, Galium, Leontodon, and Veronica, 2 each. The 20 species of grass comprise 14 genera; Festuca is represented by 4 species, Avena by 3, Poa by 2, and Anthoxanthum, *Alopecurus*, Phleum, *Agrostis*, Aira, *Holcus*, Briza, Dactylis, Cynosurus, *Bromus*, and Lolium by 1 each. The fact that the four genera whose names we have italicised were only represented by one species each serves to indicate somewhat the nature of the land. Had it been wet or marshy in parts, *Alopecurus geniculatus* might have been looked for as well as *A. pratensis*. Had not the plots

[1] "Agricultural, Botanical, and Chemical Results of Experiments on the Mixed Herbage of Permanent Meadow, conducted for more than twenty years in succession on the same land." Part ii., the Botanical Results. By Sir J. B. Lawes, Bart., F.R.S., Dr. J. H. Gilbert, F.R.S., and Dr. M. T. Masters, F.R.S. *Phil. Trans.*, Part iv., 1882. Pp. about 250.

[1] "Ammonia salts"—in all cases equal parts sulphate and muriate of ammonia of commerce.

been quite away from hedgerows, several species of Bromus might have accompanied *B. mollis*, while *Arrhenatherum avenaceum* and *Brachypodium sylvaticum* might also have been looked for. The total absence of Glyceria further shows the fairly dry character of the soil. Lastly, the 10 species of Leguminosæ fall under 5 genera—of Trifolium 4 species, Lotus and Vicia 2 each, Lathyrus and Ononis 1 each.

Ten species of grasses occur on all the plots: *Anthoxanthum odoratum*, *Alopecurus pratensis*, *Agrostis vulgaris*, *Holcus lanatus*, *Avena flavescens*, *Poa pratensis*, *Poa trivialis*, *Dactylis glomerata*, *Festuca ovina*, and *Lolium perenne*. *Festuca eliator* was only found in one plot, and *F. loliacea* in two. *Phleum pratense* occurred in about one-fourth the number of plots, *Aira cæspitosa* in about one-half, *Briza media*, *Cynosurus cristatus*, *Festuca pratensis*, and *Bromus mollis* in sixteen or seventeen. No leguminous plant occurred in all the plots, but *Lathyrus pratensis* was found in nineteen plots, *Trifolium repens* and *T. pratense* in seventeen, *Lotus corniculatus* in sixteen, and *T. minus*, *T. procumbens*, *L. major*, *Ononis arvensis*, *Vicia sepium*, and *V. Cracca* only in one each.

These details will serve to indicate the nature of the flora of the plots. Certain miscellaneous plants common on many old pastures in this country are conspicuous by their absence. The dry and level character of the meadow will account for the absence of Caltha and Juncus. No species of Geranium is recorded. But the most noteworthy fact appears to be the absence of certain scrophulariaceous genera, which are by no means uncommon on old grass lands, namely, Bartsia, Euphrasia, and Rhinanthus. The quality of the land is probably too good for the first two, and the application of manure would certainly be against Euphrasia, but *Rhinanthus Crista-galli* is very common on old meadows, as, for example, in Derbyshire and Worcestershire.

The object which the authors kept in view in writing this section of their report was, in their own words, "to show both the normal botanical composition of the herbage, and the changes induced by the application of the different manuring agents, and by variation in the climatal conditions of the different seasons; and, as far as may be, to ascertain what are the special characters of growth above ground or under ground, normal or induced, by virtue of which the various species have dominated, or have been dominated over, in the struggle which has ensued." At the outset it was noticed that those manures which are most effective with cereals grown on arable land were also most active in increasing the quantity of grass amongst the herbage, and that the manures which are most beneficial to beans or clover produced the greatest proportion of leguminous herbage. Thus, the highest gramineous produce resulted from a highly nitrogenous manure, such as ammonia salts or nitrate of soda, with alkaline salts, particularly potash; but side by side with the increase in the total gramineous herbage there was a decrease in the actual number of species of grass. On the other hand, the highest percentage of leguminous produce was the result of a mixed mineral manure with potash. The percentage results on the following plots illustrate these points:—

	Plot 7	Plots 3 and 12.	Plot 11.
Gramineæ ...	61·78 ...	67·43 ...	94·96
Leguminosæ ...	22·71 ...	8·20 ...	0·01
Other Orders...	15·51 ...	24·37 ...	5·03
	100·00	100·00	100·00

Plot 7 was the most favourably manured for leguminous produce, it received mixed mineral manure alone, including potash; plots 3 and 12 were the two unmanured ones; plot 11 was the most favourably manured for gramineous produce, it received 800 lbs. ammonia salts with mixed mineral manure, including potash.

Special observations and complete botanical separations made at intervals of five years to determine the influence of seasonal variations show that "a given quantity of the produce grown under the same conditions as to manuring might be composed very differently in two different seasons."

The influence due to the special medium through which a particular plant-food, such as nitrogen, is presented to the plant, is aptly illustrated in the following extract:—"Because a particular grass, or other plant, is little benefited by ammonia salts for instance, it does not follow that it will not be favoured by nitrates; nor, because if while growing in association with other species it may not be specially benefited by a particular manure, does it follow that it would not derive advantage from the same substance when growing separately."

Nearly all the plants on the plots are perennials, very few are annuals, *Bromis mollis* being the only case amongst the grasses. The advantage possessed by deep-rooting over surface-rooting plants was well brought out in the droughty season of 1870, when the latter suffered considerably from lack of moisture. The locomotive power of underground stems is of great use to some plants: "the stock continues to grow at one end, year after year, the opposite end gradually dying away. In the course of a few years the plant therefore occupies quite a different position from that which it at first had." Notwithstanding the general rule that the chief effect of nitrogenous manures is to favour the extension of foliage and give it depth of colour, while that of mineral manures is to encourage stem formation and the production of seed, and notwithstanding that excessive nitrogenous manuring prolongs the development of the vegetative organs till perhaps the resources of the plant are exhausted or the season is over, while excess of mineral manures may induce premature ripening, yet so far as the experiments have gone no absolute change in the distinctive form of any plant has been effected by the prolonged use of the different manures, though changes of degree are sometimes very marked, as in the tufts of *Dactylis glomerata*.

The battle for life between the various species of plants growing in the meadow is dependent much less on the chemical composition of the soil than on its physical character, its capacity for holding water and its permeability to roots. The immediate source of victory lies very generally in the powerful root-growth of the survivors, the term "root" here covering all kinds of underground stem. The various influences affecting the struggle for existence amongst meadow plants are discussed by the authors in a fascinating manner, and this part of the memoir is of special value to the botanical student.

Every plant occurring on the plots is dealt with individually, and in the case of each grass and leguminous plant and of the more commonly occurring weeds, a table showing the relative predominance is given. The fact that plants closely allied morphologically may yet differ widely in their physiological endowments is strikingly illustrated by the two species of Poa, *P. trivialis* and *P. pratensis*. These two plants, sprung at no very distant period from a common ancestor—for this, we presume, is the morphological significance of their being placed in the same genus—differ only in the most trivial points: *P. pratensis* is smooth, stoloniferous, and has a blunt ligule; *P. trivialis* is rough, has no stolons, and possesses a long pointed ligule. We read that "the stolon-bearing *Poa pratensis* is specially benefited by nitrogenous manure in the form of ammonia salts (in combination with mineral manure), but not at all by nitrate of soda, whereas the more finely-rooted and non-stoloniferous *Poa trivialis* has declined markedly on the ammonia plots, but has remained very prominent on the nitrate plots, especially where the larger amount of nitrate was used with the mixed mineral manure." Thus in 1872, on plot 9 (mineral

manure and ammonia salts) *P. pratensis* gave 22·67 per cent. of the total produce, and *P. trivialis* only 0·64; on plot 14 (mineral manure and nitrate of soda) *P. trivialis* gave 24·76, and *P. pratensis* only 2·57 per cent. It is suggested that the relatively shallow-rooting *P. trivialis* predominates on the nitrate plots by reason of its fine surface-roots arresting and taking up the nitrate before it has had time to penetrate too deeply; this plant invariably makes rapid growth upon the application of the nitrate of soda in the spring.

The remaining portion of the memoir is devoted to a discussion of the botany of each separate plot in each season of complete botanical separation, and is carried out with the same elaborate detail as the earlier portion. No one can read this memoir without being impressed with the great power, too frequently overlooked, possessed by the subterranean members of the plant body in deciding the struggle for existence; much of the internecine warfare is carried on in the dark.

It is quite possible, and indeed probable, that, had a similar series of experiments been simultaneously carried out in another part of England with a slightly different climate, and on a different kind of soil, the results might have differed, but only in slight details. Such a splendid series of experiments on grass land has never before been consummated, and the memoir embodying the results will well repay the most careful study and perusal not only of the agriculturist, but of the botanist, the chemist, and the evolutionist. It may perhaps be long before the great lessons learnt in Rothamsted Park have filtered down to those to whom they should be of most practical value, but we do not despair of a time coming when the intelligent manuring of grass lands for very specific objects will form a part of ordinary agricultural practice. Those who will put their hands to the plough in the field of agricultural research must be content to trudge along, laboriously and unnoticed, in the furrow. Their discoveries cannot be made in a week, or a month, as are many in electricity or in chemistry, but, like those at Rothamsted, which are now in their twenty-eighth year, and are still going on, they can only be looked for, even after the expenditure of much thought and of unflagging industry and perseverance, as "the long result of time."

W. FREAM

PALÆOLITHIC MAN—HIS BEAD ORNAMENTS

EVERY one who has noticed the objects found in caves of Palæolithic date knows the evidence which supports the idea that cave men wore bracelets and necklaces, but the evidence that the older river-drift men wore similar ornaments is more obscure. Still, when one notices the extreme beauty and precision of make of some Palæolithic implements, one cannot help surmising that the more ancient savages of our old river sides also had sufficient personal pride and ideas of ornament to sometimes decorate their bodies with beads in a similar fashion with the cave dwellers.

Dr. Rigollot ("Mémoire sur des Instruments en Silex," p. 16) refers to the well-known foraminiferous fossil from the chalk—*Coscinopora globularis*, D'Orb. (sometimes found in river gravels with Palæolithic implements), as beads probably used by Palæolithic men; and Sir Charles Lyell ("Antiquity of Man," p. 119) says: "Dr. Rigollot's argument in favour of their having been used as necklaces and bracelets, appears to me a sound one. He says (Dr. Rigollot) he often found small groups of them in one place—just as if, when swept into the river's bed by a flood, the bond which united them together remained unbroken." Mr. James Wyatt of Bedford, in describing these bead-like fossils (*Geologist*, 1862, p. 234), says he had examined more than two hundred specimens, and on making sections of some of them he saw markings which appeared to indicate "drilling with a tool after the object was fossilised." In specimens from the chalk the hole through the fossil, though commonly straight, exhibits of course no artificial drilling but shows the structure of the foraminifer.

I am not aware of any confirmation hitherto made of the two curious observations noted above, but so little is at present known of the habits of river-drift men that the following notes may prove of some interest. Where there is so much darkness the slightest glimmer of new light is welcome.

After long searching for the Coscinopora at Bedford without result, I lighted on many examples at Kempston in 1880. In this year I found in a few days over two hundred examples; they occurred with unabraded implements and flakes and carbonised vegetable remains. After this date the Coscinopora again ceased, and from then till now I have met with but few examples. The finding of the above-mentioned large number of specimens all congregated together appeared to lend some confirmation to Dr. Rigollot's view, for it seems unreasonable to believe that so large a number could by any natural possibility find a position in one place in any river gravel.

As my examples were found at Bedford, at a place where Mr. Wyatt must at one time also have found a considerable number, I naturally examined the specimens carefully to see if I could trace any artificial drilling or enlargement of the natural hole. I speedily noticed that the surface round each orifice in many of the beads was abraded as if by the constant contact of the bead next on a string. A few of the beads also had the hole artificially enlarged, sometimes at both ends, as at section A, sometimes in the middle, as at the section B, and sometimes at one end only, as at the section C. The dotted lines in these illustrations show the original natural orifice, the solid lines near the dotted ones show the enlargement by artificial drilling. The illustrations are all actual size. In most of the instances the drilling appears comparatively fresh, in others less so, but it must be remembered that the implements found with them were mostly unabraded, and vegetable remains were found. These specimens were found by myself. They were not touched or manipulated by the workmen. Other examples of these beads had one end near the orifice broken away as if in an attempt to enlarge the opening by breaking the substance of the fossil away as at D, E, F.

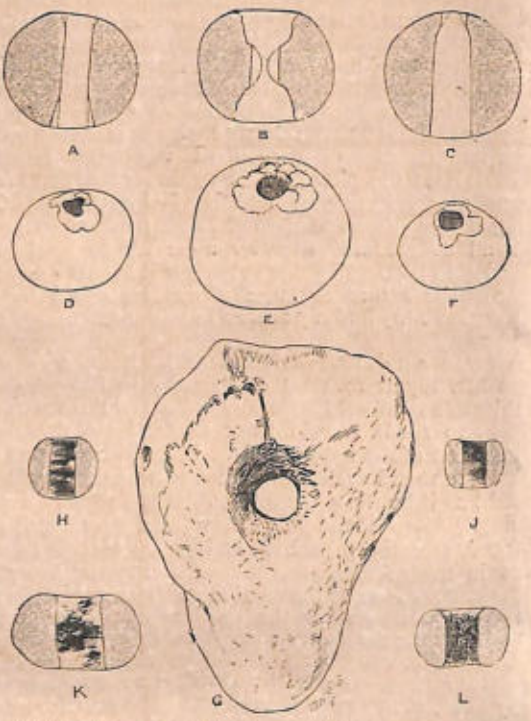
Whilst looking through the fallen material in the pit, the piece of naturally perforated fossil shell, illustrated actual size at G, attracted my attention. The hole is probably due to a shell-boring mollusk, but when I saw the object in the drift I distinctly noticed that a black substance entered at one side of the hole and emerged at the other; at the moment of picking the object up, this material fell to dust with part of the very friable surface of the fossil shell.

Some of the beads (as seen in section at H, J, K, L) also bore very distinct traces of a similar black substance within the orifice, although not seen till the sand and part of the black substance itself had fallen out. This black material I took to be the remains of part of the ligament on which the beads were originally strung by their Palæolithic owner, and with this idea in mind I sent some to an analytical chemist, who examined the material for me with the following result:—

"The testing for nitrogenous organic matters, of which animal tissues are composed, was tested in the same manner as testing water for such matter, that is, by converting it into ammonia; precautions were of course taken to eliminate from the results any ammonia already existing. The amount of ammonia was strikingly evident and showed with each bead examined separately. The blackening of the organic matter in the holes of the beads

may have taken place in a manner similar to that of the formation of coal."

On testing the beads, which consist chiefly of carbonate of lime or chalk, without the black material in the orifice, the chemist reported that, "when treated in the same manner as those originally sent, they show the presence of a considerable amount of heterogeneous or animal organic matter, as was to be expected from their origin—but not, I think, so much as those with the black deposit."



Palæolithic Bead Ornaments (*Coscinopora globularis*, D'Orb.), showing traces of the original ligament and artificial enlargement.

Mr. A. Clarke, analytical chemist of Huddersfield, who also made an analysis for me, reported as follows :—

"I divided the bead into three portions. No. 1. The thin dark crust forming the internal portion of the ring; this is most certainly organic matter. No. 2. A powdery part between No. 1 and the main body of the ring, consisting of small quantities of carbonates of iron and lime. No. 3. The outer main body of the ring, mostly carbonate of lime, and a small quantity of silica; here there is only a trace of organic matter, but it is most distinctly present."

WORTHINGTON G. SMITH

IS IKTIS IN CORNWALL, AND DID IRON AND COPPER PRECEDE TIN?

AT Penzance on October 19, 1883, I asserted that the invention of tin-smelting was Cornish, but disputed the claim of St. Michael's Mount to be the sole claimant to the title of Iktis, the tin-shipping port described by Diodorus Siculus 1800 years ago, and I thought the inventions of metals were in this order: (1) iron, (2) copper, (3) tin. We may consider the Romans invaded Britain purposely to obtain its metals, which were then worked extensively by the British inhabitants. I believe the Romans either adopted Celtic names of places or things, or translated their meaning. I find the Cornish district, or Land's End, described by Ptolemy the geographer in the second century as "Belerium," that is the land of mines, "bal" being Cornish for a mine. The word is also met with in Irish. In the same manner the skin boats used by the Cornishmen, which so much astonished the Greek travellers, were described by the Greeks under the name of "coracles," evidently a Celtic word from the Celtic root "cren" or "croen," skin. So tin, I think, is derived from the Irish word "teine," Welsh "tan," teine probably also expressing brightness. Even in the Malay Peninsula, in the East Indies, a word of similar sound, "timah," still stands for "tin," and not the Greek term for that metal "kassiteros."

Then the Cornish term "iarnn," for iron is similar to English "iron," German "Eisen," Welsh "haiarn," Greek "seiderion," in which *ei* is the important syllable. The Latin word "ferrum" is probably a form of "ierrum," and the Sanskrit "ayas" is for iron, metal. Nearly the same word for iron is therefore used in all the Aryan languages, while "æs" or "kalkos" stands for bronze or copper, and has only a comparatively local extension. The wide spread of the name for iron, or *ei*, is important, as it points to iron being the metal made before the division of the Aryan race, and therefore before copper or tin.

There is another and I believe new argument. The most easy process of copper-smelting, which even now is largely used, may have been the only plan known in prehistoric times. To use this process it was necessary to provide iron to precipitate copper from solution. At the present time 6000 tons of iron are sent annually to the Rio Tinto mines in Spain from Great Britain in order to precipitate the copper from solution.

It is possible that the discovery of the art of producing crude iron, which would be useful for precipitating copper, may have preceded the invention of bronze, and yet the art of forging difficult pieces may have been a later invention than that of casting bronze celts in metal moulds.

Iron, if not steel, appears to have been made in Egypt both in hearths and in crucibles certainly before 3124 B.C., but bronze was more used in Greece up to 650 B.C. than iron.

The smith in the sagas and folklore is the important person, not the caster or founder of bronze weapons. Why was the smith so important? Because he melted the small particles of gold found in the streams into small lumps, and with his hammer drew them out into wire and thin plates. Gold was made in such small quantities that it did not require large crucibles such as would be necessary for bronze. As iron was made by a simple welding or forging process, its production appears to be a more ancient art than bronze casting, which required large crucibles and mixing in exact proportions with tin, a process more difficult than in the infancy of metallurgy was likely to be invented. Then one ore of iron, ochre was the first metallic ore collected, long before the discovery of any of the metal. Ochre is found collected for use as a paint to ornament the cave men in the Palæolithic period, and is associated with limestone and charcoal. Accident in the fire might have thus led to the discovery of metallic iron in very early times. Such particles of iron placed in a certain stream in the Island of Anglesea (an early peopled district) would precipitate the copper in solution in that stream in a state of pure copper ready to mix with tin to make bronze.

Another point of great interest in this question is the position of Roman roads, proving a prior metallurgical trade, and therefore some considerable civilisation. The Romans erected their Roman villas and camps always near Roman roads, and these roads appear always arranged for military or metallurgical purposes, never for protecting agriculture, or levying imposts on the Britons. There is historical evidence that the Romans did not introduce metallurgy into Britain.

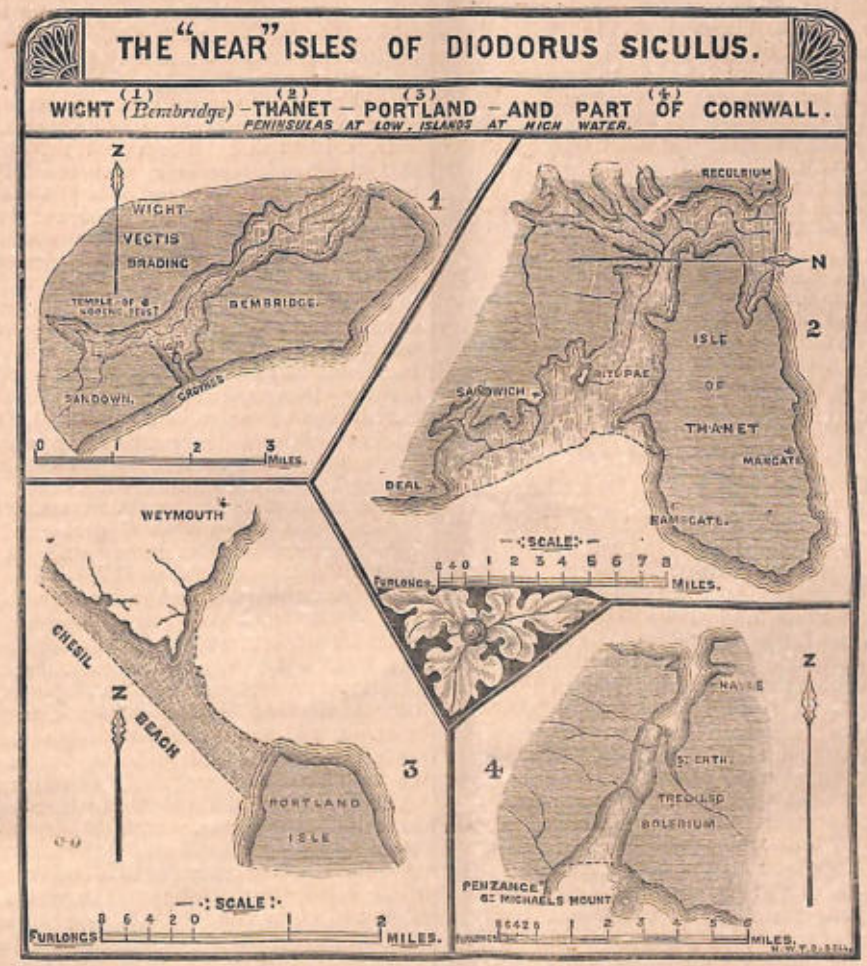
We may observe there is a great concentration of Roman roads at Winchester (Venta Belgarum). Roads meet at the point of junction from Exeter with this town, for bringing Cornish or Dartmoor tin, or lead and iron from the Mendips, to the Hampshire coast; iron from

South Wales, and lead from North Wales. There were, near Winchester, several great ports for Continental trade, viz. Magnus Portus (Portsmouth), Trisantonis and Clausentum (Southampton). Winchester is near Beaulieu. Below Beaulieu, six miles, is Stansoar (stone) Point, from "stannum," tin. This is nearly opposite Gurnard's Bay (Gubernators, across the Solent two miles), where there are remains of Roman villas. Thence to Newport and Brading, where the great Roman discoveries have been recently made. Among the "Islands of Britain" Ptolemy gives one as "Vectis," in Celtic Wyth.

Now Vectis has been hitherto treated as if it were only the name of an island, the Isle of Wight; but vectis is really the Latin term for a bolt, or security, and was probably applied to harbours, and is a translation of "Gwyth." A lock means also a canal lock.

If Prof. Rhys is right,[1] that "Ictis" and "Itius" are the same word, we may go further and say that the Portus Itius, from which Cæsar started from Britain, containing his 800 ships, was merely a technical term for a vectis or secure harbour attached to a town, such as that at the mouth of the Liane (Boulogne). It is only a century and a half since the natural basin of Boulogne has been partly filled up by the sea sand, and there was an estuary supplied by the Liane stream at the time of Cæsar, not unlike those drawn by me in shape, but without a through passage.

In fact, not only along the English coast, where



Dungeness Beach has blocked up the Roman Port Lymne, and the points where four islands have been joined to the mainland, as shown in the drawings, Figs. 1, 2, 3, and 4, but on the French coast great changes have been made by the same causes. At Sangatte and Calais, Wissant, Ambleteuse, Boulogne, St. Michael's Mount, and in fact at many places along the coast of the Pays Bas, the same filling up can be observed.

Cæsar's port of embarkation, Portus Itius, may have been named in the same sense as, according to Prof. Rhys, the old Irish wrote of the English Channel, viz. as Muir an Icht, which he renders the Sea of Icht, and which, according to the view I suggested, would be the sea of the passage, evidently a different meaning, although from the same roots, to the name, which, with the addition of Portus, we find in Cæsar. The term Portus Itius evidently was applied by the Roman writers to the harbour of Boulogne, although the city itself was called Gessoriacum. I think this philological explanation and the fact of the distance from Portus Itius (given by Strabo) thirty miles to Britain, removes every difficulty in the way of settling the position of the port from which Cæsar started. Of course the term Portus Itius might also apply to St. Valery-sur-Somme, where a passage has been partly closed, as at Marazion, in the historical period, but the distance given by Strabo is against it. Species of mollusks are found at both places, Marazion and St. Valery, not now living on the coast, and probably

[1] In a letter to A. Tylor, November 6, 1883.

these estuaries or passages were only entirely open in the Crag period.

I have said Vectis is equivalent with the Celtic word "gwyth," a passage. Now there is a closed passage or haven (a gwyth, or vectis, or iktis) from Sandown to Bembridge in the Isle of Wight (Fig. 1). From this passage the whole island gets its name "Gwyth" in Celtic, Latin "Vectis," Saxon "Wiht," English "Wight," never spelt "White," although it has white chalk cliffs.

The safety of any of the harbours called Vectis or Iktis arose from the fact of these islands (or parts of them) near the coast of Britain being peninsulas at low water and islands at high water. These were, therefore, typical natural harbours. The Greek writers, Diodorus Siculus and others, insist particularly upon this property of change with the tide. The remarkable tide contrasted strongly with the different circumstances in the Mediterranean. Now the prevailing winds on the south coast of England have caused modern beaches to form, particularly at all of these four passages on the south coast of England, and many of the passages have been closed, as we know, in the historical epoch. Their ancient form is clearly shown in my woodcut. Now the sea is entirely shut out by modern beaches and works.

The drawings show the changes which have occurred in Fig. 1, the Isle of Wight. Fig. 2 is the passage between the Isle of Thanet and Kent, closed in the historical period between Ritupæ and Regulbium. In Fig. 3, the Chesil Bank, has filled up the old waterway between the Isle of Portland and the mainland. Fig. 4, passage from St. Michael's Mount to Hayle. Gravel and stream tin-drift, closing up the ancient passage from near St. Michael's Mount at Marazion to Hayle.

The type of all that has happened is well seen, Fig. 1, Vectis, the Isle of Wight. Even in 1670 there was only a groyne and a small alluvial deposit near Sandown. Nearly all the passage to Bembridge was an estuary; now it is nearly all dry land.

The term "vectis" in Latin, or "iktis" in Greek, was no doubt applied to all the passages in these four islands.

The Cornish tin no doubt came in coracles, and by land on horses, to Magnus Portus or to Stansoar Point for shipment to Brading, and was shipped from these Hampshire ports and Isle of Wight ports to the banks of the Seine, to be carried on horseback in thirty days to Marseilles. Thus both the Bembridge peninsula and St. Michael's Mount were shipping places for tin, and both were properly called Iktis and Vectis, and as usual we find there was no error in the Greek observations.

Then as to the period when the contour lines of the south coast began to change. The Crag period was that in which the great estuaries round the British coast began to be filled up. Then pebbles and sand were driven along the coast. I believe all the four channels in the drawing, were open in the Crag period, and gradually closed up in the long period which intervened between the Crag and the present time. The continuous filling up has also occurred in the estuaries and passages on the opposite coast of the English Channel. It is probable that Portus Itius, at Gessoriacum? (Boulogne) obtained its name in a similar manner to Vectis and Iktis as I have already stated.

We find pure iron B.C. 3124 in Egypt. If iron was a necessity for the production of copper, and the metal tin was of no use without copper, we may place the inventions of the metals in the following order: (1) iron, (2) copper, (3) tin.

A. TYLOR

THE BEN NEVIS OBSERVATORY

SINCE the formal opening of the Observatory on October 17, workmen have been engaged in fitting up and finishing the interior, and pushing forward the provisioning of the establishment with tinned meats, biscuits, tea, coffee, &c., capable of lasting for six months, with fuel for a like period. Nothing that could be thought of has been left undone to render the observers as comfortable as possible during the winter. The telegraph cable is now in working order from the Observatory to Fort William, so that communication is always possible with the outer world. Mr. Omond, the superintendent, and his two assistants took up their residence on the top of the Ben about a fortnight ago; and it is extremely gratifying to learn that the building, every part of which during erection, and for some time after being roofed over, was soaked with water, is now thoroughly dry; the walls, roof, and windows have been officially inspected, and found to be perfectly tight in every respect; and in corroboration of this, during the storm of Thursday, the 8th inst., none of the finer snow particles of that elevated region entered the dwelling. As an additional protection against the severe weather which may happen, a large roll of tarpaulin, thirty-five feet long, was carried on the shoulders of twelve men to the top on Monday last week, and securely fixed over the roof of the building.

In a letter dated the 14th inst., Mr. Omond states that the Sunday previous was one of the finest days he ever saw; that Monday and Tuesday were nearly as good; and that on the Wednesday only the distant view was shut out by haze. Up to that date the top of the Ben had been all but free from stormy weather; indeed, while tempestuous weather raged below, the wind rose to a gale only on Thursday the 8th. A telegram was received direct from the Observatory on Thursday last week, which stated that the temperature for the day had been minimum 17° and maximum 28°, while inside the Observatory the temperature was 55°, which happened to be exactly the temperature of the Scottish Meteorological Society's office in George Street at the time.

A meeting of the directors was held at Edinburgh on the 15th inst., Sir William Thomson in the chair, at which Dr. Sanderson, the Treasurer, reported that the subscriptions now intimated amounted to a little over 5000*l.*, nearly three-fourths of which sum had been subscribed since the middle of May last.

A scheme of work for the coming winter, consisting of hourly observations by night as well as by day, was agreed upon. The observations include the barometer; dry, wet, maximum, and minimum thermometers; direction and force of the wind; rain, sleet, snow, and hail; evaporation from snow; species, direction, and velocity of upper and lower cloud strata; and sunshine, together with thunder, lightning, halos, auroras, meteors, &c. In addition to the regular observations, Mr. Omond is to conduct physical inquiries into the hygrometry of this boreal climate by an instrument specially designed by Prof. Chrystal; inquiries as to the direction and speed of the wind and optical phenomena by instruments specially designed by Prof. Tait; and inquiries as to the best modes of conducting the observations under the special difficulties presented by the climate of Ben Nevis.

All the hourly observations will be extended on a daily sheet, three copies of which will be made, one for the Observatory, and two for the Scottish Meteorological Society, one of which will be sent to the Scottish Meteorological Council, London. Forms have also been supplied for monthly summaries of the observations. It has further been arranged that a series of similar observations at 8 and 9 a.m. and 2, 6, 9, and 10 p.m. be made at Fort William by Mr. Colin Livingstone, one of the Scottish Meteorological Society's observers.

A Redier's continuously-recording barograph and a Richard's continuously-recording thermograph have been supplied to the Observatory, and also to Mr. Livingstone, to be used as interpellation instruments. By the double set of hourly observations thus obtained, comparisons may be made between the atmospheric conditions on the top of the Ben and those at sea-level, which are of such

vital importance in the larger questions of meteorology. It may be noted here that it was found necessary to take the barometer, which had been for upwards of two years exposed in the cairn to the severe weather of the Ben, to Edinburgh to be thoroughly overhauled. It has since been conveyed to its permanent place in the Observatory, and is in excellent order. The full equipment of the Observatory is delayed till next summer, when the directors will have before them Mr. Buchan's report on the instruments in use at the different European meteorological observatories he visited in the autumn, the work of the Observatory during the next eight months, and the results of Mr. Omond's investigations into different methods of observing on Ben Nevis.

NOTES

We deeply regret to announce the death of Sir William Siemens on Monday night, at the age of sixty years. His death is attributed to rupture of the heart, the result of a fall which he sustained a fortnight since. We must defer to next week a detailed notice of Sir William's career and work.

It is proposed to acquire for the Cambridge Museum of Comparative Anatomy the beautiful collection illustrating the fauna of the Bay of Naples, which Dr. Dohrn exhibited at the International Fisheries Exhibition. The cost will be only 80*l*., little over that of the glass jars and the alcohol in which the animals are preserved.

Lieut. Wissmann, the African traveller, has just left Hamburg again on another three years' exploration in the Congo region. He has undertaken to furnish the Royal Museum at Berlin with all the natural history specimens which he may collect during his travels, and has even been prevailed upon by some anthropologists to take plaster casts of all the races he may come in contact with.

The widow of the late Mr. John Elder, of Glasgow, has given the munificent sum of 12,500*l*. to the University of Glasgow for the purpose of endowing a chair of naval architecture.

We regret to learn of the death of Mr. James Stewart, C.E., who has done so much for the exploration of the region around Lake Nyassa. At the time of his death he was engaged in the formation of a road between Lakes Nyassa and Tanganyika.

Dr. Hector, F.R.S., stated at a recent meeting of the Wellington (N.Z.) Philosophical Society, that his two self-registering barometers had shown a remarkable up and down vibration on the revolving drum upon which the record is marked on dates corresponding with those of the Sunda earthquake, and a severe earthquake twenty-six hours afterwards, which was felt all along the northern coast of Australia. This agitation was quite distinct from those caused by ordinary atmospheric influences. He attributed the curious tidal disturbances which occurred on the New Zealand coast in August to those earthquakes.

In a letter from Maranhao, Brazil, the writer states that from August 31 up to September 6, the sun, until 7 a.m., could be looked at without the least difficulty, its light being as soft and pale as the moon's.

At its meeting, October 27, *Science* states, the Philosophical Society of Washington listened to a communication by Dr. T. N. Gill on the ichthyological results of the voyage of the *Albatross*, and to one by Prof. A. Graham Bell on fallacies concerning the deaf. Dr. Gill described two anomalous fishes, one of which required the institution of a new order.

Herr Jacobson, who has spent four years on the north-west coast of America in making ethnological collections for the Berlin Museum, has recently returned, and will sail for Europe. Dr. Leonhard Stejneger has arrived in San Francisco, *en route* for Washington. He has spent a year in Behring Island in the study of its fauna, and in collecting remains of the extinct Arctic sea-cow.

At the recent meeting of the American Association, Mr. C. V. Riley read a paper on "Some recent discoveries in reference to Phylloxera." Every new fact, he said, in the life-history of the insects of this genus has an exceptional interest, because of its bearing on the destructive grape-vine Phylloxera. The genus is most largely represented in this country by a number of gall-making species on our different hickories, and the full annual life-cycle of none of them has hitherto been traced. The galls are produced, for the most part, in early spring; the winged females issue therefrom in early summer; and thence forth, for the remainder of the year, the whereabouts of the insect has been a mystery. The author has for several years endeavoured to solve this mystery, and at last the stem-mother (the founder of the gall), the winged agamic females (issue of the stem-mother), the eggs (of two sizes) from these winged females, the sexed individuals from these eggs, and the single impregnated egg from the true female, have been traced in several species. There is some evidence, though not yet absolutely conclusive, that this impregnated egg hatches exceptionally the same season; also, of a summer root-inhabiting life. In *Phylloxera spinosa*, which forms a large roseate somewhat spinous gall on *Carya alba*, and which has been most closely studied, the impregnated egg is laid in all sorts of crevices upon the twigs and bark and in the old galls, in which last case they fall to the ground. Up to this time they have remained unhatched, and will in all probability not hatch till next spring, thus corresponding to the "winter egg" of the grape Phylloxera.

The *Times* Calcutta Correspondent, in speaking of the possibility of opening up Thibet to Indian trade by way of Darjeeling, states that the Prime Minister of the Lama at Shigatze, said to be a most intelligent man, sent recently to Darjeeling for a supply of English books, photographic and other scientific apparatus.

The piercing of the Arlberg Tunnel was unexpectedly completed on Tuesday afternoon last week. In length the new tunnel ranks third among the great tunnels of the world, its length being 10,270 metres, while the Mont Cenis Tunnel is 12,323, and the St. Gothard 14,900 metres. But while the excavation of the first lasted no less than fourteen years and a half, and that of the second about eight, the Arlberg Tunnel will have taken, when vaulted and ready to receive the first locomotive, not more than four years, thanks to the experience acquired during the construction of the first two Alpine tunnels, and to some innovations which constitute another important step in the art of engineering required for the construction of large tunnels. The engineers of the St. Gothard Tunnel introduced dynamite for blowing up the rock, already pierced through by the boring machine, which useful tool was naturally not disregarded in the construction of the new tunnel. It was also only natural that the Ferroux percussion boring machine, first introduced at the Mont Cenis works, should be again employed, under the supervision of the inventor himself, who in the meantime had considerably improved his powerful boring instrument; but this time the Brandt turning borer, first employed at the works of the St. Gothard, was allowed to compete with the Ferroux percussion borer, the former being used in boring on the tunnel's western side, and the latter on the eastern. To this end, several streams from the heights of the snow-covered Arlberg were gathered on the eastern side into reservoirs, from which two turbines and three water columns were directed to the machines, which compressed the air to five atmospheres, with

which the Ferroux borer was worked; while on the western side pumped water was pressed through pipes to the tension of over a hundred atmospheres, to work the Brandt turning borer, which cuts cylindrical blocks of rock from the mountain. The eastern entrance to the Arlberg Tunnel—namely, St. Anton—is 1300 metres above the level of the sea, while the western entrance is only 1215 metres, by which difference a good ventilation of the future railway tunnel seems secured. The vaulting and all other necessary works will be finished at the latest on August 1, 1884.

A MEETING has been held at Chester, presided over by the Duke of Westminster, to take steps to provide the city with a museum, which is intended to be a centre of scientific information for Cheshire and North Wales. North Wales was represented at the meeting by the Duchess of Westminster, Earl Grosvenor, and Sir Robert Cunliffe, Bart.; the Chester Natural Science Society by its president, Prof. T. McKenny Hughes; and the Chester Archæological Society by Dean Howson and Mr. H. Tollemache, M.P. It was decided that the building should accommodate both these societies and the School of Art. The Duke of Westminster announced his intention of giving the greater part of the proposed site, and 4000*l.* towards the building fund.

THE Council of the New University College of South Wales, at Cardiff, have resolved to try to raise 3000*l.* for mechanical laboratories.

THE inaugural meeting of the International Electrical Association took place in Paris on the 15th in the large hall of the Société d'Encouragement. M. Cochery was voted by acclamation Honorary President, and M. Berger Acting President. The number of adhesions exceeds 1000.

THE following is an illustration of what private enterprise may effect for the benefit of science. When the Swedish ship *Monark* was leaving Sweden last year for Australia the second officer on board applied to the Zoological Museum at Upsala for the loan of a trawl and some vessels for preserving natural history objects. The results have been a collection of some 120 species of fish, 50 of insects, some birds, and about 100 varieties of the lower sea fauna of the Pacific, which have now arrived at Upsala.

ON November 2 the Imperial Russian Academy of Science celebrated its hundredth year with great ceremony. Count Tolstoy, the President and Minister of the Interior, acted as chairman.

MR. GAMÉL of Copenhagen has placed the *Dijmphna* at the disposal of Lieut. Hovgaard for an Arctic expedition next year.

AT the Royal Institution Prof. Dewar will give six lectures at Christmas (adapted to a juvenile auditory) on "Alchemy in Relation to Modern Science." Before Easter, 1884, courses of lectures will be given by Mr. R. Stuart Poole, Professors McKendrick, Pauer, Tyndall, and Henry Morley, Capt. Abney, and others. The programme of the Friday evening arrangements will be issued shortly.

A SLIGHT shock of earthquake was felt on Friday at Malaga. A shock was also felt at Chios on the 16th. An earthquake occurred on the 19th at Vallo della Lucernia in the province of Salerno, Italy.

THE additions to the Zoological Society's Gardens during the past week include an Ourang-outang (*Simia satyra* ♂) from Borneo, presented by Mr. William Cross; a Grey Ichneumon (*Herpestes griseus*) from India, presented by Mrs. F. R. Flindell; a Hobby (*Falco subbuteo*), captured at sea, presented by Mr. C. Heat; six American Box Tortoises (*Terrapene carinata*), a Stinkpot Terrapin (*Aromochelys odorata*), seven Spotted Lizards (*Holbrookia maculata*), a Long-nosed Snake (*Heterodon nasicus*), two Striped Snakes (*Tropidonotus sirtalis*) from North America, presented by Mr. Samuel Garman, C.M.Z.S.; a Common Viper (*Vipera berus*), British, presented by Mr. W. H. B. Pain; a Greater Sulphur-crested Cockatoo (*Cacatua galerita*) from Australia, a Cerastes Viper (*Vipera cerastes*) from Egypt, deposited; a Sykes's Monkey (*Cercopithecus albigularis*) from East Africa, a Negro Tamarin (*Midas ursulus*) from Guiana, an Indian Badger (*Arctonyx collaris*) from Assam, two Père David's Deer (*Cervus davidianus*) from Northern China, a Downy Owl (*Pulsatrix torquata*) from South America, purchased; a Sambur Deer (*Cervus aristotelis*), born in the Gardens.

OUR ASTRONOMICAL COLUMN

BRORSEN'S COMET.—Of the known comets of short period, two will arrive at perihelion in 1884, viz. D'Arrest's on January 13, and Brorsen's about September. The former has been sought after for several months, but hitherto, so far as we are aware, without success, and there now seems a probability that (as indeed was rather to have been anticipated) it will pass unobserved at this return. The second comet was discovered by Brorsen, an amateur at Kiel, on February 26, 1846, and ten days' observations sufficed to show that its period of revolution was about five and a half years: it afforded one of the most striking instances of a close approximation to the period being deduced from a short course of observation, Mr. Hind having inferred a revolution of 5·519 years from observations between February 28 and March 10 (*Astron. Nach.*, No. 557), while the exact period at the time is now known to have been 5·568 years. The comet has been since observed at its returns in 1857, 1868, 1873, and 1879, though missed in 1851 (perhaps through some confusion as to the date of perihelion passage), and again in 1863. The ephemeris for the last appearance in 1879 was prepared by Prof. L. R. Schulze of Dobeln, after the calculation of planetary perturbations since the return in 1873, the perihelion passage being fixed to March 30·0771 Greenwich M.T. The computed positions differed considerably from those observed, as was shown in M. Otto Struve's comparison with his own observations (*Bulletin de l'Académie des Sciences de St. Petersbourg*, t. v.), and these differences led him to remark:—"Eine Änderung in der angenommenen Perihelzeit würde für sich allein wahrscheinlich nicht genügen." It will be found, however, at the end of April or beginning of May. The errors may be removed by the assumption of a later time of perihelion passage; or by taking it March 30·5418 Greenwich M.T., a difference of + 0·4674d. from the computed epoch. Thus for the observation on April 30, we find, taking the differences in the order (c − o):—

	Δα	Δδ
By ephemeris	+ 1m. 38s. ...	+43′·8
With corrected perihelion	− 0m. 6s. ...	+ 0′·2

The mean sidereal motion determined by Dr. Schulze for 1879 would, without perturbation, bring the comet to perihelion again about 1884, Sept. 14·5, at which time it would be situate in about right ascension 154° with 14° north declination, distant from the earth 1·41, consequently rising more than two hours before the sun. The conditions are therefore likely to approach those under which the comet was observed in 1873.

Some six months after the discovery of this comet in 1846 attention was directed by Mr. Hind (*Astron. Nach.*, No. 582, and in a note to the Royal Astronomical Society) to the near approach which it must have made to the planet Jupiter in May, 1842, a first calculation indicating that on May 20 the distance between the two bodies was less than 0·05 of the earth's mean distance from the sun. This point was more closely examined by D'Arrest from improved elements in 1857 (*Astron. Nach.*, No. 1087); he found that the closest proximity occurred on May 20·6924 Berlin M.T., when the comet was distant from the planet only 0·05112, and, carrying his computation backwards to the time when the comet entered the sphere of activity of Jupiter, he assigned approximately its elements previous to that time. A more elaborate investigation of the circumstances attending this near approach has been lately made by Dr. Harzer, in an inaugural dissertation published at Leipzig in 1848; he finds for the time of perijove passage, 1842, May 27·2849 Berlin M.T., and for the distance 0·05471; the ele-

ments prior to the great perturbation in this year are determined, and have been already transcribed in NATURE; they present a resemblance to those of the first comet which appeared in 1798, about which year Brorsen's comet might have been in perihelion; Dr. Harzer nevertheless expresses the opinion that, although Messier's observations of the comet of 1798 might be open to some degree of uncertainty, it is doubtful whether they would admit of being represented by an elliptical orbit with a short period. He had found the revolution prior to 1842 to be 5·170 years.

THE NAUTICAL ALMANAC.—The volume of this ephemeris for 1887 has been published during the past week, the contents being generally the same as in previous years. The track of the total solar eclipse of August 19 is given in detail for the greater part of the course, and the maximum duration of totality is found to be 3m. 50s., the central eclipse with the sun on the meridian falling in longitude 102° 0′ E. and latitude 53° 47′ N. The Greenwich list includes four occultations of *Aldebaran* during the year and one of *Regulus*.

The average annual sale of the *Nautical Almanac* during the last five years has exceeded 15,500, though many maritime nations have now their nautical ephemeris.

THE PHILOSOPHICAL SOCIETY OF GLASGOW

THE *Proceedings* for 1882-83, pp. 592, 23 plates, and 3 maps, have just been issued, and contain the following papers:—On insensibility arising from a deficiency of oxygen in the air, by Dr. Wallace, president; on technical education, by David Sandeman and E. M. Dixon, B.Sc.; on the decay of building stones, by Dr. Wallace; on some new infusoria, by William Milne, M.A.; note on Lippmann's capillary electrometer, by Dr. McKendrick; on milk and milk pollution, by Dr. John Dougall; on Struther's process for pulverising diamondiferous ore, by Wallace Fairweather, C.E.; on the use of litmus, methyl orange, phenacetolin, and phenolphthalein as indicators, by R. S. Thomson; on approximative photometric measurements of sun, moon, cloudy sky, and electric and other artificial lights, by Sir William Thomson; on the preservation of food by cold, by I. J. Coleman; on the clauses in the Glasgow Police Bill having reference to the prevention and mitigation of disease, by Dr. Ebenezer Duncan; on the ships and shipping trade of Great Britain, by N. Dunlop; on the iron ore industry of the north of Spain, by J. J. Jenkins; on the use of rosolic acid as an indicator, with additional notes on phenolphthalein and methyl orange, by R. S. Thomson; on architecture in Glasgow, by J. Sellars, jun., I.A.; on the water highways of the interior of Africa, with notes on slave hunting and the means of its suppression, by James Stevenson, F.R.G.S.; on a new seismograph, by Thomas Gray, B.Sc.; on the fertilisation of flowers, by Rev. A. S. Wilson, M.A.; on algin, a substance obtained from some of the commoner species of marine algæ, by E. C. C. Stanford; on chemical industries, by R. R. Tatlock; on nitroglycerine, dynamite, and blasting gelatine, by George McRoberts, manager of the Works of Nobel's Explosives Company; on the action of heat and the chlorides of phosphorus upon the water salts of hypophosphorus, phosphorus, and phosphoric acids, by Dr. Otto Richter; on a volumetric process for the estimation of cobalt and nickel, by Dr. John Clark; and, on the development and generic relations of the corals of the carboniferous system of Scotland, by James Thomson, F.G.S.

The society has at present 19 honorary, 10 corresponding, and nearly 700 ordinary members, and is about to enter on its eighty-first session. In addition to the ordinary meetings of the society, held fortnightly, there are sections for architecture, biology, chemistry, sanitary science and social economics, and geography and ethnology.

RESEARCHES ON SPARK SPECTRA

The Disappearance of Short Lines

IT was shown in a former Report of this Committee (Southampton meeting) that the spectra of metallic solutions were the same as those from metallic electrodes line for line, even short and weak lines being reproduced. The principal difference observable in the two spectra was a lengthening of the short lines when spectra were taken from solutions, so that discontinuous lines became long or continuous lines. A few instances of short lines disappearing have also been noticed, but such disappearances occur only when the lines are so short, mere dots, in fact, that no solution can contain a quantity of the metal sufficient to yield an image of them. Certain very short lines in the spectrum of metallic zinc are an example of this. Very short lines in the spectrum of aluminium were not reproduced by solutions of the chlorides except when the solutions were very strong, and then they always appeared. It may thus be seen that the quantity of metal present in the compound determines the presence of these lines.

The Lengthening of Short Lines.—It was remarked that in certain cases metallic electrodes showed a different spectrum according to whether the spark was passed between dry or wet electrodes. Thus it was pointed out that when iridium electrodes are moistened with calcic chloride, discontinuous lines which are very numerous in this spectrum become continuous; and on further examination into this matter it has been found that even moistening with water has the same effect. Hence the supposition, of which there seemed some possibility but no proof, that a chloride of the metal was formed is found to be untenable. The very short lines in the spectrum of zinc were lengthened by the action of water upon the electrodes. It has now been proved beyond doubt that this peculiar variation in the spectra is caused by the cooling action of the water upon the negative electrode, which in effect is the same as a strengthening of the spark, since by heating the electrodes a reverse action is the result.

Alterations in the Spectrum of Carbon.—As already stated in the previous Reports, graphite electrodes have been generally employed for the production of spark spectra from solutions. A portion of the work in connection with this subject included an investigation of the effect of water and of saline solutions in varying the spectrum of carbon. It will of course be readily understood that as carbon is capable of combining with oxygen and nitrogen, that different spectra might be obtained by making one or other of these gases the atmosphere surrounding the electrodes, but it is not so easy to explain why graphite points should give two different spectra in air when dry, and a third spectrum, again different, when moist, the same spark conditions being maintained.

Three such spectra have been photographed, but without the aid of maps their peculiarities are not capable of exact description. The maps which were drawn were presented to the Royal Society, together with a communication on this subject, three months since, so that they are not at present available. It may be said, however, that the difference between the two spectra taken from dry electrodes in air consists of the omission of a certain number of the less refrangible lines, which lines have undoubtedly been identified with carbon.

Spectra of the Non-Metallic Constituents of Salts.—A long series of experiments has been made with the object of determining the non-metallic elements which are capable of yielding spark spectra when in combination with the metals. Fluorides, chlorides, bromides, iodides, sulphides, nitrates, sulphates, selenates, phosphates, carbonates, and cyanides yield nothing. On the other hand, hydrochloric acid solutions of arsenites and antimoniates yield the spectra of arsenic and antimony. Borates and silicates in solution yield very characteristic spectra of the non-metallic constituents, but if the solutions be prepared from sodium salts the lines of the metal do not appear in the case of borates, and only the strongest sodium line ($\lambda = 3301$) can be observed in the spectra of silicates, even when concentrated solutions are used.

Line Spectra

BORON Wave-lengths	SILICON Wave-lengths
3450·1	2881·0
2497·0	2631·4
2496·2	2541·0
	2528·1
	2523·5
	2518·5
	2515·5
	2513·7
	2506·3
	2435·5

These are the first spectra of boron and silicon obtained from metallic salts.

[1] Report of the Committee on the Comparison of the Spark Spectra of the Elements with Spectra of Solutions of their Compounds, drawn up by Prof. W. N. Hartley.

In Messrs. Liveing and Dewar's map of the carbon spectrum (*Proc. Roy. Soc.* vol. xxxiii. p. 403), and in the list of the carbon lines and in the map of the iron spectrum (*Phil. Trans.* part 1, 1883), a number of lines are given which are absent from the photographs of the spectrum of graphite published in the *Transactions of the Royal Dublin Society* and in the *Journal of the Chemical Society* (vol. xli. p. 90). Many hundreds of spectra taken between graphite poles have failed to show a trace of these lines, and as the spectra have been photographed under very various conditions, it is scarcely likely that the lines in question are really carbon lines. They have now been identified in the spectrum of silicon.

Liveing and Dewar's carbon lines				Silicon lines (Hartley)
Spark [1]		Arc [2]		
—	...	2881·1	..	2881·0
2541·0	...	—	...	2541·0
2528·2	...	2528·1	...	2528·1
2523·6	...	2523·9	...	2523·5
2518·7	...	2518·8	...	2518·5
2515·8	...	2515·8	...	2515·5
2514·0	...	2514·1	...	2513·7
2506·3	...	2506·6	...	2506·3
		2478·3	...	—
		2434·8	...	2435·5

From this it appears that, in the spectrum of the arc, carbon yields but one line in the ultra-violet, wave-length 2478·3. It is perhaps a little doubtful whether the line with wave-length 2434·8 is due to silicon or not.

The Spectrum of Beryllium.—The researches made for the purpose of this report have been useful in furnishing evidence leading to a determination of the probable position of beryllium among the elements. It has been proved that the spectra of metallic solutions are identical with those of the metals themselves, and it is therefore obvious that characteristic spectra may be obtained from concentrated solutions of nitrates or chlorides when metallic electrodes are not procurable.

It was resolved to photograph the spectrum of beryllium, as obtained from its chloride, in order to observe the character of its lines and the manner of their grouping. The following were the lines observed :—

Spectrum of Beryllium

Wave-length				Description	
3320·1	...	...	...	Strong, sharp.	
3129·9	...	...	...	Very strong, extended.	
2649·4	...	...	...	Strong, sharp.	
2493·2	...	...	...	,,	,,
2477·7	...	...	...	,,	,,

The first two numbers differ slightly from those given in the *Journal of the Chemical Society* (June, 1883), but they are believed to be the more accurate. The previous measurements of the lines of beryllium were two given by Thalén (Watts's "Index of Spectra"), with wave-lengths 4487 and 4575, and two lines very close together given in Cornu's "Map of the Solar Spectrum," wave-lengths 3130 and 3130·4. It will be observed that in the spark spectrum only one line corresponding to the first of these is observed, viz. 3129·9. There is probably a difference in this case between the arc and the spark spectra, because there is no difficulty in distinguishing between two lines differing by 0·4 of a tenth-metre, and under various conditions two lines have never been observed at this point in the spark spectrum. On the other hand, such differences are by no means unusual.

Regarding the views held by Emerson Reynolds, Nilson and Pettersson, and Brauner on the subject of beryllium, however wanting in harmony they may be in detail, they at least agree in assigning a value not greater than 13·8 and not less than 9·2 to its atomic weight. The former number implies that the metal is a triad, the latter that it is a dyad. In the former case it must belong either to the series of elements of which aluminium, gallium, and indium are members, or to a sub-group of rare earth-metals, to which yttrium and scandium belong. In attempting to accommodate the element with a position in either series we are met by a serious difficulty, namely, that not only is the atomic weight out of keeping with the periodic law (a point which cannot be discussed here), but its spectrum is altogether different from the spectra typical of either class.

There is a periodic variation in the spectra of the elements as well as in their atomic weights and chemical properties, and we cannot put the periodic law out of mind in considering the position of beryllium.

Now the spectra typical of the triad group, of which aluminium and indium are the first and third terms, consist of three pairs of lines harmonically related, the intervals between the individuals of each pair increasing with increased refrangibility of the rays in each spectrum, while the intervals between the individuals in each pair in different spectra increase with the increase of atomic weight. The interval between each pair of lines contains an isolated ray. As the atomic weight of beryllium is less than that of aluminium, it should have a spectrum in which the same grouping appears, but the intervals between the pairs of lines should be shorter, and the individuals of each pair should be closer together.

The lines of beryllium are not characteristically grouped like those of aluminium and indium; it cannot therefore belong to this series of elements. If we attempt to classify beryllium in a manner which accords with Nilson and Pettersson's views (*Proc. Roy. Soc.*, 1880, vol. xxxi. p. 37), the elements scandium and yttrium, with atomic weights 44 and 89 respectively, must yield spectra typical of the series, and the similarity between the spectra of the two metals, beryllium and scandium, must be exceedingly close. Now Thalén's spectra of scandium and yttrium, though both totally unlike the spectra of any other element, have many characters in common (*Kongl. Svenska Akademicus Handlingar*, vol. xii. p. 4, and *Comptes Rendus*, vol. xci. p. 45); both spectra contain highly characteristic groups of lines in the orange and yellow, the lines or bands degrading towards the red, and the number of lines which have been measured are no fewer than 103 and 90 respectively.

From these two spectra that of beryllium is entirely different, as well in the character and grouping as in the number of the lines. Of the remaining rare earth-metals at present known, cerium is a tetrad, didymium is a pentad, and lanthanum a triad; their spectra are quite dissimilar from that of beryllium. In consideration of these facts it is impossible to classify the spectrum of beryllium along with the spectra of the rare earth-metals of the triad group.

Let us now consider the question of the dyad groups. On the assumption that beryllium has an atomic weight of 9·2, there is no difficulty in placing it at the head of the second series, in which position it stands in the same relation to the sub-groups Mg, Zn, Cd, and Ca, Sr, Ba, that Li occupies with regard to Na, K, Rb, Cs, and Cu, Ag, Hg. Its position will also be similar to that of B and of C in their relation to the triad and tetrad metals. The spectra belonging to Mg, Zn, Cd, have a very definite constitution; they consist of (1) a single line, (2) a pair of lines, (3) three to four groups of triplets, (4) a quadruple group, and (5) a quintuple group of lines. The intervals between the individual lines in their different groupings increase with the increase in the atomic weights of the elements. In fact these spectra present a considerable addition to the body of evidence in support of the view that elements whose atomic weights differ by an approximately constant quantity, and whose chemical character is similar, are truly homologous bodies, or, in other words, are the same kind of matter in different states of condensation (*Journal of the Chemical Society*, September, 1883, p. 390, *Trans.*). Their particles are vibrating in the same manner, but with different velocities. In the spectra of the metals Ca, Sr, Ba, successive pairs of lines are a strong feature, in addition to which there are some other groups in the spectrum of barium. The individuals of each pair are separated by smaller intervals the more refrangible the lines, and by larger intervals the higher the atomic weights. It cannot be said that the spectrum of beryllium is precisely similar in constitution to either of these groups of elements.

There is some slight resemblance in character to the spectrum typical of the calcium group, beryllium having two pairs of lines, the individuals of the first or less refrangible pair being separated by a greater interval than those of the second pair. It is a spectrum analogous to that of lithium, hence it was concluded that beryllium is the first member of a dyad series of elements to which probably calcium, strontium, and barium are more strictly homologous than magnesium, &c. It is to be understood that this is a conclusion drawn from one point of view only, and is open to correction or modification when fresh facts shall have been discovered, but so far the classification of beryllium among the dyads is confirmed and maintained by its position being in harmony with these spectrum observations. The metal is shown to be quite out of place among the triad elements.

[1] *Proc. Roy. Soc.* [2] *Phil. Trans.*

SPLENIC FEVER IN THE ARGENTINE REPUBLIC[1]

THE author stated that he did not think any one who had worked much on the subject of splenic fever could doubt that the bacilli which caused that disease were capable of considerable variation in their effects on animals and man. Whether this disease, which is without doubt the one which has been most thoroughly investigated of all zymotic affections, gave any support to the views of Dr. Carpenter was another matter, but there could be no doubt that the *Bacillus anthracis* can be so modified by artificial means that the disease which it produces when introduced into animals, such as sheep and cattle, varies considerably as to duration, amount of fever produced, as well as to its mortality.

That, on the other hand, this bacillus has at least a very strong tendency to retain the characters which it at present presents in Europe is shown by the fact that in the Argentine Republic,—into which the affection was introduced at least thirty years ago, and where the conditions are very different from those which exist in Europe,—we find that the minute organism retains its characteristic form and the properties with which we are so well acquainted in Europe, and that the disease which it produces is practically identical with the European disease. That it should vary in some particulars is perhaps only to be expected, but Dr. Roy preferred leaving that point to be treated of elsewhere and occupying the time at his disposal with an account of the observations which he had made as to the means of protecting from the disease by means of inoculation.

Some six months ago he had been requested by a City company who possess a large tract of land in the Argentine Republic, to pay a visit to their property in order to investigate a disease which was causing much mortality amongst the cattle, sheep, and horses, and which was affecting the *employés* as well to a very serious extent. This disease, he found on arriving at the River Plate, was splenic fever, of which the absence of efficient veterinary surgeons and the general apathy of the owners of stock had prevented the recognition. Having spent some time in studying the characters of the disease, he proceeded to make observations on the best means of protecting the stock by means of inoculation, which work was much facilitated by the liberality of the company (the "Las Cabezas Estancia Company") who gave him "carte blanche" as to the number of animals which he might employ for his experiments. Having previously found, in a small series of observations made in this country in conjunction with Dr. E. Klein, that splenic fever virus from white mice was of the proper strength to protect sheep from the disease, he proceeded in the same lines, employing such animals as were available to produce the inoculating fluid. After a number of animals had been tried, he found that the blood of *Biscachas* (prairie dog) which had died of the disease gave satisfactory results when used to inoculate cattle and horses. It was, however, a little two powerful, as 1 or 2 per cent. of the cattle so inoculated died. The pecuniary loss entailed by this was, however, more than counterbalanced by the arrest of the mortality from the natural affection. With regard to sheep, greater difficulties were encountered, and no animals were found giving a virus sufficiently mitigated to cause only a slight form of the disease with subsequent protection. Unfortunately it was impossible to repeat on a large scale the successful experiments which Dr. Roy and Dr. Klein had made with virus from white mice, these animals not being obtainable. Virus from field-mice and rats did not prove satisfactory.

Under these circumstances the speaker then proceeded to investigate the results obtained by artificial mitigation of the bacilli in the laboratory. He first employed the method of Toussaint, which consists in warming the fluid containing the pathogenic organisms to a temperature of 55° C. for a period varying from a half hour to one hour and a half. It was found possible by this means to diminish the strength of the virus so that it took longer to kill, and by graduating the duration of the heating it is not difficult to obtain a virus which will only kill a small percentage of the animals inoculated. But unfortunately, in weakening the virulence of the organised poison, this process weakens also its power of protecting from a second attack, and it was easy to kill the animals so inoculated by subsequently introducing into their system strong virus which had not been subjected to heat. This method having failed, Dr. Roy proceeded to Buenos Ayres, where, in the laboratory of the "Collegia Nacional," which was kindly placed at his disposal, he manipulated the virus by the method of Pasteur, which consists in cultivating the virus in sterilised chicken broth at a temperature of 42°—43° C. At this temperature the bacilli grow much less readily than at one more nearly approaching blood heat. The bacilli so cultivated diminish in virulence day by day, and after being cultivated for six or eight days no longer caused the death of full-grown sheep, although they still killed lambs and prairie dogs.

Careful experiments with inoculating fluid prepared in this manner showed that with it a slight fever could be induced which suffices to protect, at least for some time, from a second attack of the disease. The same objection, however, which characterises the inoculating fluid prepared by Toussaint's method exists, though to a less extent, with regard to Pasteur's fluid; in the case of the latter as well as the first named, the protecting power is seriously diminished at the same time that the virulence of the bacilli (as indicated by the mortality) is lessened. With care it is possible, however, to prepare a liquid which, while its virulence has been brought sufficiently below the lethal limit to insure that none of the inoculated animals succumb to the inoculation, still retains enough protecting power to enable the sheep to resist the effects of strong virus employed some ten to fifteen days after the first inoculation. Dr. Roy was, therefore, able to confirm the assertions of M. Pasteur regarding the attributes of his inoculating fluid in so far that it is possible effectually to protect sheep from anthrax by its use. Still, it was impossible to overlook the fact that its employment necessitated very careful graduation of the strength of the mitigated virus to the resisting power of the animals inoculated. The speaker did not think that the method was one which was likely to be adopted universally, and he rather looked forward to the general acceptation of some inoculating fluid which had been mitigated by cultivation in the bodies of some animal distinct in species from that which it was desired to protect. In the case of cattle the virus taken from *Biscachas* seemed to protect in all cases, whether the illness produced by the inoculation was mild or severe. It was to be hoped that more extended inquiries would confirm the favourable results obtained by employing the virus from white mice to protect sheep. The speaker stated that he proposed communicating the results of his observations on this subject to the Royal Society at an early date.

[1] Abstract of a paper read at the British Association by Dr. C. S. Roy.

SUGGESTIONS FOR FACILITATING THE USE OF A DELICATE BALANCE

IN some experiments with which I have lately been occupied, a coil of insulated wire, traversed by an electric current, was suspended in the balance, and it was a matter of necessity to be able quickly to check the oscillations of the beam, so as to bring the coil into a standard position corresponding to the zero of the pointer. A very simple addition to the apparatus allowed this to be done. The current from a Leclanché cell is led into an auxiliary coil of wire coaxial with the other, and is controlled by a key. When the contact is made, a vertical force acts upon the suspended coil, but ceases as soon as the contact is broken. After a little practice, the beam may be brought to rest at zero at the first or second application of the retarding force.

This control over the oscillations has been found so convenient that I have applied a similar contrivance in the case of ordinary weighings, and my object in the present note is to induce chemists and others experienced in such operations to give it a trial. Two magnets of steel wire, three or four inches long, are attached vertically to the scale pans, and underneath one of them is fixed a coil of insulated wire of perhaps fifty or one hundred turns, and of four or five inches in diameter. The best place for the coil is immediately underneath the bottom of the balance case. It is then pretty near the lower pole of the magnet, and is yet out of the way. The circuit is completed through a Leclanché cell and a common spring contact key, placed in any convenient position. The only precaution required is not to bring other magnets into the neighbourhood of the balance, or, at any rate, not to move them during a set of weighings.

The other point as to which I wish to make a suggestion relates to the time of vibration of the beam. I think that with the view of obtaining a high degree of sensitiveness the vibrations are often made too slow. Now the limit of accuracy depends more upon the smallness of the force which can be relied upon

[1] Paper read at the British Association by Lord Rayleigh, F.R.S.

to displace the beam in a definite manner, than upon the magnitude of the displacement so produced. As in other instruments whose operation depends upon similar principles, *e.g.* galvanometers, it is useless to endeavour to increase the sensitiveness by too near an approach to instability, because the effect of casual disturbances is augmented in the same proportion as that of the forces to be estimated. If the time of vibration be halved, the displacement due to a small excess of weight is indeed reduced in the ratio of four to one, but it is not necessarily rendered any more uncertain. The mere diminution in the amount of displacement may be compensated by lengthening the pointer, or by optical magnification of its motions. By the method of mirror reading such magnification may be pushed to almost any extent, but I am dealing at present only with arrangements adapted for ordinary use.

In the balance (by Oertling) that I am now using, the scale divisions are finer than usual, and the motion of the pointer is magnified four or five times without the slightest inconvenience by a lens fixed in the proper position. The pointer being in the same plane as the scale divisions, there is no sensible parallax. In this way the advantage of quick vibrations is combined with easy visibility of the motion due to the smallest weights appreciable by the balance.

To illuminate the scale, the image of a small and distant gas flame is thrown upon it by means of a large plate-glass lens. This artificial illumination is found to be very convenient, as the instrument stands at some distance from a window, but it is not at all called for in consequence of the use of the magnifying lens.

ON THE DEVELOPMENT OF PERIPATUS[1]

AMONG the acquisitions I made during my journey to the West India Island of Trinidad, a rich collection of Peripatus stands in the first rank. This has put me in a position to correct many mistakes, and to contribute a good deal to the knowledge of the histological anatomy of this interesting animal form, as well as especially to follow the process of development from beginning to end. Postponing for the present the anatomy of the adult animal, inasmuch as we have on this subject a good many studies, some of which are very good (for instance, that of Gaffron in *Zool. Beiträge*, edited by Dr. A. Schneider), I shall confine myself to a preliminary notice of the earliest stages of the development of Peripatus, although my investigations have not as yet been brought to a conclusion, nor have I been able to devote any attention to the development of the organs. I do this chiefly because the treatise published by Moseley and Sedgwick from the posthumous notes of Balfour contains some representations of embryos and cross-sections of the same, upon whose accuracy in details I, with my rich and well preserved collection of specimens, and observations on fresh objects, must cast some doubt, and the interpretation of which does not bear investigation. And yet these already serve as evidence for some theoretical explanations of embryonic processes in other groups of animals, which it would be well to avoid in such a case.

I collected in Trinidad over a hundred specimens of *Peripatus Edwardsii*, and a small number of a new species which is distinguished by its size from all those hitherto known, and which may briefly be thus characterised: The females, which are considerably larger than the males, attain a length of 15 cm. and a diameter of 8 mm.; the males grow to a size of about 10 cm. Their colour is a plain reddish brown above, darkening a little towards the middle line of the back, and growing pale a little towards the sides. The head, or, more correctly, the forehead, as well as the antennæ, is black, and marked off on the dorsal side by a light yellow necklace, which is often slightly interrupted in the middle, from the rest of the body. The under-side is of a dark flesh colour. This species is especially characterised by possessing forty-one to forty-two pairs of feet, which is the highest recorded number, and a number which differs greatly from that of all other species. I call this new species *Peripatus torquatus*.

The ovaries are two small, elongated bodies, which are generally united along their whole length, and so appear as a narrow, spindle-shaped body, which is connected by one or often by two delicate muscular threads to the body wall. The ovaries are prolonged into the two horns of the uterus, which, each forming a bow with several curves, unite immediately before reaching the genital pore to form a very short vagina. At the point where the ovaries pass over into the uterus is situated a small, nipple-shaped gland and a spherical receptaculum seminis, the orifice of which every egg has to pass before it can enter the uterus. Now as a large number of embryos, from the "just furrowed" egg to the matured young, are always found in the uterus, it is very probable that each female Peripatus is only fertilised once.

The eggs of Peripatus contain no yolk, and seeing that in spite of this an animal of half the length that it attains when adult develops itself in the uterus out of a small egg whose diameter is about 0·04 mm., there must be some quite peculiar means for its nutrition, and this is the case to the most astonishing extent and in the most surprising manner.

As soon as the fertilised egg enters the thin portion of the uterus, a small enlargement takes place in its lumen, which is very narrow and is surrounded with very deep cylinder epithelia. Simultaneously with this the epithelium cells mass themselves a little together; the furrowed egg settles upon the epithelium, and immediately the lumen widens a good deal by the epithelial cells of the uterus becoming very depressed at that spot; so flattened do they become that they form a very thin pavement-epithelium, whereas before and behind the "breeding-nidus" (*Bruthöle*) an embankment is formed by the thickening of the connective tissue of the uterine walls, so as nearly to fill up the uterine canal.

In this stage we find a hemispherical mass of homologous cells attached by a broad basis to the extraordinarily thin lining of the uterine cavity, a lining which has been formed out of the two cells that originally surrounded the egg. Presently a small depression develops in this hemispherical mass, and now the embryo forms something like the half of a hollow sphere, still consisting of but a few cells. Through the multiplication of these the hemisphere and the cavity in it become a little larger, and now a difference is perceptible between the cells of the embryo which are situated immediately upon the uterine epithelium and the rest. The former, which I shall for brevity's sake here call basal cells, have a long, narrow, and very compact nucleus, whereas the others have a large, circular, granular nucleus. The basal cells multiply, and in doing so close the opening of the hemisphere, and form a layer which, lying between the embryo and the uterine epithelium, fastens the former to the latter. In the meantime the cells of the hemispherical mass have also multiplied to such a degree that the side looking towards the lumen of the uterus appears thickened by the cells mutually displacing each other.

In this stage the whole condition of the embryo resembles that of a flattened hollow sphere whose free wall has been thickened; the longer diameter is 0·09 mm., and the lesser 0·07mm. The basal cells of the embryo now spread themselves out a little, a few isolated ones come out from under the embryo, and thus enlarge the basis of attachment—they form an *embryonic placenta*. From them is also developed a very delicate membrane, which becomes closely applied to the uterine epithelium, and envelops the embryo—it may be shortly designated as *amnion*.

In the meanwhile changes are also going on in the uterus; the epithelium of the "breeding-nidus" has become a little thicker, the nuclei have increased in number, and a number of small dark brown pigment granules have developed and collected in the protoplasm of the flat cells, which for a long time mark off sharply the uterine epithelium from the embryonic portions.

The basal cells now multiply to a remarkable extent, partly so as to increase the size of the placenta, and partly in a direction perpendicular to it, forming a solid stalk upon which the embryo is pushed out free into the lumen of the "breeding-nidus." The whole now forms a pyriform mass; the little head of the pear, the actual embryo, is, however, now no longer hollow; cells have been thrust in from the side furthest away from the stalk, which have filled up the whole "furrow cavity"; a sharp limit, however, is visible between them and the ectoderm at every point except the place where they have been invaginated; this point, which is comparable to the blastopore of other embryos, persists for a long time as the spot where material for the inner germinal layers is being continually provided by invagination, and is still demonstrable in embryos in which the form of Peripatus has long since been recognisable.

As soon as the "furrow cavity" has been filled up in the manner that has been described, a new cavity develops by fission in the central mass of cells. This is the definite visceral cavity. It develops by the embryo becoming composed of two layers (ectoderm and entoderm) in the half that is nearest to the

[1] Translated from a notice, by Dr. J. von Kennel of Würzburg, in the *Zoologischer Anzeiger* for October 8, 1883.

stalk, whereas a thick prominence in which no differentiation can be made out, lies on the side furthest from the stalk. One must, however, regard its innermost cell layer as belonging to the entoderm, which also is continued into it.

While these changes have been taking place in the embryo, the "breeding-nidus" has increased considerably in size, the uterine epithelium has become thicker, and consists of a finely granular mass of protoplasm in which large round nuclei are found, and often lie in several layers one on top of another; cell boundaries are no longer recognisable, and the pigment granules, which are disappearing, still form a narrow border towards the lumen of the uterus. Before and behind the breeding-nidus is almost altogether closed by great thickenings of the uterine walls. In the region of the breeding-nidus, however, there is a fissure in the connective tissue wall of the uterus which is probably a blood space.

The next stage in the development of the embryo may be shortly characterised as the mushroom form; the embryo becomes more clearly marked off from its stalk, and expands in all directions, but most of all in the direction of the longitudinal axis of the uterus, and now for the first time a bilateral symmetry can with certainty be made out; the whole embryo resembles a mushroom with a thick stalk; the pileus is oval, as seen from above, and is a little broader at one end than at the other, and on the surface, towards the narrower end, is to be seen a shallow depression, which is limited towards the broader end by a slight prominence. This depression corresponds to the spot where the meso- and entoderms have been invaginated. There is as yet no opening to connect the visceral cavity with the outer world. The broader end of the embryo is the head end, the stalk side the back, the surface that projects into the lumen of the uterus the future ventral surface. In this stage a multiple layer of cells has already freed itself from the ectoderm, in front of the place where the invagination took place, and it lies, passing over behind into the undifferentiated cell-mass, between the ecto- and entoderm, but is marked off from both of them by a distinct boundary.

Now while the embryo increases in length, more and more cells press in from the ectoderm at the spot that has been indicated, and specialise themselves towards the front into a real mesoderm, which, however, at first, and for a long time afterwards, occupies only the ventral aspect and also the lateral regions between ectoderm and entoderm, where it of course multiplies independently.

In the meanwhile the thickening of the uterine epithelium has gone on; it now forms a ring, which surrounds three-quarters of the circumference of the breeding-nidus, and which as a broad zone divides the breeding-nidus into two halves, where, by the way, the epithelium has been thickened to a considerable though a less degree; the pigment granules have now disappeared, the placenta has become very large, and the amnion, which has attained a high degree of development, and which consists of numerous large cells with large nuclei, lies closely applied to the uterine epithelium.

It is only when the embryo has still further increased in length, the part posterior to the stalk increasing very quickly in size, that the anus and mouth are formed, but not from a common opening, the blastopore of Balfour. The anus develops as a small fissure in the median line upon the prominence in front of the spot where the invagination has taken place; but the mouth develops far further forwards as an invagination of the ectoderm, consisting of only very few cells. This invagination has an inclination obliquely from behind forwards as it proceeds, and reaches the intestine, dividing its epithelium at the point of junction. This mouth invagination has as yet no lumen; this makes its appearance later, when the embryo already shows its segmentation plainly.

The first trace of this segmentation is the appearance of a cavity on each side in the oldest portions of the mesoderm, *i.e.* in the anterior extremity of the embryo, which splits the mesoderm plates into an inner membrane adjoining the intestine, and an outer one adjoining the ectoderm. These, however, are still connected to each other dorsally and ventrally. Soon afterwards a second pair of similar cavities develops behind, and so on from before backwards. These cavities that appear in segments, and which in their appearance closely resemble the original segmental formation of a vertebrate animal, are the first rudiments of the body cavity. The different structures that develop out of its walls cannot be made out till later. With the exception of the further growth of the posterior end of the embryo, which soon curves itself, rolls itself up spirally, and finally forms manifold loops, and of the progress of the segmentation, and of the corresponding formation of cavities in the mesoderm, no changes take place in the interior of the embryo. Embryos of *P. Edwardsii* of 1–1·5 mm. length always present the same appearance on cross-section: an ectoderm slightly thickened on the ventral aspect, an extraordinarily thin entoderm, and between them on each side a pocket of mesoderm, whose walls touch each other in the ventral median line, and which in well-preserved embryos always are closely applied to the ectoderm, as well as to the entoderm, but which always present a sharply-defined boundary line. The anus is still nothing more than a narrow longitudinal fissure; the mouth has at last opened. Behind the anus is situated the depression, with the place where invagination has taken place.

Externally, on the other hand, a distinct segmentation of the body has taken place corresponding to the cavities in the mesoderm; the anterior segment (head segment) exceeds all the others in size; it consists of two symmetrical, spherical halves, to which the other segments are connected posteriorly; the ventral aspect of the head segment contains the mouth opening. I remark here that the mouth and anal opening that have been mentioned must be regarded as primary in Peripatus; the latter closes at a later stage to make room for a later-developing structure, and the former is thrust in further by a new invagination of the ectoderm, and becomes converted into the œsophageal opening of the intestine. (These two observations require to be checked, and I shall have to do so by examining other embryos.) Each segment carries on each side a prominence which is the rudiment of the limbs that are developed later. The first pair of limbs is surrounded by a number of secondary papillæ, and is drawn into a wide mouth cavity to be utilised as a jaw; the second pair gives the papillæ on whose apices the large slime glands afterwards have their orifices. The tentacles are simply dorsal comtinuations or prolongations of both head cavities. Now at last, after the embryo has attained its full complement of segments, the first appearance of the nervous system can be made out as a paired ventral thickening of the ectoderm, which, soon separating itself from the ectoderm, extends in two separate threads from one end of the body to the other, only united by the brain, which has been developed in a similar manner in the head. The embryo itself, until it develops a definite gullet, is intimately connected by its ectoderm, by means of the placenta with the maternal organism, and receives its nutriment through its dorsal stalk, which can be quite properly characterised as a navel-string, and which belongs to the first body segment. As soon, however, as it can swallow by help of its gullet, this connection is loosened, and the embryo now eats the food that is provided by the extraordinarily thickened uterine epithelium, which is rich in protoplasmic materials. At any rate, from that time forward coagulated protoplasm is always to be found in the intestine of the embryo, which was previously always empty.

This is, in a few words, an abstract of the most important results of my investigations up to date, which have been made upon something like a hundred young embryos. I here abstain for the sake of brevity from all discussion, but must, however, call attention to the fact how little Balfour's illustrations and the descriptions of the editors agree with the facts as they are here given. I hope it will not be long before I shall be able to lay before my fellow-workers my investigations, which I hope soon to complete, of these interesting and exceedingly anomalous phenomena of embryonic development, accompanied by numerous illustrations.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE

OXFORD.—By a mistake last week the stipend of the Professorship of Botany was given as 500*l.* instead of 700*l.* with a residence rent free. An election will take place in the course of Hilary term. The duty of the professor is to lecture and give instruction in botany. He will also have charge and supervision of the Botanical Garden and of the botanical collections belonging to the University; and it will be part of his duty to make such gardens and collections accessible to and available for the instruction of students attending his lectures. Candidates are requested to send to the

Registrar of the University their application, and also any documents which they may wish to submit to the electors, on or before Saturday, January 26, 1884.

The Professorship of Rural Economy—now separated from that of Botany—will be filled up in December. Candidates are requested to send to the Registrar of the University their applications, and any documents they may wish to submit to the electors, on or before Monday, December 10, 1883. According to the regulations sanctioned by the Court of Chancery, the Sibthorpian Professor of Rural Economy shall lecture and give instruction on the scientific principles of agriculture and forestry. He shall be entitled to the emolument of 200*l.* derived from the benefaction of Dr. John Sibthorp, Doctor of Medicine, and assigned to the professorship. The professor holds his office for a period of three years from election, and no longer. He may be re-elected for a second period of three years, and no longer; but no professor shall hold the professorship for more than six years consecutively. The professor will have the use of the garden appropriated for making experiments on the subjects of his professorship. The professor shall give not less than twelve lectures in the course of the academical year, in full term, and not more than two in any one week.

CAMBRIDGE.—The following are the speeches made to the Senate of the University by the Public Orator (Mr. J. E. Sandys) in presenting Professors Foster and Macalister for the complete degree of M.A. *honoris causâ*, on November 8:—

"Dignissime domine, domine procancellarie et tota Academia: In hoc ipso loco, duodecim abhinc annos, unum e Collegii maximi Prælectoribus auspiciis optimis titulo vestro honorifico exornastis. Hodie eundem, tot annorum usu et experientia spectatum probatumque, et Academiæ totius Professoribus merito adscriptum, senatus nostri in ordinem honoris causa adsciscimus. Quantum interim, hujus præsertim laboribus, inter alumnos nostros creverit vigueritque physiologiæ studium, vosmet ipsi omnes animo grato recordamini. Ut animantium in corporibus ex ipso corde, velut e fonte quodam, salutares illi sanguinis rivi per membra omnia fluunt refluuntque; non aliter corporis Academici in partes quam plurimas ex hoc fonte scientiæ flamina effluxisse atque inde rursus redundasse dixerim. Tali e fonte quot alumnis vires novæ redditæ sunt: quotiens ex alumnis rivuli fontem ipsum denuo auxerunt! E discipulis vero tam multis cum magistro tanto feliciter consociatis, plurimos adhuc superesse, nonnullos etiam adesse hodie gaudemus; unum illum non sine lacrimis desideramus qui nascentis vitæ primordiis hujus auxilio sagacissime investigatis, nuper inter Alpium culmina, in ipso ætatis flore, morte immatura e nobis est abreptus. Talium filiorum progenies Matri Almæ indies nova succrescat: magistrorum talium accesionibus et Professorem et Senatorum ordo identidem nobis augeatur!

"Vobis præsento Collegii sacrosanctæ Trinitatis socium, Physiologiæ Professorem illustrem, MICHAELEM FOSTER."

"In Professoribus novis vestro omnium nomine salutandis, fato quodam iniquo successoris laudes decessoris desideria nonnunquam aliquatenus iuminni videntur. Hodie vero ornat adhuc Professorum ordinem eloquentissimus ille Anatomiæ Professor quem diu sumus admirati. Integro igitur sinceroque gaudio Professorem illum salvere jubemus, quem Caledonia Hiberniæ quondam donavit, Hibernia Britanniæ nuper reddidit. Salutamus virum qui corporis humani scientiam interiorem, antiquissimum illud atque regium (uti nuper audivimus) scribendi argumentum, quasi propriam provinciam penitus exploravit; qui ne his quidem finibus contentus, sed etiam in alias rerum naturæ regiones egressus, non modo de zoologia et de comparativa quæ dicitur anatomia egregie meritus est, sed geologiæ quoque operam singularem impendit, petrographiæ præsertim recentiores, progressus curiositate minuta perscrutatus. Idem et litterarum amore et linguarum peritia insignis, inter rerum antiquarum monumenta ne hieroglyphica neglexit, neque historiam ecclesiasticam intactam reliquit. Ergo non uni tantum Collegio sed toti Academiæ gratum est, virum tot tantisque animi dotibus instructum, societati illi tam cito esse adscriptum, cui medicinæ studia commendavit olim vir et de litteris antiquis et de scientiis recentioribus præclare meritus, Thomas Linacre.

"Vobis præsento Collegii Divi Johannis socium, Anatomiæ Professorem insignem, ALEXANDRUM MACALISTER."

The allusions to the growth of the physiological school, to the loss of Prof. F. M. Balfour, to Prof. Macalister's inaugural lecture with its happy antiquarian illustrations, and his speedy enrolment as a Fellow of St. John's, were heartily taken up by the members of the Senate and the undergraduates present.

The Special Board for Medicine publish for the guidance of students proceeding to medical and surgical degrees the following schedule defining the range of the examination in elementary biology under the regulations which come into effect on the first day of January, 1884 (Grace, November 15, 1883). The examination in elementary biology will have reference to (1) the fundamental facts and laws of the morphology, histology, physiology, and life-history of plants as illustrated by the following types: *Saccharomyces, Protococcus, Mucor, Spirogyra, Chara* or *Nitella*, a fern, *Pinus*, and an angiospermous flowering plant; (2) the fundamental facts and laws of animal morphology, as illustrated by the following types: *Amœba, Paramœcium* or *Vorticella, Hydra, Lumbricus, Astacus, Anodon, Amphioxus, Scyllium, Rana, Lepus*. Under the head of vegetable physiology the student will not be expected to deal with special questions relating to the more highly differentiated flowering plants. He will be expected to show a practical knowledge of the general structure of each of the animal types above specified, and an elementary knowledge of the chief biological laws which the structural phenomena illustrate. He will also be expected to show an elementary knowledge of the general developmental history of *Amphioxus* and of *Rana*. He will not be expected to deal with purely physiological details.

The subject announced for the next Adams Prize to be adjudged in 1885, is as follows: Investigate the laws governing the interaction of cyclones and anticyclones on the earth's surface. In order to give precision to this, the following suggestions are given to the examiners:—An infinite plane has surface density $\frac{g}{2\pi}$ (where g is gravity); on one side of it is air in equilibrium, the density of which must diminish according to the barometric law as we recede from the plane. The system revolves as a rigid body, about an axis perpendicular to the plane, with a constant angular velocity ω. If one or more vortices, with a revolution either consentaneous with ω (cyclones), or adverse thereto (anticyclones), be established in the air, investigate their motions. It may be well to consider the axes of the vortices as either straight or curved, and perpendicular or inclined to the plane. If possible, pass to the case in which the vortices exist in the atmosphere surrounding a rotating globe.

The Rev. H. W. Watson has been approved for the degree of Sc.D.—Prof. Darwin is arranging to give a course of practical teaching in astronomy with the instruments under his charge. Next term Mr. H. H. Turner of Trinity College will undertake this course.—The General Board of Studies, in reissuing its recommendations as to Readers, Demonstrators, &c., has asked that power be given to the Museums and Lecture Rooms Syndicate to obtain plans for a foundry for the Department of Mechanism, for buildings for Botany, and for additional buildings for Comparative Anatomy and Physiology.—It is recommended that a Curator of the Museum of General and Local Archæology be appointed, at a salary of 100*l.* per annum.

SCIENTIFIC SERIALS

Journal of the Franklin Institute, vol. cxvi. No. 694, October, 1883.—The commercial and dynamic efficiencies of steam-engines, by Prof. R. H. Thurston. In this paper there are calculated the ratio of expansion to furnish power most economically, the maximum efficiency of a given plant, and maximum efficiency of fluid, when such data are taken into account, as total annual cost of steam, and total annual cost of all items variable with size of steam-cylinder.—Mr. R. Grimshaw, in a paper on the steam-engine indicator as a detector of lost motion, describes the use of the indicator to pick out defective setting of cranks, cross-heads, &c.—The next three articles are on the water supply of cities in ancient times, on oil-dressed belting, and a report on the pressure-governed gas-meter and burner.—The address by Prof. Rowland, entitled "A Plea for Pure Science," lately reprinted in NATURE, is also reproduced *in extenso*.

Annalen der Physik und Chemie, xxii. No. 10, contains a long memoir by Professors Sohncke and Wangerin on interference phenomena obtained with thin and especially with wedge-shaped laminæ. The article will be continued in the next number.—On the changes of volume of metals and alloys on melting, by Prof. Eilhard Wiedemann. The metals were cast in thin rods, then dropped into a nearly-fitting glass tube,

ending into a capillary. The wide end was sealed, and a dilatometric fluid such as oil introduced. The conclusions arrived at are that tin, soft solder, and probably also lead, expand on melting; but bismuth contracts. Many observations were made on alloys of bismuth and lead.—On the liquefaction of oxygen, nitrogen, and carbonic oxide, by S. von Wroblewski and C. Olszewski. Intense cold was obtained by evaporation, under reduced pressure, of liquefied ethylene in an apparatus modified from that of Cailletet. Temperatures were measured by a hydrogen pressure-thermometer. Oxygen proved to be liquefiable at temperatures varying from −129°·6 to −135°·8 C., under pressures varying from 27·02 to 22·2 atmospheres. The liquefaction of nitrogen and of carbonic oxide proved more difficult, and was not accomplished at a temperature of −136° C., even under a pressure of 150 atmospheres, though a sudden release of pressure produced a temporary mist of condensed spherules, and a slower release of pressure yielded a deposit of liquid with a distinct meniscus. Liquefied nitrogen and liquefied carbonic oxide are both colourless and transparent.—On the internal friction of certain solutions, and on the viscosity of water at different temperatures, by K. F. Slotte. The results confirm those previously obtained by Rosencrantz and Poiseulle. —On a lecture apparatus for demonstrating Poiseulle's law, by W. C. Röntgen.—On the deduction of the crystal systems from the theory of elasticity, by H. Aron; a mathematical discussion of the possible cases arising from the position of planes of symmetry, proving that no others than the recognised six systems of crystals can exist.—On the properties of benzine as an insulator and as a substance exhibiting electric reaction, by H. Hertz. *Pure* benzine appears to be remarkably good as an insulator and remarkably free from reaction effects.—On the influence of galvanic polarisation on friction, by K. Waitz. Treats of the phenomenon discovered by Edison, and recently examined by K. R. Koch.—On the properties of calc-spar in the homogeneous magnetic field, by Fr. Stenger.—Notes on a photometric apparatus, by Leonhard Weber.—On "the Exhibition of the Treatise on Light" of Ibn al Haitam, by E. Wiedemann.—On the Cologne air-pump of the year 1641, a historical notice by Dr. G. Berthold.—Remarks on the memoir of Herr Christiansen, "Researches on Heat-Conductivity," by A. Winkelmann.

Atti of the Royal Academy dei Lincei, July 12-15, 1883.—Obituary notice of William Spottiswoode.—Two communications from Signor Tacchini on the observations made by him at Caroline Island during the solar eclipse of May 6, 1883.—On the average variation in tension of the atmospheric aqueous vapour according to latitude and elevation in Italy, by A. Lugli. —Meteorological observations at the Royal Observatory of the Campidoglio for the months of June and July.—Most of the present number is occupied with the new reforms and statutes of the Academy, whose constitution has recently been remodelled. There are also long inventories of the works of art, furniture, and fixtures of the Palazzo Corsini, which has been purchased as the future home of the Academy.

Rivista Scientifico Industriale, Florence, September 15-30.—The total eclipse of May 6. Results of the observations of Tacchini, Janssen, and others, in Caroline Island.—Eclipses and terrestrial magnetism, by P. Denza. All connection is denied between eclipses and magnetic phenomena.—On the compressibility of water, by S. Pagliani and G. Vicentini.—A new electrodynamometer, by Prof. Bellati.—On the deformation detected by Gouy in polarised electrodes, by A. Volta.—An improved reversible magnetico-electric machine, by M. Delaurier.—Anatomical description of two extremely rare birds (*Somateria mollissima* and *Phalaropus fulicarius*) preserved in the Civic Museum of Venice, by P. A. Ninni.—On the fossil vertebrates of the Miocene formations in the Venetian Alps, by Baron Achille de Zigno.—On the fossil gastropods, cephalopods, and corals of the lower titonic formations of Sicily, by Dr. G. de Stefano.

SOCIETIES AND ACADEMIES

LONDON

Chemical Society, November 15.—Dr. Perkin, F.R.S., president, in the chair.—It was announced that a ballot would take place at the next meeting (Dec. 6).—The following papers were read:—On the estimation of starch, by C. O'Sullivan. The method may be briefly described as follows:—About five grms. of the finely ground grain are successively extracted with ether, alcohol (sp. gr. 0·90), and water at 35° to 38°. Fat, sugar, albuminoids, amylams, &c., are thus got rid of. The starch in the washed residue is gelatinised by boiling with water, cooled to 62°, about 0·03 grm. diatase (prepared by precipitating a cold, aqueous extract of malt with alcohol) added; the starch is thus converted entirely into maltose and dextrin, and by a quantitative determination of these two products the starch originally present can be calculated. The author states, as the result of his experience with the method, that the difference in results obtained by any two observers need not exceed 0·5 per cent. of the total starch.—On the illuminating power of ethylene when burnt with non-luminous combustible gases, by P. F. Frankland. The author summarises his results as follows:—Pure ethylene burnt at the rate of five cubic feet per hour from a Referees Argand burner, emits a light of 68·5 standard candles; the illuminating power of equal volumes of mixtures of ethylene with either hydrogen, carbon monoxide, or marsh gas is less than that of pure ethylene; when such mixtures contain 60 per cent. of ethylene or more, the illuminating power of the mixture is but slightly affected by the nature of the diluent; in mixtures containing less than 60 per cent. of ethylene, the illuminating power is the highest when marsh gas, and lowest when carbon monoxide, is the diluent.—On the products of decomposition of aqueous solutions of ammonium nitrite, by G. S. Johnson. The nitrogen evolved from alkaline solutions of ammonium nitrite contains no oxides of nitrogen; nitrogen is evolved from aqueous solutions below 100°; by adding crystallised cupric chloride, a continuous evolution of pure nitrogen takes place in the cold. When solutions are acid, the nitrogen may contain 4 per cent. of nitric oxide. About 2 per cent. of the nitrogen evolved by the cupric chloride is stated by the author to possess peculiarly active properties, and forms ammonia when passed with hydrogen over spongy platinum.—On the estimation of iron by standard potassium bichromate, by E. B. Schmidt. The author recommends the above process, but states that zinc should not be used to reduce the iron, as it interferes with the end reaction with potassium ferricyanide. He prefers Kessler's method of reduction with stannous chloride.

Western Microscopical Club, November 5.—Mr. W. Crookes gave a lecture on "Recent Discoveries in High Vacua." He illustrated his theme with a series of brilliant and interesting experiments. The effects were produced by a large electric coil, having sixty miles of secondary wire, and worked by two cells of a storage-battery. The coil, when attached to its full complement of thirty cells, would give a spark in air of twenty-four inches. "High vacua" were defined as those ranging from above the 1/1000 to the 1/100,000,000 of an atmosphere. Air and all gases are conceived to consist of myriads of excessively minute molecules, which in the ordinary state vibrate with enormous velocity; but being crowded together in that condition their extent of vibration is impeded by each other, and is, in fact, limited to a path of only 1/10,000 of a millimetre. When, as in a partial vacuum, there are fewer of these molecules, they have more room in which to vibrate, and hence their "mean length of path" is increased. Under the influence of electricity these molecules are driven in straight lines from the negative pole. In a comparatively low vacuum, on the passage of an electric current, the residual air assumes a stratified condition, showing alternate light and dark bands. The width of the dark bands marks the length of the excursions of the molecules. Further exhaustion increases the width of these bands, so that in a vacuum of 1/1,000,000 of an atmosphere the free path of the molecules was seen to extend to about four inches. By means of an exhausted V-shaped tube it was shown that these molecules are driven from the negative pole in straight lines, and hence cannot turn a corner. First one limb of the V, then the other, was connected with the negative pole of the coil, with the result that each in turn was in darkness. In another vacuum-tube a concave negative pole was fixed; the molecules were driven normally from this concave surface, and, meeting the cylindrical surface of the glass inclosure, were thrown into beautiful caustic curves. That these molecules, under the influence of electricity, possessed mechanical force was shown by causing them to impinge on the vanes of a radiometer, when a rapid rotation took place. On reversing the current, the direction of rotation was also reversed. That this was not due merely to the passage of an electric current was shown by a vacuum-tube containing a small, horizontal "water-wheel." Its upper and lower floats being struck equally by the radiant matter, no motion took place; but

on diverting the flow of radiant molecules by means of the external application of a magnet, the molecules were caused to strike the upper floats only, when revolution took place. By reversing the magnet, the path of the molecules was diverted so as to strike the lower floats, and thus to reverse the rotation. Radiant molecules are not attracted by one pole of a magnet and repelled by the other, but tend to rotate round the north pole in one direction and round the south pole in the opposite direction. Hence, with a horseshoe magnet, they are deflected in a line at right angles to the line that joins the two poles. The mechanical effect of the impact of these radiant molecules was further shown by converging them by means of a concave negative pole to a focus in which was a small bundle of platinum wires. These wires were rapidly raised to a white heat by the vigorous though inaudible bombardment. Further, the impact of radiant molecules on certain bodies produces phosphorescent light; thus they give to potash-glass a green and to lead-glass a blue tinge. If in an exhausted tube an obstacle, such as a piece of mica in the shape of a cross, be set up, a dark shadow of it is thrown on the positive end of the tube, the part surrounding the shadow being rendered phosphorescent by the impact of the molecules. On suddenly removing the obstacle, the part that was in shadow glows brighter than in surrounding luminous space. This effect is due to the molecules acting suddenly on a new and, as it were, untired surface.

CAMBRIDGE

Philosophical Society, October 29.—The following officers for the ensuing year were elected:—President, Mr. Glaisher; Vice-Presidents: Prof. Cayley, Prof. Stokes, Lord Rayleigh; Treasurer, Mr. J. W. Clark; Secretaries: Mr. Trotter, Mr. Glazebrook, Mr. Vines; New Members of Council: Prof Humphry, Prof. Babington, Prof. Adams, Prof. Newton, Mr. F. Darwin, Mr. Shaw, Mr. Sedgwick.—The following papers were communicated to the Society:—On the effect of viscosity upon the tides, by Rev. Osmond Fisher.—Note on Mr. Larmor's communication on "Critical Equilibrium," by Mr. Greenhill.—On some general equations which include the equations of hydrodynamics, by Mr. M. J. M. Hill.

EDINBURGH

Mathematical Society, November 9.—Mr. J. S. Mackay, F.R.S., in the chair.—The opening address of the session was delivered by Prof. Tait, who chose for his subject "Listing's Topologie."—The office-bearers elected were:—President, Thomas Muir, F.R.S.E.; Vice-President, A. J. G. Barclay; Secretary and Treasurer, A. Y. Fraser; Committee: R. E. Allardice, William Peddie, Robert Robertson, David Traill, B.Sc.

PARIS

Academy of Sciences, November 12.—M. Blanchard, president, in the chair.—On the velocities acquired in the interior of a vessel by the diverse elements of a fluid during its discharge through a lower orifice, and on the simple means possible to be employed in determining very approximately the numerical residuums of slightly converging double series, by MM. de Saint-Venant and Flamant.—Extract from a letter addressed to M. Daubrée by M. Nordenskjöld on the results of his recent expedition to Greenland.—On a tribasic oxalate of alumina, by M. Mathieu-Plessy.—Note on the letter communicated to the Academy by M. Martial, Captain of the *Romanche*, on his return from Tierra del Fuego and neighbouring waters, by M. Alph. Milne-Edwards. Soundings and dredgings were taken at depths of 600 metres; a careful study was made of the fauna and flora on the mainland, as well as of the Fuegian aborigines, and 167 cases of collections were brought back, including two skeletons of whales, and several living specimens of animals and plants. On his return M. Martial determined the presence of a deep trough about the twentieth meridian south of the equator, 7370 metres deep, near the ridge of submarine banks discovered by the *Challenger* and *Gazelle*.—Observations on the Pons-Brooks comet made at the Observatory of Nice (Gautier-Eichens equatorial), and comparison with MM. Schulhof and Bossert's ephemerides, by M. Perrotin.—On certain astronomical formulas of Hansen and Tisserand, by M. P. Appell.—On the asymptotic lines of wave surfaces, by M. G. Darboux.—On the functions of two independent variables rendered invariable by the substitutions of a discontinued group, by M. E. Picard.—Note on the nature of an algebraic relation between two uniform functions of an analytical point (x, y), by M. E. Goursat.—On an algebraic problem in the theory of elimination, by M. Cyparissos Stéphanos.—A description of the differential pyrometer patented in February, 1882, by M. E. H. Amagat.—On an optical photometer, by M. L. Simonoff.—On the measurement of electromotor forces (two illustrations), by M. E. Reynier.—On an electric sounding apparatus for great depths (four illustrations), by M. E. de la Croix.—On a rapid method for determining the work absorbed or produced by a dynamo-electric machine, by M. Pierre Picard.—On a new series of combinations of titanium, by M. A. Piccini.—Qualitative research and quantitative analysis of zinc and lead in iron ores, by M. A. Deros.—On the formation of considerable quantities of alcohol in the fermentation of bread stuffs, by M. V. Marcano.—Determination of the causes tending to diminish the susceptibility of certain regions of the organism to the virus of bacterian or symptomatic charbon, transforming a fatal into a prophylactic inoculation, by MM. Arloing, Cornevin, and Thomas.—On the source of the imperfectly-oxydised sulphur present in urine, by MM. R. Lépine and G. Guérin.—On the development of the branchia of cephalopods, by M. L. Joubin.—On the functions of the renal sac in heteropods, by M. L. Joliet.—Remarks on the *Crocodilus robustus*, Vaill. and Grand., of Madagascar, by M. L. Vaillant.—On the osmotic force of diluted solutions, by M. Hugo de Vries.—On the interpretation of an experiment by Hales touching the function of vegetable vessels, by M. J. Vesque.—Note on the direct observation of the movement of water in plants, by M. G. Capus.—Remarks on the saccharoid and serpentine limestones of the northern slopes of the Pyrenees, by M. Dieulafait.—On the causes of abnormal winters (five illustrations), by M. L. Teisserenc de Bort.—The election was reported of M. Charcot in place of M. Cloquet in the Section of Medicine and Surgery.

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THURSDAY, DECEMBER 6, 1883

THE GEOLOGY OF THE LIBYAN DESERT

Beiträge zur Geologie und Palæontologie der Libyschen Wüste und der angrenzenden Gebiete von Ægypten, unter Mitwirking mehrerer Fachgenossen, herausgegeben von Karl A. Zittel. I Theil und II Abtheilung, 1 Heft. (Contributions to the Geology and Palæontology of the Libyan Desert and of the Neighbouring Districts of Egypt. By Karl A. Zittel, with the assistance of several scientific men. Part I. and Part II., Section 1.) (Cassel: Fischer, 1883.)

IN NATURE, vol. xxii. p. 587, there appeared a notice of the anniversary address for that year to the Academy of Natural Sciences in Munich delivered by Prof. Karl A. Zittel, the well-known Professor of Geology and Palæontology at the Munich University. The address contained a preliminary sketch of the work, the complete account of which occupies the quarto volume and portion of a second volume now before us.

In the winter of 1873-74 a scientific expedition under the leadership of Gerhard Rohlfs was despatched with aid from the late Khedive of Egypt, Ismail Pacha, to explore the Libyan desert or north-eastern portion of the Sahara. The scientific results of this expedition are now being published in a series of separate volumes, of which the Geology and Palæontology will form two. The first of these lies before us, the second is as yet incomplete, and only one section containing a description of the Eocene Echinoidea, by P. de Loriol, has hitherto appeared. The first volume comprises the geological description of the country by Prof. Zittel himself, an account of the fossil wood from the Nubian sandstone and from the well-known "fossil forest" near Cairo (Cretaceous), by Dr. A. Schenk; of the Miocene fauna of Egypt and the Libyan desert, by Dr. Th. Fuchs; of the Tertiary (Upper Eocene or Oligocene) fossils from the western island in the lake of Birket-el-Qurûn (about fifty miles south-west of Cairo), by Prof. Karl Meyer-Eymar; of the Foraminifera (the Nummulites excluded) from the Eocene beds of the Libyan desert and Egypt, by Conrad Schwager; a monograph of the Nummulites from the same areas, by the late Dr. Phil. de la Harpe; and a description of the Eocene corals, by Magister E. Pratz. These palæozoic descriptions are illustrated by thirty-six plates.

The remaining portions of the second volume will include an account of the Eocene Mollusca, by Prof. Meyer-Eymar; of the Cretaceous fauna, chiefly by Prof. Zittel himself; and of a few other subjects. Amongst the contributors, besides those already enumerated, the names of Prof. Beyrich, the Marquis de Saporta, Prof. Haushofer, and Prof. Zirkel are mentioned in the preface to the first volume.

An array of scientific names like the above, chosen from amongst the most eminent specialists of Germany, Switzerland, and France, proves that this is a work of more than ordinary geological importance. The principal author and editor, Prof. Zittel, is both a good geologist and a good palæontologist, a much rarer combination than is usually supposed.

On the geological map in the first volume an area occupying rather more than 5° of latitude (25° to 30° N.) and above 8° of longitude (about 25° 30′ to 33° 40′ E.) is coloured. This country includes the Nile valley from Cairo to Edfu (the geology of the valley itself is shown as far south as Assuan), and extends eastwards to the shores of the Red Sea, and westward far into the great desert tract of Northern Africa. The whole area coloured geologically may be roughly estimated at between 150,000 and 160,000 English square miles.

It will easily be understood that the mapping is of a very rough description, a geological sketch in fact, but in desert countries, owing to the want of vegetation to conceal the rocks, and to the clearness of the atmosphere, it is remarkable with what accuracy geological formations can be traced by the eye to great distances. A considerable proportion of the area is coloured from the observations of other travellers, and especially of Schweinfurth. The routes of the expedition under Rohlfs and of other travellers are marked on the map, and show how much of the area has actually been examined.

Among the numerous points of interest presented by the volume it is difficult to select any one as superior to the others. In the former notice in NATURE the general characters of the geological systems observed (Cretaceous, Eocene, Miocene, and the so-called Quaternary and recent) were briefly described. To enter at any length into a notice of the palæontology would take too long. At the present time when the writings of F. von Richthofen and others have called especial attention to the subaërial or Eolian formations of the latest geological times and the present day, the description of the surface phenomena presented by the desert tracts of the Sahara, coming from so keen an observer as Prof. Zittel, are well worthy of attention, and a few remarks upon them may prove interesting.

The geological portion of the work is divided into two chapters: the first, containing forty-two pages, being devoted to the Sahara as a whole; the second to the geology of the Libyan desert and Egypt. In both of these chapters considerable space is devoted to the superficial characters of the desert. The surface of the Sahara is divided by Prof. Zittel, according to its characters, into four kinds:—(1) Plateau-desert or Hammâda, occupying the largest portion of the area, a level, hard, stony surface in general, without noteworthy elevations or depressions, but passing locally into (2) mountainous desert. The so-called (3) erosion-desert consists of depressions more or less occupied by salt-marsh. The last form of surface, the most remarkable and interesting of all, is the (4) sandy desert or Areg, composed of drift sand forming hills or downs (dunes).

Prof. Zittel shows, on what appears to be an overwhelming amount of evidence, that the popular idea of the Sahara having been the basin of a sea in Pleistocene times is without foundation. The greater part of the area has apparently been above water ever since the Cretaceous epoch; a comparatively small tract in the north-eastern portion was submerged beneath a Tertiary sea, whilst the only part that can have been under water in post-Tertiary times consists of a tract extending from the Nile delta to the oasis of Ammon, and to the so-called "Chotts" of Tunis, and even in this tract marine conditions in late

geological times are doubtful. But Prof. Zittel considers that the climate must have been damper, the rainfall heavier, and freshwater denudation more active in Pleistocene days than now, to account for the erosion that has taken place, the abundance of fulgurites, and the present distribution of the fauna and flora, especially in such cases as the occurrence of Central African crocodiles in the marshes and streams of the completely isolated Ahaggar Mountains. Reasons are also given for believing that the Nile was formerly a larger river than it now is. It is probable that Prof. Zittel's views on some of these points will be contested, but it is impossible to deny that his arguments are admirably expressed and clearly reasoned out.

Some very interesting details are given about the desert sand, and a careful description of its arrangement in the form of sandhills. The sand of the Sahara is considered to have been largely derived from the decomposition of the so-called Nubian sandstone, the original matrix of the well-known silicified wood. In the Libyan desert there are some remarkable anomalies in the arrangement of the sandhills, and it is clear that they cannot have been entirely formed by accumulation through the agency of the prevailing wind as it exists at the present day. It may here be remarked that very similar observations were made, a few years since, upon the sand ridges of the Indian desert east of the Indus. Some of the sand ridges, both in Africa and India, attain an elevation of about 500 feet, and in both areas the largest appear to have undergone no change within the memory of man, although in places, in both continents, moving tracts of sand occasionally overwhelm cultivated land and buildings.

One mistake in the book deserves notice. In the comparative table of Upper Cretaceous and Eocene beds in Europe, Asia, North Africa, and North America the position assigned to some of the Tertiary stages of the Indian rocks requires correction. The lower Nari beds in especial were never supposed to be so old as Middle Eocene (Parisian), and they are now known to be in all probability true Oligocene. But trifling mistakes of this kind are to be expected: it is surprising that more should not have been observed.

W. T. B.

APPLIED MECHANICS

Applied Mechanics. By H. T. Bovey, M.A., Professor of Civil Engineering and Applied Mechanics, McGill University, Montreal, Fellow of Queen's College, Cambridge. Part I., pp. 190. Part II., pp. 150. (Montreal: J. Lovell and Son, 1883.)

THIS work appears to be designed as a college text-book for somewhat advanced students, who have already received good training in mathematics (as far as the elementary parts of the integral calculus) and theoretical mechanics.

Part I. treats of the strength of materials, dealing with longitudinal stress, the strength of beams and pillars, torsion, and the strength of hollow cylinders and spheres.

In Part II. we have chapters on frames, roofs, bridge-trusses, suspension bridges, arched ribs, and in conclusion one on "details of construction," which includes a discussion of the strength of rivets and other fastenings.

In his exposition of these subjects the author manifests a power of clear and precise statement; and the treatment of the more difficult problems of the first part is perhaps as profound as could be attained without a knowledge of the general theory of elasticity. The numerous illustrations serve sufficiently well in Part I., where they consist chiefly of diagrams; but in Part II. they are on too small a scale for the complicated structures illustrated: and in clearness of detail are far below the standard reached in recent English books on the same subjects. Analytical methods are preferred throughout; and generally speaking geometry is used merely to illustrate results previously obtained in a symbolical form. Thus graphical statics is quite subordinate in Part II.; stress diagrams are introduced, but there are not sufficient instructions in the text to enable a student, who has not studied the subject independently, to construct them for himself.

In the extended treatment of a parabolic rib of uniform stiffness (pp. 101-120) the author follows very closely the lines in Rankine's "Civil Engineering," with some further consideration of the additional terms depending on change of temperature.

There is no acknowledgment in regard to this and other parts of the work where Rankine's influence is clearly apparent. But as no preface is given to the present volume, perhaps other portions of the great subject of applied mechanics are in course of preparation by our author; and till the completion of his work he is postponing the statement of his obligations to those who have gone over the ground before.

We have referred to the apparent excess of symbolical reasoning: but none of this is due to the introduction of investigations better left to treatises on pure mathematics and theoretical mechanics.

Difficulties special to the subject of the work, such as the equations of the "neutral axis" (so-called) for all the different modes of loading and supporting a beam, the theorem of three moments, the moments of inertia of complicated forms of section, the deflection of struts, are however treated with the fullness of detail required by ordinary students.

Such investigations constitute the best feature of the book. The detailed application to problems such as occur in actual practice is but slightly touched on; perhaps for this we are to look to the "Examples," of which some few are worked out in the text; appended to the several chapters, moreover, are close upon 400 proposed for the exercise of the student.

These form a very important collection. A great number involve numerical results, and unfortunately the answers are not given; this greatly lessens their value for private students at any rate. Several examples are taken from existing structures, and are liberally furnished with diagrams in illustration of the data.

Many are new to text-books, and the author has evidently taken great pains in collecting and arranging them.

A. R. WILLIS

LETTERS TO THE EDITOR

[The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, or to correspond with the writers of, rejected manuscripts. No notice is taken of anonymous communications.

[The Editor urgently requests correspondents to keep their letters as short as possible. The pressure on his space is so great that it is impossible otherwise to insure the appearance even of communications containing interesting and novel facts.]

Meteors

HERE, November has generally been unpropitious for astronomical observations. However, during favourable intervals I have seen many brilliant meteors; from twenty to thirty on an average every night. They were principally seen with the face to the north, and glancing from shoulder to shoulder; but not a single Andromede did I see. I had the pleasure of seeing altogether about a score of Leonids before the 12th and after the 19th November. Leo Minorids and Arietids were plentiful, and a goodly number of Geminids were seen; but the richest field for meteors during the month was in the neighbourhood of the Plough. November 6, at 4.30 a.m., a large meteor passed from γ Ursæ Majoris right down to the horizon. From 4.35 to 5.15 three veritable Leonids proceeded from the Sickle; one dashed down to the right-hand, and another from the top of the Sickle to the left over the Lion's back. They were very large. November 10, at 8 p.m., a brilliant meteor started from a point nearly half way between Aldebaran and Saturn, and disappeared at a point down more than half way to the horizon. At 9.30 a very bright one appeared at a point about 1° above Castor and above Jupiter to the north. At 11.25 an exceedingly large and brilliant meteor burst out from ½° below Menkar (in the Whale), and went down at right angles to the very horizon, leaving a long, bright streak behind. November 11, a large one, at 0.15 a.m., dropped down to the horizon from θ Ursæ Majoris. At 0.55 a.m. a very large one proceeded from ½° to the right of α Lacertæ and disappeared at γ Cygni. November 18, at 1.40 a.m., a very large reddish meteor burst out from the top of Ursa Major's head, and passed right above Vega, and disappeared about 4° beyond it in a strange sparkling explosion. At 1.55 a.m. a very brilliant meteor dashed out about 2° above α Arietis, went through the Square of Pegasus, leaving a beautiful stream of blue fire behind, and lasting a few seconds. About 5.30 another large blue meteor passed from the centre of Leo's back through a point 4° above Denebola, and ended in a beautiful explosion 15° beyond. On the night of November 22 there was a fine display of (generally) large meteors from Taurus to Ursa Major; many of them proceeded from the Lion's Head. During the month a great number of meteors passed from some point in Scorpio, under Jupiter and Mars, right into the Lion's Head. They were all large and bright. During the last half of the month some fine displays of morning meteors were seen. At 4 a.m., November 29, I observed a very large and swift meteor. It blazed out from a point about 8° above Denebola, and dashed with great velocity up the heavens, passing 4° above δ Leonis and over the Lion's Head, and exploded about 5° beyond, leaving a stream of the most beautiful blue light in its wake that I ever witnessed.

DONALD CAMERON

Mossvale, Paisley, December 3

As your columns frequently contain notices of meteors, I may mention that I observed one of unusual brilliancy last night (November 28) at 10.50. It appeared in the constellation Taurus, and, following the line of the ecliptic, disappeared about five to ten degrees above the eastern horizon. The meteor was visible for not less than fifteen seconds, had a brilliant train or cone of light of from two to three degrees in length, and outshone Jupiter, near which it passed. From the slow, angular movement of the meteor I feel certain that the train was not an optical impression, but a real luminous object. F.R.S.E.

Edinburgh, November 29

A FINE meteor was observed here by me at 10h. 38m. last night, Wednesday, November 28. Bursting into sight near λ Ursæ Majoris, it passed in a course almost parallel to, but about 2° north of, a line joining α, δ, ε, ζ, and η Ursæ Maj., its light expiring near λ Bootis. Length of path = 40°. No train was observed; the only variation of uniformity of light being at about half way of its passage, where it slightly paled for an instant and then as quickly recovered. Duration about four seconds. Brilliancy three or four times Venus at its brightest. Colour resembled that of magnesium light. W. WICKHAM

Radcliffe Observatory, Oxford, November 29

LAST night, about 10.30, I saw a magnificent bolide shoot across the sky in a northerly direction. It came from the middle star in Orion's belt, and disappeared at a point almost in a line with "the Pointers" in the Great Bear, and at a distance below the lower of the two stars almost equal to the distance between them. Its path was perceptibly arched, but not to any great extent, and, as far as I could judge, it was not parabolic. When the bolide first appeared, it seemed a mere luminous point moving with great rapidity, and without a tail. But about half way it suddenly grew large and brilliant, a tail shot out, and the path behind it remained luminous and distinct. I could compare the bolide at this point to nothing so much as to a red-hot cannon ball emitting sparks of fire. It was accompanied by no sound, and was gone in half a dozen seconds. During its passage the streets seemed to be lit up with the electric light. It was apparently so close that I should think a few miles would have made a very sensible difference in its apparent position in the heavens. J. B. OLDHAM

Stockport, November 29

LAST night at 11h. 2m. I saw in the north-west, near the horizon, one of those slow-moving balls of fire, not so bright as an ordinary meteor, and leaving no train. This seemed the size of a cricket ball; but I have seen one the size of a chee-e-plate. A few flashes of lightning occurred soon after. From the slowness of the motion the phenomenon seemed to be wholly atmospheric. It was in sight for about three or four seconds. It instantly suggested an incandescent vortex whorl; but I cannot say whether the appearance confirmed the idea or not, for I do not know how such a meteor would look. Its red light might be due to its proximity to the horizon, perhaps 8°. Hence there is no dependence to be placed upon my impression that the light was the result of friction rather than of electricity. I have seen probably a dozen in the course of my life, always in the west or north-west, and always about the same height from the horizon, but never annular. HENRY H. HIGGINS

Rainhill, December 4

"Anatomy for Artists"

MAY I add a few more words on the subject of Mr. Marshall's book, and in answer to his letter in NATURE? Mr. Marshall says the reasons that led him to adopt the plan of omitting reference letters to his illustrations of the bones "still remain sound." Turning to p. 30 of the book to learn those reasons, I find he says that "The numerous minute points which demand the attention of the anatomist and the surgeon necessitate such aids; but the art-student's mind should be left unincumbered by such unnecessary details."

I cannot see that this is a reason; I wanted references to what is described in the text—to the necessary, not the unnecessary details.

Secondly, Mr. Marshall says, "The pure form of the bones, represented on so small a scale, in black and white, would have been seriously marred by such references." If this be "sound," may there not be more and equally sound reasons for opposing it? I think there are; and if Mr. Marshall will turn to p. 136 of the book, I will try to show him how his plan works. The student reads there that "All the bones of the hand are visible in the skeleton, on its palmar aspect (Fig 58), carpal, metacarpal, and phalangeal;" he turns to Fig. 58, but where is it? It is mentioned in a list of figures under *three* illustrations. He has to make up his mind which of the three is 58, recalls that it is the palmar aspect, and goes on. He has no clue, let Mr. Marshall observe, by which to know which are the carpal, metacarpal, and phalangeal portions of the hand for which he originally looked at the palmar aspect of it. He hopes he may come to that; and, reading on, finds that the eight carpal bones are "in the carpus;" but then, which *is* the carpus? He does not know, and is not told. Never mind, he thinks, he will find that out by the description of the single bones, and, beginning with the first-mentioned, he reads that the semi-lunar bone ". . . . occupies the centre of the first row, and is eccentric

in shape." Looking again at the illustration, for "rows" he finds that the bones which seem to be arranged in rows are those which he may afterwards learn to be the metacarpals and phalanges. Supposing, however, that he guesses the carpus rightly, which of its bones is semi-lunar or crescentic in shape? I think if the picture were put before *any* ordinary observer, told to point out a crescentic bone, he would select the scaphoid. There is, thinks the student, still a clue left, for the semi-lunar "occupies the centre of the first row." But the first row contains *four* bones; at least he has read that "the eight bones are clustered together so as to form two groups," and he is not told that these groups are not the "rows" afterwards mentioned. He gives it up, and reads the other bones to learn them and find the semi-lunar by the exhaustive process. The guide he finds to the cuneiform bone is that it is "on the ulnar side of the semi-lunar," which he has perhaps failed to guess rightly, and articulates with certain other bones, which are to be afterwards described, and are unknown to him; and so on.

The mode of progression is like that I made once in Ireland, when on asking a peasant my way I was told to take the last turning before coming to the next milestone. There were a good many steps to retrace after finding the next milestone.

I have no doubt at all of the moral influence of Mr. Marshall's plan *if the student perseveres in using his book*; he will have exercised patience, attention, command of temper, and careful criticism of words, but I do not think his anatomical will equal his moral gain.

The process described above simply distracts the student's attention from the form of what he is studying. Would Mr. Marshall wish the Map of England taught in the same manner—no names or references given to the counties, and Hampshire to be recognised because it is in the last row and adjoins certain other counties, which in their turn adjoin it?

ART STUDENT

Barytes from Chirbury

I HAVE to thank Mr. Woodward for pointing out that the plane (412) has been established for barytes. It was first given by Helmhacker (*Denksch. der K. Akad. der Wiss. Wien*, vol. xxxii. 1872) as occurring on crystals from Svárov and Krušná hora in Bohemia, but is rejected by Schrauf as insufficiently determined. The distinguishing peculiarities of the Chirbury crystals are (1) the predominance of the plane E which does not truncate an edge as is the case in Carl Urba's crystals; (2) the frequent occurrence of ω and ξ; (3) the tendency of the face o to develop small faces on its edges which are inclined to o at angles near 3°. Such faces are Q and Y, and I have since determined a face A on the edge $o\mu$ with indices near (25.1.27).

British Museum, November 26 H. A. MIERS

THE ORIGIN OF CORAL REEFS[1]

II.

THE most detailed investigation of coral-reefs which has yet appeared has just been published by Prof. A. Agassiz.[2] This able naturalist is engaged in prosecuting a series of researches into the biological phenomena of the seas on the eastern side of the United States, under the auspices of the United States Coast Survey, and in the course of these explorations he has had occasion to devote himself to the detailed study of the coral-reefs of the Florida seas. For purposes of comparison he has likewise visited the reefs among the West Indian Islands, as well as those on the coast of Central America. His observations are thus the most exhaustive and methodical which have yet been published, and the deliberate conclusions to which he has come deserve the most attentive consideration. He traces the history of a coral-reef from its latest stages as dry land to its earliest beginnings, and even beyond these to the gradual evolution of the conditions requisite for the first starting of the reef. His familiarity with the nature of the bottom all over the area in question, and with the life so abundant in the tropical waters, gives him a peculiar advantage in this inquiry. The upheaval of recent coral-formations to considerable heights above the sea in various parts of the region enabled him to examine the inner structure and foundations of the reefs, and to obtain therefrom altogether new data for the solution of the problem. Following him in his induction we are led back to a comparatively recent geological period, when the site of the peninsula of Florida was gradually upraised into a long swell or ridge, having its axis in a general north and south direction, sinking gently towards the south, but prolonged under the sea as a submarine ridge. The date of this elevation is approximately fixed by the fact that the Vicksburg limestone was upraised by it, and this limestone is assigned to the Upper Eocene series. As a consequence of the elevation, a portion of the sea-bottom was brought well up into the waters of the Gulf Stream, which were probably shifted a little eastward.

No marine fauna yet explored equals in variety of forms or number of individuals that which peoples the waters of the Caribbean Sea and the Gulf of Mexico from the depth of 250 to about 1000 fathoms. This prolific life is traced by Prof. Agassiz to the copious food-supply carried by the warm tropical currents, combined with the food borne outwards from the sea-board of the continent. The corresponding abundant fauna found by the *Challenger* in the Japanese current may be regarded as its counterpart in the Pacific Ocean. Prof. Agassiz points also to the diminished richness of the fauna on the western side of the continents as being probably connected with the absence of those warm equatorial currents which bring such an abundant supply of food to the eastern shores. "No one," he remarks, "who has not dredged near the hundred-fathom line on the west coast of the great Florida Plateau can form any idea of the amount of animal life which can be sustained upon a small area, under suitable conditions of existence. It was no uncommon thing for us to bring up in the trawl or dredge large fragments of the modern limestone, now in process of formation, consisting of the dead carcasses of the very species now living on the top of this recent limestone." Mollusks, echinoderms, corals, alcyonids, annelids, crustacea, and the like, flourish in incredible abundance on the great submarine banks and plateaux, and cover them with a growing sheet of limestone, which spreads over many thousands of square miles and may be hundreds of feet in thickness. In these comparatively shallow waters, and with such a prodigiously prolific fauna which supplies constant additions to the calcareous deposit, the solvent action of the carbonic acid upon the dead calcareous organisms is no doubt reduced to a minimum, so that the growth of the limestone is probably more rapid than on almost any other portion of the sea-bottom.

From the charts we learn how extensively submarine banks are developed in the West Indian region in the track of the warm currents. East of the Mosquito Coast, in Central America, one of these banks may be said to stretch completely across to Jamaica. Similar banks rise off the Yucatan coast; likewise on the windward side of the islands, where the ocean currents first reach them.

That these banks lie upon volcanic ridges and peaks can hardly be doubted, though we have no means of telling what depth of recent limestone may have accumulated upon them. Among the islands, recent volcanic masses rise high above sea-level, in Martinique reaching a height of more than 4000 feet. And as usual in volcanic regions there are numerous proofs of recent upheaval, such as the Basse Terre of Guadaloupe, the successive terraces of recent limestone in Barbadoes, and the upraised coral-reefs of Cuba, which lie at a height of 1100 feet above sea-level.

The West Indian seas have long been famous for their coral-reefs. Prof. Agassiz insists that the distribution of these reefs is determined by the direction of the food-

[1] Continued from p. 110.
[2] "On the Tortugas and Florida Reefs." *Trans. Amer. Acad.* xi. (1883).

bearing ocean currents. They flourish on the windward side of the islands and along the whole eastern coast of Honduras, Venezuela, and Yucatan. But on the leeward shores they do not exist at all. Cuba is fringed both on the north and south side with reefs, but the southern reefs, directly bathed by the Gulf Stream and exposed to the prevailing winds, are more flourishing than the northern reefs, which are to some extent cut off from the equatorial current by banks and islands.

The depth at which corals will flourish in these seas has been found to be rather less than that which has been ascertained to be in general their downward limit elsewhere. Prof. Agassiz concludes that they do not thrive below a depth of six or seven fathoms in the Florida seas, though on the outer reef, directly exposed to the open currents and prevalent winds, they descend in scattered heads to about ten fathoms.

Each successive stage in the growth of an atoll seems to be laid open for study in the prolongation of the Florida reefs. The map of that region (Fig. 2) shows a remarkable broken line of islets and strips of land running parallel with the coast, first in a southerly direction, but gradually curving round until it takes a due westerly trend. This westward curve is attributed mainly to the influence of the strong counter-current which, with a width of ten to twenty miles, sweeps westward into the Gulf of Mexico along the left side of the Gulf Stream, and heaps up organic debris in its track. Florida is growing westward in the line of this current. Reef after reef is added to the land at the east end, while towards the west, new reefs successively begin on the bank, as its surface is gradually built up by the accumulation of organic debris.

The last and youngest of the reefs marked on the maps and charts is the group known as the Tortugas. But immediately to the west of this group Prof. Agassiz has found a prominence on the submarine bank, on which corals have begun to grow. Large heads of Astræans and Madrepores have fixed themselves at a depth of from six to seven fathoms, and Gorgoniæ are found a little lower. This is the beginning of an atoll. The Tortugas, which present a further stage of development, consist of an elliptical, atoll-shaped reef, in three chief parts, whereof the largest forms a crescent, fronting to the east

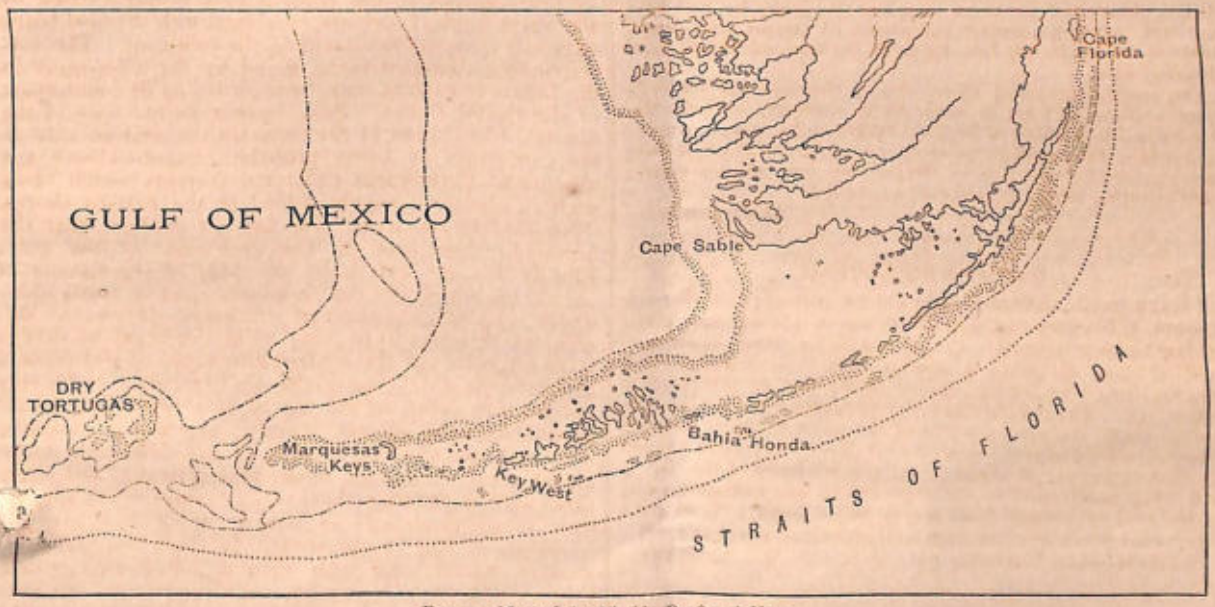

Fig. 2.—Map of the Florida Reef and Keys.

round the edge of the submarine bank, while the two other portions have grown south-westwards along the bank. Three channels between these portions allow powerful tidal currents to rush across the central chiefly submerged parts of the atoll. Seven islands have been formed at the higher parts of the reef by the accumulation and induration of calcareous debris tossed up on the reef by the waves. To the breakers and currents combined with the distribution and habits of growth of the reef-builders Prof. Agassiz entirely attributes the form and growth of the reef. The most important corals are the Madrepores, which flourish in extensive patches, two common species of *Porites* occurring in clusters over the shallow tracts of coarse sand, and *Mæandrina areolata*, growing between the marine lawns of *Thalassia*, with occasional patches of *Anadyomene*. Immense masses of nullipores and corallines grow on the tops of the dead branches of Madrepores which have been killed by exposure to the air during extreme low tides or when strong winds have blown the water off the flats. Large heads of Astræans and *Mæandrina* occur here and there towards the edge of the reef, which is occupied mainly by clusters of *Gorgoniæ*. The destruction of the reefs by the waves is very great, the sea being occasionally discoloured with the chalky sediment to a distance of from six to ten miles after a storm. Broken coral-heads, and branches, dead corallines, shells of mollusks, old serpulæ tubes, stalks of *Gorgoniæ*, and other organisms are thrown up in lines that consolidate into a low dyke, which in turn is pounded up and removed by the breakers. A prodigious quantity of calcareous sediment is thus produced, much of which is swept into the interior of the reefs, where it accumulates in flats of sand and silt. It is only on the outer edges of the reef, where the scour of the sea is greatest, that the corals can flourish; elsewhere they are choked and buried under the deposit of calcareous sediment. Some of this sediment accumulates in steep submarine banks, like sand-dunes, which shift to and fro as winds and currents vary; though by the action of the carbonic acid of the sea-water they are apt to be cemented into solid slopes, some of which have an angle of as much as 33°. So great is the destructive and transporting influence of the sea under the combined or antagonistic working of tides, currents, and wind-waves, that the whole mass of the reef as well as the flats and shoals inside may be said to be in more or less active movement. Hence none of the

landmarks furnished by the islands can be relied upon for the location of buoys.

A still more perfect example of an atoll formed under similar conditions is that of Alacran on the opposite coast of Yucatan. Its eastern face is a great arc of about 20 miles, where, exposed to the open sea and easterly winds, the corals flourish vigorously. On the eastern or interior face of the western chord of the reef, however, the silt derived from the pounding of the breakers to the eastward has already killed the corals. The lagoon is occupied by detached coral-heads with lanes of deep water between them [1]

To the east of the Tortugas, nearer the mainland of Florida, older stages of development among coral-reefs may be traced. By the westward drift of the calcareous sand and silt the lagoons have been converted into flats, and these in succession have been turned into more or less continuous dry land. There is no evidence of subsidence. The area seems to have remained stationary for a long period, or if there has been movement at all, it has been in an upward direction. Should the present condition of things be prolonged, there will be a further extension of the Florida coast-line. By the heaping up of the shells of dead organisms in the track of the counter current, the submarine bank will continue to be brought up within the depth at which reef-building corals can flourish. Successive clumps of reef-builders, springing up and growing outward, will build up atoll-shaped reefs. The abrading action of the waves upon these reefs will furnish detritus to be drifted into the lagoons and channels, which will eventually be silted up into dry land.

An interesting indication of the progress of these changes is furnished by the terrestrial flora and fauna of the reefs. The plants of the mainland are found likewise on the reefs, but become fewer in number as they are followed southward, until on the Tortugas,—the last addition to the dry land,—the flora consists of a few Bay-cedars, a hop-vine with a thick white flower, Bermuda grass, and a solitary mangrove tree. One of the species of land-shells common at Key West has found its way to the Tortugas. No terrestrial reptiles have yet reached that furthest atoll, though at Key West, less than 100 statute miles to the east, many of the frogs, toads, lizards, and snakes common to the southern mainland have already established themselves.

It will be observed that the conclusions arrived at by Prof. Agassiz from his own independent researches entirely confirm those previously announced by Mr. Murray. That two observers, who have enjoyed exceptional advantages in the investigation of this subject, should come to practical agreement must be admitted to be a strong argument in favour of the views which they have adopted.

Putting together all the data which have here been summarised, I think we are driven to admit that barrier reefs and atolls may be formed without subsidence of the sea-floor. Whether this has been the usual or only an exceptional manner of their origin is a question that will depend for its solution upon whether or not it can be shown that there are general phenomena which can only be explained by subsidence. Three such phenomena may be adduced: I am not aware of any others that deserve serious consideration.

1. One of the early difficulties which Darwin's explanation satisfactorily solved was the necessity for the existence of so many peaks, coming up from the depths of ocean just to the zone in which reef-building corals live. No cause was conceivable which should have so generally arrested the upward growth or upheaval of these submarine heights at the limit where coral-reefs might begin. And this difficulty has always been looked upon as furnishing one of the strongest arguments in favour of the theory of subsidence, for that theory completely removes it, by showing how, in a general submergence, peak after peak would sink, and come within the sphere of the operations of the reef-builders.

The difficulty is met in a totally different way by those who believe it to be more formidable in appearance than in reality. They contend that, while it must not be forgotten that many peaks do rise above the sea-level, and many submarine banks still fall far short of the coral-zone, two powerful causes conspire to bring submarine banks to a common uniformity of level at a short distance below the surface of the ocean. On the one hand, those portions of volcanic mountains that rise above the sea-level are worn down by the atmosphere and the waves, and unless otherwise preserved, must inevitably be reduced to the lower limit of wave-action, which is probably nearly coincident with the lower limit of reef-builders. On the other hand, submarine banks in tropical seas are built up towards the surface by the accumulation of the aggregated remains of plants and animals which live on the bottom or fall down to it from upper waters, and the magnitude of this upward growth is hardly yet adequately realised.

In balancing these opposite views, we must, I think, admit that subsidence is adequate to provide platforms for coral-reefs, but that these platforms could likewise be furnished by the two other processes just referred to. Subsidence has been invoked because no other solution of the problem seemed admissible. But as another solution has been found the argument in favour of subsidence has no longer the same force. The new solution, being based upon facts which are everywhere observable in the coral regions, appears to me to be more probable than the older one, which is only an inference resting on no positive proofs.

2. The precipitous descent of the outer face of the reefs to depths far below those at which corals can live is another difficulty which finds a ready explanation on the theory of subsidence. If it were true, as is popularly assumed, that a coral reef presents towards the ocean a vast perpendicular wall of limestone, entirely composed of solid coral, there could be no escape from the conclusion that subsidence must have occurred, to permit of such an aggregation of coral-rock. We learn, however, that much misconception exists on this subject. Some of the earlier accounts of coral-islands speak of "unfathomable" depths at a short distance seawards from the reefs; but more recent soundings afford no confirmation of these statements. Instead of being the summits of vast submarine pillars of limestone, atolls, as well as barrier-reefs, appear to be really planted on the tops of submarine peaks and ridges. The outer face of the reef is undoubtedly steep, in some places vertical. At Tahiti, for example, as shown in Fig. 2, the living face of coral may extend to a depth of 30 to 35 fathoms, beneath which huge detached blocks of coral are piled up and cemented together, forming a steep face, which descends to about 150 fathoms at a distance of 180 fathoms from the upper edge of the reef. The sea-bottom beyond that point is covered with coral sand and slopes at 25° to 30°, after which the angle lessens to 6°. By the abrading action of the breakers in tearing off blocks of coral, and strewing them down in steep talus-slopes, a platform is prepared on which the actually growing part of the reef can build outwards.

In Darwin's section of the Gambier Islands the thickness of the encircling reef is made to be about 2000 feet.[1] Prof. Dana by one estimate puts it at 1150, and by another at 1750 feet. He assumes that in general the thickness of solid coral must be considerable, though he admits that calculations based on the seaward continuation of the slope of the land are liable to error from many causes.[2] Even if we admit (what cannot be proved) that the calcareous mass of any coral-reef does attain a thickness of many hundred feet, it would not necessarily con-

[1] *Bulletin Mus. Comp. Zool.*, v. No. 1.

[1] "Coral Reefs," 2nd edit. p. 65.
[2] "Corals and Coral Islands," 2nd English edit. (1875), p. 126.

sist wholly of solid coral.[1] Prof. Agassiz has followed the growth of a reef upon a platform of calcareous organic debris, and he has found elevated coral-reefs which rest on such a platform. Mr. Murray's observations explain how a reef may grow outward on a talus of its own debris. There appears to be no reason, indeed, why a calcareous mass of almost indefinite thickness might not be formed without the aid of subsidence. Its upper zone might be directly due to coral growth, while the larger part of the mass might be composed of an aggregate of coral debris mixed with the remains of mollusks, echinoderms, and other calcareous organisms. So rapid is the destruction of organic structure through the solution and redeposit of carbonate of lime by infiltrating water, that a special and careful search might be required to determine the actual limits of the true reef and of its calcareous platform, and even such a search might not be successful.

After a full consideration of this second difficulty I feel compelled to admit that no valid argument in favour of subsidence can be based on the steepness of the seaward face of a reef and the thickness of the calcareous mass of the reef itself.

3. The depth of some lagoons and lagoon-channels furnishes probably the strongest argument in favour of Darwin's views. Occasionally a depth of forty fathoms is reached, and as this is beyond the depth at which reef-builders ordinarily live, it has been regarded as a proof that subsidence has taken place.

This third difficulty is thus met by the opponents of subsidence. We must remember, they say, that from the very conditions of their growth, patches of coral tend to assume an annular or atoll-like form, because the outer parts grow vigorously, while the central portions eventually die. Where the coral-patches coalesce and extend along a bank or shore, it is their outer or seaward faces that flourish. The inner parts, as they are more and more cut off from the food-supply, gradually die. While the outer face of the reef grows seaward, the inner margin is attacked partly by the solvent action of the carbonic acid of sea-water, partly by wind-waves, and the tidal scour sweeps away much fine detritus through gaps in this reef. In this way the lagoon-channel is widened and deepened. In a perfect atoll, that is, an unbroken annular reef of coral, the lagoon could not be deepened by any mere action of the dead coral and removal of the detritus in suspension, but solution by carbonic acid would still come into play. It is further to be borne in mind that small lagoons are shallow and are being filled up, and that it is only the large ones, encircled by nearly continuous reefs, where the corals in the lagoon and along the margin are dead, and where the effects of solution may be conceived to have been longest in operation, that the depth of the lagoon descends below the limits at which reef-builders live.

I do not regard this solution of the difficulty as wholly satisfactory. Of the fact that dead calcareous organisms are attacked and carried away in solution by the carbonic acid of sea-water there cannot be any question, and this process must be of great geological importance. Whether the solvent action is sufficient to account for the exceptional depth of some lagoons, is still, I think, open to inquiry. It seems to me not improbable that these comparatively few deep lagoons may owe their depth partly to subsidence. But if this be the case it would lend, I am afraid, but slender support to a theory of wide oceanic depression. That there must be some areas of subsidence over the coral regions is almost certain, and the few scattered deep lagoons may possibly indicate some of these areas.

Having thus fully examined the arguments on both sides of this interesting and important question, I feel myself reluctantly compelled to admit that Darwin's theory can no longer be accepted as a complete solution of the problem of coral-reefs. No one could be more impressed than myself with the simplicity of this theory, the brilliancy of its generalisation, its remarkable fitness in geological theory, and the grandeur of the conceptions of geographical revolution to which it leads. I am fully alive to the serious changes which its abandonment will make in some departments of geological speculation. But in the face of the evidence which has now been accumulated, I can no longer regard the accepted theory as generally applicable. That it may possibly be true in some instances may be readily granted. There may be areas of subsidence, as there certainly are areas of elevation, over the vast regions where coral-reefs occur. It may be conceded that subsidence may sometimes have provided the platform whereon coral-reefs have sprung up, and may have contributed to heighten some reefs and to deepen some lagoons and lagoon-channels. But I do not believe that we are now justified in assuming subsidence to have taken place, from the mere existence of atolls and barrier-reefs. Its occurrence at any locality must be proved by evidence of special local movement. It may have gone on at many localities where atolls and barrier-reefs are found, but the existence of such reefs is no more necessarily dependent upon subsidence than upon elevation. These subterranean movements must be looked upon as mere accidents in a general process of coral growth which is wholly independent of them.

I may in conclusion refer to one or two difficulties which have long been felt to be serious drawbacks to the theory of subsidence, but which disappear when the newer views of the origin of coral-reefs are accepted. If, as Darwin supposed, the coral-islands of the Pacific and Indian Oceans represent the last peaks of submerged continents, it is incredible that continental rocks should not be found among them. The oceanic islands (except of course those composed of coral-rock) are of volcanic origin and show none of the granites, schists, and other rocks which might have been looked for on such elevated summits. They have been piled up by the accumulation of lavas and tuffs discharged from the earth's interior, and, where they occur, point to upheaval rather than subsidence. Again, as Mr. Murray has shown, the inorganic deposits of the ocean-floor are composed of volcanic debris with a singular absence of the minerals that constitute the usual crystalline rocks of our continents.

No satisfactory proofs of a general subsidence have been obtained from the region of coral-reefs, except from the structure of the reefs themselves, and this is an inference only, which is now disputed. From the nature of the case, indeed, traces of subsidence can hardly be expected. A few examples have been cited, such as the occurrence of trunks of cedar-trees in a layer of red soil at Bermuda, lying between the calcareous deposits and at a depth of 42 feet below low-water mark. This indicates a recent subsidence of that tract; but it may be merely local, and may be due to the sinking down of the roof of one of the caverns into which the limestone is so abundantly honeycombed. Occasionally along the margins of lagoons trees are found at the water edge, in a position suggestive of subsidence. But the removal of the calcareous rock by solution or wave-action might equally account for their condition.

Of elevation in the region of atolls and barrier-reefs, there is almost everywhere more or less distinct evidence. Prof. Dana has collected the facts which prove that recent elevatory movements of unequal and local extent have occurred in all parts of the ocean.[1] Upheaval has taken place even in areas where barrier-reefs and atolls are in vigorous growth. Such an association of upheaval with an assumed general subsidence requires, on the subsidence theory, a cumbrous and

[1] Prof. Dana (*op. cit.*) cites examples of raised coral-reefs 250 to 300 feet above sea-level; but we do not yet know how much of the rock is solid coral and how much may be formed of aggregated organic debris.

[1] "Corals and Coral Islands," 2nd edit. p. 284.

entirely hypothetical series of upward and downward movements. These are unnecessary if we can be convinced that coral-reefs grow up independent of terrestrial movements, which may in one area be in an upward, in another in a downward direction. From this point of view the reefs stand up as the result of a complex series of agencies, among which the more important are on the one hand, the temperature, solvent power, currents, tides, and waves of the sea, and on the other hand, the amount and direction of the supply of pelagic food, the up-building of calcareous deposits to the zone of reef-builders, the outward vigorous growth of the coral-masses and their decay and death, and the solution of their skeletons in the inner parts of the reefs. All these causes are known and visibly active. Without the cooperation of any other supposed or latent force they appear to be entirely adequate to the task of building up the present coral-reefs of the oceans. ARCH. GEIKIE

DR. JOHN LAWRENCE LECONTE

INFORMATION has just been received in this country announcing the death of Dr. LeConte. He was born in New York on May 13, 1825, and was the son of a distinguished officer in the United States army, himself an entomologist. He adopted the medical profession, and during the secessionist war he entered as medical officer of volunteers. The foregoing necessarily brief, specially biographic account is chiefly derived from information furnished in Dimmock's "Special Bibliography of American Entomologists, No. 1."

LeConte could have been only nineteen years old when he published his first entomological paper on certain new species of North American *Coleoptera* (*Proceedings of the Academy of Natural Sciences of Philadelphia*, vol. ii.). From that time forward a continuous series of works and papers on North American *Coleoptera* was produced by him until his death. He made a speciality of *Coleoptera*, and, with few exceptions, all his writings were devoted to that order of insects, and through his exertions the beetles of the United States are now almost as well known as are those of Europe. At the time of his death his published papers must have been nearly 200. Moreover he was the acknowledged authority in the United States on all matters coleopterological, a position which must naturally have caused him vast trouble and correspondence, sometimes with inadequate results. Latterly he worked greatly in company with Dr G. H. Horn, of Philadelphia, a worthy follower of his tutor and a worthy successor. Their joint labours culminated *this year* when was published ("Smithsonian Miscellaneous Collections," No. 507) a "Classification of the *Coleoptera* of North America," a volume extending to nearly 600 pages. It is needless here to refer to the revolution this work and other memoirs (chiefly by Dr. Horn) created in the minds of coleopterists as to the sequence of main divisions, &c. All working entomologists are sufficiently alive to the importance of the new ideas put forth. In fact this volume might have been considered a model of a special monograph were it not for a somewhat crude "Introduction" on insects in general that precedes the systematic portion.

In the present condition of entomological science in the United States the loss of Dr. LeConte seems almost irreparable. He and his coadjutor, Dr. Horn, and one or two others, stood almost alone amongst the prominent American entomologists in holding no special official position in connection with their subject.

LeConte once made a lengthy stay in Europe, and was well known personally in this country to all the prominent Coleopterists. Moreover he was honorary member of several of the European entomological societies, including the Entomological Society of London; his personal friends in this country were numerous. Since the death of Say (whose scattered works were carefully collated and re-edited by the subject of this notice) entomological science in America has not had to deplore so severe a loss, and Say's death was not fraught with the same significance.

R. MCLACHLAN

THE LATE MR. DARWIN ON INSTINCT

AT the meeting of the Linnean Society this evening (December 6) a highly interesting posthumous paper on Instinct, by Charles Darwin, will be read and discussed. We have been favoured with an early abstract of the same, which we here present to our readers.

After detailing sundry facts with reference to the migratory instincts of different animals, Mr. Darwin proceeds to suggest a theory to account for them. This theory is precisely the same as that which was subsequently and independently enunciated by Mr. Wallace in NATURE, vol. x. p. 459. Thus, to quote from the essay: "During the long course of ages, let valleys become converted into estuaries, and then into wider and wider arms of the sea; and still I can well believe that the impulse [originally due to seeking food] which leads the pinioned goose to scramble northward, would lead our bird over the trackless waters; and that, by the aid of the unknown power by which many animals (and savage men) can retain a true course, it would safely cross the sea now covering the submerged path of its ancient journey."

The next topic considered is that of instinctive fear. Many facts are given, showing the gradual acquisition of such instinctive fear, or hereditary dread, of man, during the period of human observation. These facts led Mr. Darwin to consider the instinct of feigning death as shown by sundry species of animals when in the presence of danger. Seeing that "death is an unknown state to each living creature," this seemed to him "a remarkable instinct," and accordingly he tried a number of experiments upon the subject with insects, which proved that in no one case did the attitude in which the animal "feigned death" resemble that in which the animal really died; so that the instinct really amounts to nothing else in the case of insects at all events, than an instinct to remain motionless, and therefore inconspicuous, in the presence of danger. From the facts given with regard to certain vertebrated animals, however, it is doubtful how far this explanation can be applied to them.

A large portion of the essay is devoted to "Nidification and Habitation," with the object of showing, by an accumulation of facts, that the complex instincts of nest-building in birds and of constructing various kinds of habitations by mammals, all probably arose by gradual stages under the directing influence of natural selection.

The essay concludes with a number of "miscellaneous remarks" on instincts in general. First the variability of instinct is proved by sundry examples; next the fact of double instincts occurring in the same species; after which, "as there is often much difficulty in imagining how an instinct could first have arisen," it is thought "worth while to give a few, out of many cases, of occasional and curious habits, which cannot be considered as regular instincts, but which might, according to our views, give rise to such." Finally, cases of special difficulty are dealt with; these may be classified under the following heads:—(1) Similar instincts in unallied animals; (2) dissimilar instincts in allied animals; (3) instincts apparently detrimental to the species which exhibit them; (4) instincts performed only once during the lifetime of an animal; (5) instincts of a trifling or useless character; (6) special difficulties connected with the instinct of migration; (7) sundry other instincts presenting more or less difficulty to the theory of natural selection.

The "Conclusion" gives a summary of the general

principles which have been set forth by the whole essay. This, therefore, we shall quote *in extenso*:—

"We have in this chapter chiefly considered the instincts of animals under the point of view whether it is possible that they could have been acquired through the means indicated on our theory, or whether, even if the simpler ones could have been thus acquired, others are so complex and wonderful that they must have been specially endowed, and thus overthrow the theory. Bearing in mind the facts given on the acquirement, through the selection of self-originating tricks or modification of instinct, or through training and habit, aided in some slight degree by imitation, of hereditary actions and dispositions in our domesticated animals; and their parallelism (subject to having less time) to the instincts of animals in a state of nature: bearing in mind that in a state of nature instincts do certainly vary in some slight degree: bearing in mind how very generally we find in allied but distinct animals a gradation in the more complex instincts, which shows that it is at least possible that a complex instinct might have been acquired by successive steps; and which moreover generally indicate, according to our theory, the actual steps by which the instinct has been acquired, in as much as we suppose allied instincts to have branched off at different stages of descent from a common ancestor, and therefore to have retained, more or less unaltered, the instincts of the several lineal ancestral forms of any one species: bearing all this in mind, together with the certainty that instincts are as important to an animal as their generally correlated structures, and that in the struggle for life under changing conditions, slight modifications of instinct could hardly fail occasionally to be profitable to individuals, I can see no overwhelming difficulty on our theory. Even in the most marvellous instinct known, that of the cells of the hive-bee, we have seen how a simple instinctive action may lead to results which fill the mind with astonishment.

"Moreover, it seems to me that the very general fact of the gradation of complexity of instincts within the limits of the same group of animals; and likewise the fact of two allied species, placed in two distant parts of the world and surrounded by wholly different conditions of life, still having very much in common in their instincts, supports our theory of descent; for they are explained by it: whereas if we look at each instinct as specially endowed, we can only say that it is so. The imperfections and mistakes of instinct on our theory cease to be surprising: indeed it would be wonderful that far more numerous and flagrant cases could not be detected, if it were not that a species which has failed to become modified and so far perfected in its instincts that it could continue struggling with the co-inhabitants of the same region, would simply add one more to the myriads which have become extinct.

"It may not be logical, but to my imagination it is far more satisfactory to look at the young cuckoo ejecting its foster-brothers, ants making slaves, the larvæ of the Ichneumonidæ feeding within the live bodies of their prey, cats playing with mice, otters and cormorants with living fish, not as instincts specially given by the Creator, but as very small parts of one general law leading to the advancement of all organic bodies—Multiply, Vary, let the strongest Live and the weakest Die."

PORTO RICO

THROUGH the courtesy of Sir Joseph Hooker, we are able to publish the following interesting communication from Baron Eggers on the island of Porto Rico:—

St. Thomas, October 22, 1883

DEAR SIR JOSEPH HOOKER,—It is a long time since I wrote you last. I have meanwhile at last accomplished my long-cherished design, partly at least, of exploring the Luguillo Mountains in Porto Rico, which island I visited during April and May this year.

I spent about five weeks there, living for some time in the hut of a "fibaro" or native labourer on the Sierra, at an altitude of about 2200', on the edge of the primeval forests that still cover all the higher part of the mountain range.

Since my return I have been busy arranging my collections, the greater part of which appears in the ninth and tenth century of my "Flora Indiæ Occidentalis Exsiccata."

As for the general character of the Sierra forests, they of course resemble in their main outlines those of the other West India Islands. There is, however, especially one feature that strikes me as being peculiar to this mountain ridge compared with the woods of other islands, for example, of Dominica. Whilst the climate is just as moist in the Sierra of Porto Rico as in that of Dominica, the forests of Porto Rico seem nearly entirely *destitute of epiphytes* with the exception of some few Bromeliads and a very rarely occurring stray orchid. But orchids in general and epiphytical ferns, such as *Trichomanes* and *Hymenophyllum*, &c., are conspicuous by their absence. Of palms I found but one species, which I have distributed in my "Flora," I believe it is a *Euterpe*, grows gregariously at an altitude from 1500' to 3000'. No Cycads were seen at all.

On the other hand, I found several interesting trees, especially a beautiful *Talauma*, with immense, white, odorous flowers and silvery leaves, which would be very ornamental. The wood is used for timber, and called Sabino. A *Hirtella* with crimson flowers I also found rather common; it is not described in any of Grisebach's publications. An unknown tree with beautiful, orange-like foliage, and large, purple flowers very similar in shape to those of *Scævola Plumieri*, split along one side, a tall *Lobeliacea*, a large *Heliconia*, nearly allied, it seems, to *H. caribbæa*, Lam., and several other as yet undetermined trees and shrubs, are among the most remarkable things found.

On the whole I was somewhat disappointed with regard to the result of the voyage, as I had expected a greater number of novelties, as well as a richer vegetation in general, at least something like the Caribbean Islands. But these partly negative results may no doubt be of some value also in forming an idea of the West Indian flora in general. Of tree-ferns, *Cyathea Serra* and an *Alsophila* were not uncommon.

One of the most conspicuous trees in some parts is the *Coccoloba macrophylla*, which I found on my first visit to Porto Rico. This tree is found up to an altitude of 2000', but chiefly near the coast, where it forms extensive woods in some places, which at the time of flowering, with immense, purple spikes more than a yard long, are very striking. The tree is named Ortegón by the inhabitants; it does not seem to occur on any of the British islands, but to be confined to Porto Rico and Hayti; at least I do not see it mentioned in Grisebach's "Cat. Plant. cubensium."

The people cultivate sugarcane in the plains, which are very fertile, yielding three hogsheads on an average per acre without any kind of manure. Besides this staple produce, a very good coffee is produced; it does not appear that any blight has as yet perceptibly affected the shrubs here. Rice is very commonly cultivated on the hills in the Sierra. I suppose it must be a kind of mountain variety, as no inundation or other kind of watering is used. Rice is in fact the staple food of the labourers, together with plantain and yaüdia, *i.e. Caladium esculentum*. Immense pastures of *Hymenachne striatum* (Malahojilla) occupy a part of the lowland, and feed large herds of cattle of an excellent quality. St. Thomas and the French islands all obtain their butcher's meat from

Porto Rico; I believe even Barbados comes to Porto Rico for cattle.

The island is very richly endowed by nature, but miserably governed, and the people themselves not worth a much better government, being given to gambling in the extreme throughout, thus squandering away every dollar, from the rich planter and priest down to the lowest labourer and beggar. Yet they are hospitable and very polite to strangers, with that remarkable, unchanging, inbred Spanish politeness.

It may finally interest you to hear, from the fact that you take a prominent part in the advancement of the material progress of the English West India Islands, how we are working in that respect here in St. Thomas.

I have on my estate now about 4000 Divi-Divi trees growing and doing well, except for the deer, which do much damage. On the coasts I have over 2000 cocoa-nut trees planted; cultivation of the *Sanseviera guineensis* is going on for making fibres; a large tract of land stocked with *Hæmatoxylon* I have now preserved, and try to make it a regular forest, to be cut down gradually.

In company with an engineer here I have now ordered a machine from England, Smith's fibre machine, which is being used in the Mauritius, in order to work up our immense quantity of *Agave* and *Fourcroya*, the raw material being close at hand in unlimited quantity near the sea.

I have published a couple of articles on the material resources of these islands in one of the largest Danish newspapers, of which I beg to send you a copy, in order to make private persons and Government move. Among the former a good many have started on, but, as you may perhaps have heard, governments are sometimes slow in moving, representing, as they do eminently, that great law of nature, *vis inertiæ*.

However, so far, and considering the short space of time, I am very well satisfied. I think there is a fair chance now of the West Indies in general entering upon a new prosperous career.

I am also going to try experiments with the manufacture of tannin extracts from bark of *Coccoloba*, *Rhizophora*, and the pods of the various Acacias, which are a great nuisance here on account of their rapid growth.

The *Aloe sempervirens* will also be made useful in a similar manner as in Barbados and Curaçoa, it growing here spontaneously on barren rocks. H. EGGERS

THE REMARKABLE SUNSETS

UNDER the headings of "Cloud-Glow" and "Optical Phenomena" we have published several letters already on the recent remarkable sunsets; we have received many others, the most important of which we bring together here:—

PERHAPS it will interest you and your readers to hear that the phenomenon called "cloud-glow" in your last numbers, was seen also at Berlin on the three evenings of November 28, 29, and 30. As far as I could overlook the sky, the details were almost the same as your correspondents describe them: A greenish sunset at 3.50, an unusually bright red sky with flashes of light starting from south-west. An interesting physiological phenomenon which we call "Contrast-Farben," was there beautifully illustrated by some clouds, no longer reached by direct sunlight; they looked intensely green on the red sky. At 4.30 the streets were lighted by a peculiarly pale glare, as if seen through a yellow glass. Then darkness followed, and the stars became visible. But half an hour afterwards, at 5 o'clock, the western sky was again coloured by a pink or crimson glow. Persons who were not quite sure about its direction mistook it for a Polar aurora; others spoke of a great fire in the neighbourhood. If atmospheric refraction could be neglected, the matter (whatever it may be) thus illuminated by the sun one hour after sunset and 45° above the horizon, would be found to be at a height of about forty miles! At 6 o'clock all was over. The first day (November 28) this glow was still stranger, because the lower western sky was covered by a large, dark cumulus-cloud; but besides this the three remarkable evening skies were quite like each other. ROBERT VON HELMHOLTZ

N.W. Berlin, Neue Wilhelmstrasse 16, December 1

P.S.—To-day it rains; nevertheless an unusual brightness was to be seen in the west till 7 o'clock, which perhaps may be attributed to the same "glow."—R. v. H.

THE red glow described by your correspondents continued to be visible here every evening until yesterday (2nd inst.), and there was another fine display of *rayons du crépuscule*. Is not "cloud-glow" a misnomer as applied to what is seen in perfection only when there are no clouds, and is invisible when the clouds are thick? "After-glow" is too comprehensive an expression, as it embraces the usual effects of a brilliant sunset, and too limited, as it could not be applied to the phenomenon as recently seen before sunrise. In the absence of a scientific title for something which has been but little investigated, might not the name "upper-glow" be adopted, in contrast to the under-glow which is the predominant feature of ordinary effective sunsets. The red colour of the reflected light is in both cases I suppose equally due to diffraction, particles suspended in the air obstructing the rays of least wave-length. But in the "upper-glow" the reflecting matter is at a great height above the cloud-level, in the "under-glow" it consists of the lower surface of the clouds themselves. ANNIE LEY

December 3

Erratum.—In the first paragraph of my letter of the 27th ult. (p. 103) 2600 should be 26,000.

THE following extracts from my observations at York may assist in determining the cause of the extraordinary series of sunrise and sunset effects during the past month:—November 24: Unusual cloud tinge in morning. November 25: Similar effect in morning. From 2.45 to 3 p.m., blue sky from 10° to 25° or 30° from the sun, of a delicate rose pink. This noticed by several, when asked to say if they saw anything peculiar. It gave a greenish-gray cast to cirro-cumuli through which it was seen. Round the sun the sky looked yellowish. 5.30 p.m., "the west ruddy as from glare of fire;" not entirely gone till 6. Time of local sunset 3.38, calculated from almanac and observed sunrise on 28th.

A letter from my father, Street, Somerset, 26th, evening, speaks of "a wide arc above the sunset lit up with the most glorious pink shade. The clouds low in the horizon a stone-gray; but the most remarkable of all was a longish cloud to the north of sunset and above and beyond the circle of pink; that was a bright sage green. I never before saw such a colour in any cloud. . . . Later, rays shot up from the sun like the rays of aurora."

28th: Same pink halo at noon. Cloud-glare on morning of 26th and 27th; to-day, about 6 a.m. (sun rose at York 8.0, set 3.35). Sunset most striking; pink above, orange lower at 4.20; grass appeared of brownish sage green. At 5 p.m. lit up all over like red aurora. 29th: Same red glare, like that of a fire, at 6.20 a.m. Glare gone by 6.35; cirri in east-south-east lit up by 6.45. True sunrise glow 7.10; orange at base turned to yellow-green at 7.25, and cirri again black; relit at 7.35, with rosy tinge. Sun seen to rise clear of horizon at 8.2; Jupiter visible among faint haze until 8.13. 9.45 a.m., rosy glow round sun; 4.30 p.m., a fading ordinary sunset; 4.45, glare reappearing; 5 p.m., "finer than ever," as observed by Mrs. Clark. December 3: Remarkable lurid effects, 4.30 to 5.0 p.m. Letters from Street and Birmingham mention similar effects on the 28th and 29th. A para-

graph in the *Daily News* reports them from Bideford, Devon, on Monday, 26th, soon after 5 p.m.; 27th, a.m.; and from 9.45, a "dusky orange and rosy band round the sun," till hidden by clouds at noon; 28th, p.m., 29th, a.m., and coloured "bands" again round the sun at 11 a.m. To me the glare never seemed as if reflected from cirrus clouds; it was much more like that from the smoke-originated clouds of manufacturing districts. The day effect was evidently from the same cause as the after-glow. May it not help us to connect it with the "green sun" phenomenon of India? In that case the possible connection of the latter with the volcanic eruptions of Java assumes special interest, and may give us a new insight into the upper currents of wind. We have already heard how ashes fell at great distances to windward, reckoning by the surface currents. The same upper winds, in the time that elapsed, seem to have carried lighter ashes, projected still higher, over India. May not the lightest and highest-projected, almost impalpable dust have been spread over the greater part of our hemisphere, or at any rate as far as England, whose distance from Calcutta is not double the distance from Calcutta to Java? The recent Greenland expedition has enforced the lesson of ocean soundings on the wide prevalence of such material. If this suggestion has any foundation, then the comparison to the lurid glare over cities may be a true analogy. Just as frozen fog particles form around solid nuclei of smoke, so the impalpable dust may have formed centres for cloud-formation in air strata above the normal range of clouds.

York, December 3 J. EDMUND CLARK

P.S.—December 4: My observations on last night's sunset were from hurried glances indoors. I find from Mrs. Clark that the appearances differed from the general character, being like those of Sunday evening, the 25th. She noticed, as did also another lady, the curious *green* colour of the moon. This fact was recalled to my mind to-night, when yesterday's sunset effects were repeated, the moon, to my surprise, having a most striking green tint. This was about 4.25, and it was still noticeable at 4.45.—J. E. C.

THIS singular atmospheric aspect prevails here daily at sunrise and sunset, though there seem to be indications that its splendour is on the wane. It has been visible for nearly a month, prolonging daylight upwards of an hour. At sunrise, on the 28th, the rich colours of the phenomenon again suffused the sky, and at sunset and for upwards of an hour afterwards the sky was effulgent with all the prismatic colours. The sunrise of the 29th surpassed all previous ones in magnificence, spread, and duration of colour. The day being favourable for observation, it was possible to detect a mass of attenuated, white, nebulous vapour surrounding the sun for a distance of some 30° or 40°. The sunset was less remarkable for tone and brilliancy of colour. Pearly-whites and steel-grays mostly prevailing at 4.15 p.m., a faint rosy colour suffused the whole sky. At 4.30 p.m. a band of glowing orange-coloured light, about 23° in altitude, stretched from north-west to a point near the south, and at 5.15 p.m. a remarkable body of rosy light formed in the west above the orange-coloured mass, and separated from it by a dark slate-coloured space, about 2° wide, small and pillar-shaped at first, with the apex pointing north, but soon spreading north and south. This nebulous body deepened in colour as it grew in mass till it became a remarkable volume of vivid crimson light some 5° or 6° in height, and 25° or 30° in length. At 6 p.m. the colour of the western sky had changed to orange; afterwards the colour slowly died out, and night prevailed. On the morning of the 30th ult. the glow was indistinctly apparent. In the afternoon there was a dense cloud canopy and considerable rainfall, but an orange coloured glare at sunset was discernible through the clouds. On the 1st inst. the radiance of the glow was conspicuous, and the sky richly coloured just before sunrise. At 4 p.m. the glare in the west was brilliant, with golden carmine and green colours. At 4.15 the carmine colour disappeared, the greater part of the sky became of a delicate blue, and long streaks of cirri of changeful colour lay across the sky. After many changes of tints and the appearance of the usual glow like that of a second daylight, at 5.15 p.m. the usual fiery glow rose in the west to an altitude of 25°, and continued till 6 p.m. On the 2nd, the sky was cloudy before sunrise, but the radiance was visible all the same, showing carmine and golden hues. On that morning a pale yellow coloured the sky till 11 a.m. At sunset the iridescent display was less brilliant than usual, and commenced later. But there were fiery reds, glowing yellows, and olive-greens in a sky with a detached cloud canopy. The usual fiery glow appeared at about 5.50 and prevailed till 6 p.m. On the morning of the 3rd, before sunrise, the coloured radiance reappeared in great beauty, and a yellow tint pervaded the sky throughout the day. The wind on this day was rough from the north-west. The thermometer at midday was 51°. At sunset the glow was less splendid than heretofore, and the fiery reds were dilute and diffuse. The sky was cloudy. The glow lighted up the heavens till 6 p.m. as usual. This morning (4th) the sky before sunset was resplendent with rich masses of prismatic colour. Suddenly, at 8.30 a.m., when the brilliant colours had vanished, a halo of iridescent colours encircled the sun for a short time, as though a body of vapour was swiftly traversing the sky. In a moment afterwards the colour of the sun changed to an exquisite emerald hue, staining the landscape and investing houses, buildings, glazed windows, and greenhouses with a remarkably weird aspect. Before there was well time to notice how things appeared in a bright green light, the rays of the sun changed to a deep yellow, and in a moment afterwards, as though some obscuring medium had been withdrawn, the ordinary daylight reappeared. At sunset to-day the display was magnificent in variety and tint of colour. At 4.15 the usual orange-colour bank of glowing, luminous vapour appeared in the west, extending to north-west and south-west, having above it a system of rays of a dull, fiery red. The sky was clear, flecked here and there with cirro-cumulus. At 4.45 the crescent of the moon, being just above the fringe of red light, assumed a lively green hue, and continued to exhibit the novelty of an emerald crescent till 5 p.m., when, the colour passing away, the satellite resumed its silvery hue and shone in the blue sky, while the fiery glow still lighted up the west and north-west. It seemed to me that the moon's rays neutralised in the neighbourhood the fiery tints which characterise this peculiar glow, as in the vicinity of the crescent blue sky prevailed. It may be mentioned that foreign particles are traversing the atmosphere. On July 14 black rain fell at places round this city, and some was collected at Crowle. A good observer, Mr. J. S. Haywood, the hon. secretary of the Naturalist Field Club, noticed the black sediment which the rain had deposited on the leaves of the plants and shrubs in his nursery. At the time I drew attention to the rainfall, and ventured to ascribe the discoloration to the presence of volcanic dust. It has since transpired that Krakatoa was in violent eruption from May 20 down to the fatal 26th of August, throwing up vast masses of dust. Discoloured rain again fell in the vicinity of this city on the 17th ult. J. LL. BOZWARD

Worcester, December 4

THE ruddy glow near the sun, so well described by J. Ll. Bozward in your last number (p. 102), was most conspicuous here on the 30th ult. both at sunrise and sunset. It should be examined with a spectroscope. Here there were neither clouds nor cirri visible. Yesterday it rained the whole day; towards evening the sky

became clear near the zenith, heavy clouds clustering all round the horizon; above them the unexplained glow was very remarkable at sunset. If it has been observed in England on the same days, at a distance of 10° in latitude, its cause must be high in the atmosphere. Would it not be interesting to ascertain how far it has been seen, at least throughout Europe?

ANTOINE D'ABBADIE

Abbadia, near Hendaye, December 2

DURING the latter half of November we have had here also a constant succession of remarkable sunsets, and at least one sunrise of the same character. But here the effects have been accurately described by the expression "cloud-glow." Masses and streamers of cirro-cumulus vapour have hurried up from the west, evening after evening, as sunset approached, at a rate greatly in excess of the wind below, and then as the sun sank the whole sky has shone with a lurid coppery light which I have only very occasionally and partially seen before. Even when the dusk was early and thick, the same lurid glare has shone as it were behind the clouds.

HENRY CECIL

Bregner, Bournemouth, December 1

I SHOULD not have troubled you with a letter respecting the wonderful after-glows which have presented such magnificent displays during all the past week, especially on the 26th, and which have attracted such universal attention, had I not observed that no one has alluded to their appearance in the spectroscope. I made some observations on the 26th and 27th about 4.30 p.m., when the colour was at its greatest brilliancy, and was struck with the following particulars :—(1) The ordinary delicate tints of the spectrum were merged into two, a deep red and a peculiar blue-green; (2) in the middle of the red was a strong dark band; (3) on the green side of the D line, and separated from it by the light band so often conspicuous, was another band of deep citrine. The only *line* clearly distinguishable was one at the extreme end of the red.

E. BROWN

Further Barton, Cirencester, November 30

THE following note of observations of the western sky made with a pocket spectroscope on the evenings of Wednesday, November 28, and of the 4th and 5th inst., may be of interest. At about 4 o'clock—just after sunset—the band which Mr. Piazzi Smyth has termed the "low sun band," was abnormally strong, so was the line he calls *a*. The lines constantly seen in the "rain band" were not visible, and C_1 was very slight. In place of the ordinary "rain band"—a band of absorption shading off from D towards the less refrangible end of the spectrum—there was a broad band of absorption which extended nearly three-fourths of the way from D towards *a*, or nearly half way to C, its darkest part being at rather less than one-third of its width from D. From this darkest part it shaded off in both directions. In a short time this band gradually nearly disappeared, the low sun band also diminishing in intensity, while *a* became extraordinarily prominent—very dense in the middle, and slightly shaded off at both edges. At this time the yellow and orange of the spectrum seemed nearly to have disappeared, the green apparently extending to a considerable distance on the less refrangible side of D. This evening (the 5th), as Mr. Lockyer pointed out, there was also a strong band of absorption between *b* and F. I had not remarked this on the 28th or the 4th, and believe it is unusual or unusually strong.

December 5 J. F. D. DONNELLY

AN optical phenomenon has appeared at Hunstanton each afternoon commencing Sunday, the 25th ult., at about 4.30 p.m., up to and including to-day. The first appearance was a brilliant yellow light in the west, which, after a few minutes lit up the whole western horizon, the upper sky being a beautiful azure blue, showing up in contrast a few fleecy dark stratus clouds; after a few minutes the yellow light gradually turned to pink, and the horizon all round was tinged with this colour, eventually a crimson arch formed in the west, and gradually the whole thing disappeared. From the position of Hunstanton, facing west and north, remarkable and beautiful sunsets are of frequent occurrence. This morning as the sun was rising a thin layer of clouds pervaded the whole of the heavens, which were tinged with pink in every direction.

CHARLES W. HARDING

The Chase, King's Lynn, December 1

There has been much correspondence in the daily papers on the subject, and it may be useful to give here the leading points in these communications.

The phenomenon has not been confined to this country. The *Times* Rome correspondent telegraphs under date November 30:—"Yesterday evening the population of Rome was struck with admiration, mingled with awe, at the sight of a splendid phenomenon. From fifteen minutes after sunset until more than an hour later the north-western hemisphere was tinged with crimson, gradually increasing in intensity until it had the appearance of the reflection of an extensive conflagration, in front of which the tower of the Castle of Saint Angelo, the cupola of St. Peter's, and the outline of Monte Mario, as seen from the Pincio, stood out in prominent relief. Immediately above the horizon there was a broad belt of orange red, and above that another of green, surmounted by the crimson glare of the aurora. The sky of the eastern hemisphere presented a uniform sea-green tint. The phenomenon was repeated again this morning, and again this evening. A strong north wind blew all day yesterday; the sky was exceptionally clear, and the temperature was gratefully warm and balmy."

Again, an observer at Viareggio, Italy, near the Carrara Mountains, writes :—"At sunset the whole horizon, from Corsica to the Bay of Spezia, is literally bathed in a flood of red light, which, during the last few evenings, has been intensified in a remarkable degree, and prolonged till about 6 p.m., when the glow spread over the whole cloudless firmament, and was reflected on the Carrara Mountains—a truly glorious phenomenon, produced by the more than usually rarefied condition of the atmosphere under the influence of the low temperature which has prevailed for some days, the wind being north-north-west."

At the Cape also they have attracted attention. "A. D. S.," writing to the *Times* of December 4, says :—"The phenomenon in question seems to have been first noticed in this country on the evening of the 9th ult., and it recurred on several evenings during last week. A lady, who has lately been an early riser, informs me that the sky has had the same unusual light at sunrise. We have just received a letter from the Cape of Good Hope, dated November 2, in which the following passage occurs:—'We have had such extraordinary lights nearly every evening for the last five weeks. Shortly after sunset a red or yellow glow appears in the west, and it gets quite light again, and remains so for some time, and then it dies away. During the time it lasts all the flowers seem of such very brilliant colours, the pink roses especially. They look as bright as they are painted on Christmas cards, and the green of the oak trees is something wonderful. The lights appear sometimes in the morning also, an hour before sunrise, when it is generally pitch dark here.'"

So Mr. C. J. Thornton writes to the *Standard*, under date November 28, as follows :—"This afternoon I received a letter from Monghyr, Bengal, dated November 5,

in which was the following passage : 'Have you seen any unusual appearances in the sky lately? For some time past in this country an extraordinary red glow has been seen in the sky just before sunrise and just after sunset. It seems to have been noticed all over India and in Egypt also, but I do not know if it has been seen in Europe. The natives are full of superstitious fears on account of it. No one, so far as I know, has been able to account for it, but several theories, more or less absurd, have been started, one trying to connect it with the eruption in Java, another with the spots on the sun, and so on. I do not know what it can be, but it is certainly very remarkable, and I never saw anything like it before.'"

A correspondent of the *Times* sends the following extract from the *Gold Coast Times* of September 14. The phenomena alluded to were seen at Cape Coast Castle:—"On the 1st or 2nd of this month the sun was described as being blue in the morning. It seems it rose as usual, and that the clouds which passed over it, from their greater rarity or density, gave it different apparent shades of rose colour, pink, and so on. After the passage of the clouds its appearance through the haze was white like the moon. In fact, an Englishman is said to have taken it for the moon."

In Paris also, and elsewhere in France, the phenomenon has been very striking.

A correspondent writing from Croydon to the *Standard*, under date November 26, says:—"At half-past three this afternoon the sky in the west quickly assumed a deep red colour, which, after some minutes, spread over the sky to a considerable distance, tinging it with a pale pink colour. This, again, in a few minutes, disappeared, and the sky assumed its normal condition."

Another correspondent on the same date, from Derby, states:—"This evening we have witnessed a most remarkable sunset, the sky being lit up with a pale bluish-yellow light, changing to orange and red."

Again, a correspondent to the same paper writing on November 28 from Skegness, Lincolnshire, says:—"Here, in the fens of Lincolnshire, where gorgeous sunsets are the rule, the phenomenon has been most remarkable, and each evening since Sunday last the heavens have presented an appearance both interesting and awe inspiring. On Monday evening last, when the sun set at 3.57, the western heavens were all aglow until 6.30, and the rich, lurid glare of the 'after-glow' had all the appearance of an immense illumination, the rays of which, starting from the direction of the setting sun as a centre, extended well towards the zenith. The most remarkable thing was the fact that whilst the western sky was thus all aglow the stars in the northern heavens were shining as brilliantly as at midnight. The 'blood-red' appearance has been repeated during the rest of this week. The effect was altogether different from the 'Aurora Borealis,' there being an utter absence of the peculiar scintillation common to that phenomenon."

From Eastbourne, according to a correspondent there, "a considerable space above the hills where the sun had disappeared was a clear sky with no tinge of red in it, but a pale greenish-blue transparency, to describe which I can find no precise words. Across this there floated three or four opaline cloudlets, while a great mass of violet-coloured vapour lay piled up in the south-west. Above the pale and clear transparency was a broad zone of rose-colour, which seemed denser here and there, and also appeared to shoot upwards in tongue-shaped undulations. As the evening advanced, and the true sunset, at 3.57, took place, the clear sky disappeared, as if drawn down behind the hills, which the rosy zone now touched, and was gradually drawn down in its turn, but remained unfaded to the last."

Mr. Sydney Hooper, writing to the *Standard* from Ealing, says:—"In none of the correspondence on the subject of the remarkable sunsets we have had lately have I seen any reference to what strikes me as the most curious fact in connection with them, and which in my experience is quite unique. I have observed sunsets carefully for the last thirty years, and I have invariably found that the crimson glow is the last; coming usually a considerable time after the yellow glow has faded. The crimson light is always followed by the cold gray which precedes the night, as many must have observed when the rosy light dies out from an Alpine peak. For the last few evenings, however, notably on Wednesday night, there has been a reversal of this rule. A yellow glow has first overspread the sky, extending almost to the zenith. This has gradually deepened to orange, then to crimson. The crimson has then gathered in intensity towards the horizon until it has become a deep, rich, horizontal bar, lingering long after sunset. Then came the effect which I refer to as unique. After the crimson had died away, the west was again lit up by a deep orange glow extending over half the sky, so intense in colour that the lamps showed as white light against it. This second glow is to me unaccountable, and indicates a very peculiar condition of the atmosphere. Another fact, equally remarkable, was that the whole effect was reproduced the following (Thursday) morning, but the order of the tints was, of course, reversed. At a quarter to six an exact reproduction of the orange tint of the previous evening was seen in the south-eastern sky. This was followed by the deep crimson bar low down in the horizon. Then the crimson gradually passed upwards, giving place finally to the greenish yellow with which the phenomena commenced in the evening."

NOTES

IT is proposed to hold, during the year 1884, an International Exhibition, which shall also illustrate certain branches of health and education, and which will occupy the buildings at South Kensington erected for the International Fisheries Exhibition. The object of the Exhibition will be to illustrate, as vividly and in as practical a manner as possible, food, dress, the dwelling, the school, and the workshop, as affecting the conditions of healthful life, and also to bring into public notice the most recent appliances for elementary school teaching and instruction in applied science, art, and handicrafts. The influence of modern sanitary knowledge and intellectual progress upon the welfare of the people of all classes and all nations will thus be practically demonstrated, and an attempt will be made to display the most valuable and recent advances which have been attained in these important subjects. The Exhibition will be divided into two main sections, Division I. Health, Division II. Education, and will be further subdivided into six principal groups. In the first group it is intended specially to illustrate the food resources of the world, and the best and most economical methods of utilising them. For the sake of comparison, not only will specimens of food from all countries be exhibited, but the various methods of preparing, cooking, and serving food will be practically shown. The numerous processes of manufacture connected with the preparation of articles of food and drink will thus be exemplified; and, so far as the perishable nature of the articles will admit, full illustrations will be given of the various descriptions of foods themselves. In the second group, dress, chiefly in its relation to health, will be displayed. Illustrations of the clothing of the principal peoples of the world may be expected; and a part of this Exhibition, which, it is anticipated, will be held in the galleries of the Royal Albert Hall, will be devoted to the history of costume. In the third, fourth, and fifth groups will be comprised all that pertains to the healthful construction and fitting of the dwelling, the school, and the workshop; not only as respects the needful arrangements for

sanitation, but also the fittings and furniture generally in their effect on the health of the inmates. The most improved methods of school construction will be shown, and the modes of combating and preventing the evils of unhealthy trades, occupations, and processes of manufacture will form portions of the Exhibition. The sixth group will comprise all that relates to primary, technical, and art education, and will include designs and models for school buildings; apparatus and appliances for teaching; diagrams, text-books, &c. Special attention will be directed to technical and art education, to the results of industrial teaching, and to the introduction of manual and handicraft work into schools.

On the 22nd ult. the remainder of the furniture and stores for Ben Nevis Observatory were carried to the top under great difficulties. The party had intended to make the ascent at the beginning of the week, but, owing to the state of the weather, they could not think of it. On Thursday morning, however, although the weather was not very favourable, it was decided to make the ascent, and at 9 a.m. Mr. James M'Lean, contractor, and Alex. Turban, who is in charge of the stores, along with two assistants, started with some chairs and other stores. The first part of the journey was easily accomplished. The snow lay pretty heavy down to within a mile of Achintee farmhouse, and several deep wreaths were encountered before reaching the lake. On reaching the Red Burn they came upon a long wreath of about fourteen feet deep. The snow being somewhat soft, the party had to cut a passage through, which was a rather difficult task. Determined if possible to reach the top, they proceeded slowly, and, as they ascended, the snow was found to be deeper, in which they sometimes sank to their shoulders. Parts where the wind had driven off the snow were covered with ice, rendering the path difficult and dangerous. Their efforts were, however, ultimately crowned with success, for at 2.30 p.m., five and a half hours after starting, the party reached the Observatory. The average depth of snow on the level parts on the summit was about six feet, and round about the Observatory it was eight feet. Mr. Omond and his assistants were in excellent spirits, are very comfortable, and now feel quite at home. The party started on the return journey at 3.30, and Fort William was reached at 6.30 p.m., the whole journey, including a stay of an hour at the Observatory, occupying nine hours.

We regret to learn of the death, on the 30th ult., of the celebrated Swedish zoologist, Prof. Sven Nilsson, of the Lund University, at the age of ninety-seven.

M. Renard has communicated recently (November 3) to the Royal Academy of Brussels the results of a chemical and microscopic examination of the ashes from the great eruption of Krakatoa, which fell at Batavia on August 27 last. He finds that the volcanic dust consists mainly of glassy particles, among which may be distinguished crystals of plagioclase, often in rhomboidal lamellæ, augite, rhombic pyroxene, and magnetite. The rock which has been blown into this finely divided state presents the general mineralogical composition of the augite-andesites, but with a rather higher proportion of silica, which, on analysis, was found to amount to 65 per cent. of the whole.

A meeting will be held on Friday at the rooms of the Royal Society, Burlington House, Piccadilly, when it will be proposed to appoint a Committee, and to make such other arrangements as may be considered necessary for the successful promotion of the William Spottiswoode Memorial Fund. The chair will be taken by Prof. Huxley, President of the Royal Society, at four o'clock precisely.

The members of the Polar meteorological station which Denmark maintained at Godthaab in Greenland under the international scheme, have just returned to Copenhagen. The chief of the expedition, Lieut. A. Paulsen, reports that, having left Copenhagen on May 18, 1882, in the sailing ship *Ceres*, they arrived at Godthaab on June 14. On the voyage out observations of the temperature of the sea and air were made every hour. On the arrival out the expedition had to select the most suitable spot for the erection of the four wooden buildings brought with them, in which the magnetic and astronomical observations were to be made. A small mountain ridge near the church in the colony was chosen for this, as the preliminary researches in its neighbourhood showed that the influence of iron strata on the magnetic current was here very small. The buildings were then erected and the pillars raised on which the transit instrument, the great astronomical clock, and the eight different magnetical instruments were mounted, and simultaneously the instruments for the meteorological observations were also placed so that the weathercock and the anemometers, as well as the thermometer hut, were situated as free as possible. On August 1 the meteorological observations could be commenced, but the magnetic ones were through an accident delayed until the 7th. From that date complete observations were made in exact accordance with the international programme without interruption every hour until August 31 this year, and the expedition has thereby fully accomplished its object, viz. of obtaining a full year's magnetical and meteorological observations in this locality. A number of other scientific researches have also been pursued, of which those on the aurora borealis should particularly be mentioned. This phenomenon was frequently observed and studied during the winter, while some exceedingly valuable statistics were obtained as to the altitude of the aurora borealis above the earth's surface by measurements effected simultaneously in various places by light signals. The measurements of atmospheric electricity have also led to valuable results. It is stated to have been the best equipped Polar expedition ever despatched from Denmark. We hope soon to give further details.

The following communication from Mr. Charles Ford, of the Botanic Garden, Hong Kong, dated October 3, 1883, has been forwarded to us from Kew for publication:—"By the s.s. *Laertes* which left this place for London last week I have sent two Wardian cases of live plants, one case of living orchids, and a case of herbarium specimens, which I brought back from the Lo-Fau Mountains up the East River, and distant about sixty miles from Canton, where I spent about three weeks in August. On this excursion I travelled over about eighty miles of country after leaving the river, and consequently had a considerable amount of trouble when the natives knew I had no boat to fall back upon, and was therefore very much in their hands. I intended to make another trip up the North River during this month, but that is now impossible, as Dr. Hance, who is Acting Consul at Canton, will not apply to the Viceroy for passports for any one, and he says he is afraid it will be a long time before he will feel at liberty to do so. You have no doubt heard of the very serious trouble at Canton, in which a riot occurred and nearly twenty European residences were attacked and burnt down by the Chinese and the valuable contents of the houses carried off by the mob. There is a very hostile feeling to foreigners prevailing now amongst the Chinese, and it is considered quite unsafe to travel in the country. I was in the Lo-Fau Mountains when the trouble at Canton commenced, but no one attempted to molest me, and I returned to Canton in a passage junk with 150 Chinese on board, and no foreigner besides myself; since then, however, matters have become much worse. Mr. Sampson's herbarium and house were burnt when his house was set fire to, and Dr. Hance's, which was not more than fifty yards off, might easily have shared the same fate, but very fortunately it was spared. Dr. Hance is extremely busy with official matters, and he thinks it will be a long time before he can resume botanical work. There is an encampment of 1000

Chinese troops in the foreign settlement at Canton, and five foreign and about a dozen Chinese gunboats in the river opposite to it: all these for the protection of the foreign residents and their property. The missionaries have left the country districts, and do not expect to be able to return for many months. These things will prevent any botanical work being done in China for some time. I hope something may be done in Formosa in the beginning of next year."

LARGE use is made at the Forth Bridge Works of electricity for lighting purposes. At South Queensferry the workshops are it up by sixteen arc lights, supplemented by a certain number of movable small incandescent lights. Outside twelve large arc lights serve to illuminate the various lines of rails and the approaches to the workshops. The offices, canteen, and other buildings are lighted throughout with Swan incandescent lights of 20-candle power, over 200 being there alone required for the purpose. The staging, which, beginning near the Hawe's Pier, extends for nearly half a mile into the Firth, has, with its approaches, twelve large lights devoted to its illumination. On the island of Inch Garvie in mid channel, four large arc lights are in use outside, and small incandescent lights in the offices and workshops, in the old castle, and in the neighbouring buildings. At North Queensferry six large arc lights serve for the outside illumination, and a number of incandescent lights for that of the interior of the offices and workshops. Nowhere is a dangerous degree of electric pressure allowed; and in all interiors, workshops, or operations under water the limit is but little more than one-half of that permitted by the Board of Trade in their provisional orders for dwellings in towns.

THE mathematical magazine conducted under the name of the *Analyst* for the past ten years, by Mr. J. E. Hendricks, will, we learn from *Science*, be continued under the editorial charge of Ormond Stone, Professor of Astronomy, and William M. Thornton, Professor of Engineering, with the title, *Annals of Mathematics, Pure and Applied*. The numbers will be issued at intervals of two months, beginning February 1, 1884. In scope the journal will embrace the development of new and important theories of mathematics, pure and applied; the solution of useful and interesting problems; the history and bibliography of various branches of mathematics; and critical examinations and reviews of important treatises and text-books on mathematical subjects. The office of publication will be at the University of Virginia.

DR. HOLUB has left England on his expedition to the interior of Africa. He leaves for this journey of a year accompanied by his wife and eleven good servants, including a carpenter, a waggonmaker, a blacksmith, a gunmaker, a tailor, and a butcher, besides his black servant-girl and a dog. In South Africa he will increase his staff by nineteen, and afterwards in Central Africa by forty more black servants.

IT is reported from the Storelvdal, a valley in Central Norway, between 61° and 62° N. lat., that the snow during the night of November 17 became covered with a gray and black layer of dust. No scientific investigation of the phenomenon has as yet been effected.

THE report of the death of Julius Payer, the discoverer with Weyprecht of Franz Josef Land, is, we are glad to say, without any foundation.

THE Annual Report for 1882-83 of the Liverpool Geological Association reports favourably, we are glad to see, on the position and work of that society.

THE Report of the Smithsonian Institution for 1881 shows how admirably that many-sided organisation continues to carry on its invaluable work. The museum in its various departments is constantly increasing; the library will soon be almost without a rival; while a successful chemical laboratory has been added to the other resources of the institute. The appendix, containing as it does a record of progress in all departments of science by specialists, is of great utility; while the special papers on anthropology continue to be a well-known feature of the Report. The Report, like the Institution, reflects the greatest credit on its secretary, Prof. Spencer Baird.

THE additions to the Zoological Society's Gardens during the past week include a Moorhen (*Gallinule chloropus*), British, presented by Mr. T. E. Gunn; two Common Wolves (*Canis lupus* ♂ ♀), European, a Dufresne's Amazon (*Chrysotis dufresniana*) from South-East Brazil; a Bell's Cinixys (*Cinixys belliana*) from West Africa, two Carp (*Cyprinus carpio*) from British fresh waters, purchased; an Indian Gazelle (*Gazella bennetti*), born in the Gardens.

OUR ASTRONOMICAL COLUMN

VARIABLE STARS.—The following are Greenwich times of geocentric minima of *Algol*, during the first quarter of 1884: the later observations of Prof. Julius Schmidt have been brought to bear upon the predictions.

	h. m.		h. m.		h. m.
Jan. 10 ...	13 35	Feb. 2 ...	12 9	March 13 ...	15 38
13 ...	10 24	5 ...	8 58	16 ...	12 28
16 ...	7 13	8 ...	5 47	19 ...	9 17
30 ...	15 19	22 ...	13 53		
		25 ...	10 43		
		28 ...	7 32		

According to Mr. Knott's observations of U Cephei, 1881-1883, a minimum is indicated on January 5 at 15h. 21m. G.M.T., the period being 2d. 20h. 48·9m. The ephemeris published in the *Vierteljahrsschrift* gives it 1h. 10m. earlier; but it is not stated upon what elements this rests.

Minima of S Cancri occur on December 31 at 8h. 41m., January 19 at 7h. 57m., February 7 at 7h. 12m., and February 26 at 6h. 28m. G.M.T.

The fine variable R Leonis will be due at maximum on February 23, and *Mira Ceti* on March 11.

THE FIRST COMET OF 1798.—A recalculation of the elements of the orbit of this comet, made by Mr. Hind from Messier's observations on April 12, 13, 14, May 1, 2, 3, and May 20, 21, 22, as they are given in Zach's *Allgemeine Geographische Ephemeriden*, vols. i. and ii., does not lead to any suspicion of ellipticity, which is rather confirmatory of the view taken by Dr. Harzer as to its non-identity with the greatly perturbed comet of Brorsen (1846 III) to which reference was lately made in NATURE. The new orbit is as follows:—

Perihelion passage 1798, April 4·51482 Paris M.T.

	° ′ ″	
Longitude of perihelion	105 5 43	Mean Equinox 1798·0
,, ascending node	122 7 22	
Inclination	43 48 1	
Log. perihelion distance	9·6857689	

Motion—direct.

The error in longitude for the second normal is − 19″; the latitudes agree.

THE GREAT COMET OF 1882.—We do not hear that this comet has been recognised since its conjunction with the sun. As was pointed out in this column, it was just possible that it might have been re-observed as the earth somewhat overtook it in its orbit, between the beginning of September and the end of last month. On November 30 the distance was at a minimum of 5·708, and is once more on the increase.

The comet was seen at the Observatory of Cordoba until June 1; the last complete observation for position was made there on May 26, when the distance from the earth was 5·048. There is no parallel to this in the whole history of cometary astronomy, except in the case of the very exceptional comet which was observed in 1729 and 1730; at the time of Cassini's last observation this body was distant from the earth 5·135.

Between the first accurate observation at the Royal Observatory, Cape of Good Hope, on September 7, 1882, and the Cordoba observation above referred to on May 26, 1883, the

comet described an orbital arc of more than 340°. The ellipse deduced by Kreutz from observations to November 14 assigns a period of 843 years; that by Fabritius, from observations to March 3, one of 823 years; but we may soon hope to see the result of a definitive discussion of the whole series of observations.

THE ANNIVERSARY MEETING OF THE ROYAL SOCIETY

THE Anniversary Meeting of the Royal Society took place as usual on St. Andrew's Day, November 30, when the President, Prof. Huxley, delivered his address; after which the Fellows elected the officers of the Society for the year, whose names we have already given in NATURE, Nov. 8, p. 43. The following is Prof. Huxley's address:—

It will be as much in consonance with your feelings as it is with my own that the first sentences of this address should give utterance to our sense of the calamity which befell us during the recess.

On June 27 our honoured and loved President, William Spottiswoode, fell a victim to that cruel malady, typhoid fever, which is at once the scourge and the reproach of modern civilisation; and we were bereaved of a chief of whom all those who had the highest interests of this Society at heart hoped that he would continue for many a year to discharge the responsible and laborious duties of his office with that broad intelligence, that faithful diligence, that inexhaustible patience and courtesy, which were so characteristic of the man.

Every one of the Fellows of the Society in whose hearing I speak knows that these are no words of conventional eulogy, as of a customary epitaph. But it is only those of us who worked with our late President in the Council, or as officers of the Society, who are in a position fully to appreciate his singular capacity for the transaction of business with clear judgment and rapid decision, and yet with the most conscientious consideration of the views of those with whom he was associated.

And I may add that it is only those who enjoyed Mr. Spottiswoode's intimate friendship, as it was my privilege to do for some quarter of a century, who can know how much was lost when there vanished from among us that rare personality, so commingled of delicate sensitiveness with marvellous self-control, of rigid principle with genial tolerance, of energetic practical activity with untiring benevolence, that it always seemed to me the embodiment of that exquisite ideal of a true gentleman which Geoffry Chaucer drew five hundred years ago:—

> "... He lovede chyvalrye,
> Trouthe and honour, fredom and curtesie.
> . . . . . .
> And though that he was worthy he was wys,
> And of his port as meke as is a mayde.
> He never yit no vilonye ne sayde
> In al his lyf unto no maner wight.
> He was a verray perfight gentil knight."

It is not for me to pass any judgment upon Mr. Spottiswoode's scientific labours; but I have the best authority for saying that having occupied himself with many branches of mathematics, more especially with the higher algebra, including the theory of determinants, with the general calculus of symbols, and with the application of analysis to geometry and mechanics, he did excellent and durable work in all; and that, in virtue of his sound and wide culture, his deep penetration, and the singular elegance with which he habitually treated all his subjects, he occupied a place in the front rank of English mathematicians.

The interment in Westminster Abbey of one who, though compelled to devote a large share of his time to business, was a born man of science, and had won himself so high a place among mathematicians, was doubtless grateful to us as men of science; it could not but be satisfactory to us as Fellows of the Royal Society that, on the rare occasion of the death of our President in office, the general public should show its sympathy with our bereavement; yet as men I think it is good to regard those solemn and pathetic obsequies as the tribute which even our busy, careless, cynical, modern world spontaneously pays to such worth and wisdom, to such large humanity and unspotted purity as were manifested in the "very perfect gentle knight" who so well represented the chivalry of science.

The total number of Fellows deceased during the past year amounts to twenty; a large inroad upon our ranks in mere numbers, an exceptionally severe mortality if we consider the scientific rank of many names in the death-roll. Almost at the same time with Mr. Spottiswoode's untimely death we lost, at the ripe old age of ninety, a very distinguished Fellow and former President of this Society, Sir Edward Sabine. It is said that the average age of Fellows of the Royal Society is greater than that of any body of men in Europe; and it is certainly a remarkable fact that one who so long presided over us in this generation should, as a man of thirty years, have been the contemporary of Sir Joseph Banks, who became our President more than a century ago. And nothing can give a more striking exemplification of the gigantic progress of physical science in modern times than the fact that the discovery of oxygen by Priestley, and that of the composition of water by Cavendish, fall within the period of Sir Joseph Banks's presidency, while Black's work was but a score years earlier. We are as it were but two Presidents off the budding of modern chemistry, as of many another stately growth of the tree of natural knowledge.

Sir Edward Sabine's long services to this Society, first as Treasurer and then as President, deserve more than a passing allusion; but for a due appreciation of them, no less than of his great labours in terrestrial magnetism, I must refer you to our obituary notices.

By the unexpected death of Prof. Henry John Stephen Smith the University of Oxford lost one of the most distinguished, as he was one of the most influential, among those who have guided its destinies during this generation, and a capacity of the first order, not yet weakened by the touch of time, has disappeared from the ranks of the foremost mathematicians of Europe.

As Chairman of the Meteorological Committee, Prof. Smith rendered invaluable services to that body; and we have all a grateful recollection of the readiness with which his knowledge and sagacity were brought to our aid in Council and in Committee.

For the rest, I dare add nothing to that which has been said of him by our late President in that just and loving appreciation of his friend, which is now touched with a sadder gravity and a deeper pathos.

It is difficult to say of Prof. Smith whether he was more remarkable as a man of affairs, of society, of letters, or of science; but it is certain that the scientific facet of his brilliant intelligence was altogether directed towards those intelligible forms which people the most ethereal regions of abstract knowledge. In Sir William Siemens, who but the other day was suddenly snatched from among us, we had a no less marked example of vast energy, large scientific acquirements, and intellectual powers of a high order, no less completely devoted, in the main, to the application of science to industry.

I believe I am expressing the opinion of those most competent to judge, when I say that Sir William Siemens had no superior in fertility and ingenuity of invention; that hardly any living man so thoroughly combined an extensive knowledge of scientific principles with the power of applying them in a commercially successful manner; and that the value of his numerous inventions must be measured, not merely by the extent to which they have increased the wealth and convenience of mankind, but by the favourable reaction on the progress of pure science which they, like all such inventions, have exerted, and will continually exert.

Time permits me to be but brief in alluding to the remainder of our long list of deaths. But I may not omit to mention that we have lost a distinguished mathematician in Prof. Challis; in Mr. James Young, a chemist whose skilful application of theory to practice founded a new industry; in Mr. Cromwell Varley, an ingenious inventor; in Lord Talbot de Malahide, a warm friend of science and a zealous promoter of archæological research; in Mr. Walker, an eminent engineer; in Mr. Howard, an eminent quinologist; and in the Rev. Dr. Stebbing, an accomplished and amiable man of letters, who for very many years filled the honourable, but not very onerous, office of Chaplain to the Society.

And it would ill become us, intimately connected as this Society always has been, and I hope always will be, with the sciences upon which medicine bases itself, to leave unnoticed the decease of the very type of a philosophical physician, the venerable Sir Thomas Watson.

Two well-known names have disappeared from among those of the eminent men who are enrolled upon our foreign list; the eminent physicist, Plateau, and the no less distinguished anatomist and embryologist, Bischoff.

I now beg leave to bring under your notice a brief general review of the work of the Society during the past year.

The papers printed in the *Transactions* for 1882 and 1883 will occupy two volumes, of which three parts, containing 1038 quarto pages and fifty-two plates, have already been published. Two parts more, to complete 1883, will shortly be published.

The *Proceedings*, which steadily increase in size from year to year, amount during the past year to 780 octavo pages, with four plates and numerous engravings.

You are aware that nothing is printed in the *Proceedings* or in the *Transactions* except by the authority of the Council, which, in the latter case, calls in the assistance of at least two carefully-selected and independent referees, by whose advice it is in practise, though not necessarily, guided. I am inclined to think that Fellows of this Society who do not happen to have served on the Council, are little aware of the amount, or of the value of the conscientious labour which is thus performed for the Society by gentlemen whose names do not appear in our records. And I trust I may be forgiven for stepping beyond precedent so far as to offer our thanks for work which is always troublesome and often ungrateful; but, without which, the contributions to our pages would not maintain the high average of excellence which they possess.

Among the points of importance, by reason of their novelty or general significance, which have been laid before us, much interest attaches to the result brought out in Prof. Osborne Reynolds's "Experimental Investigation of the circumstances which determine whether the motion of water shall be direct or sinuous, and of the law of resistance in parallel channels;" which shows that when the conditions of dynamical similarity are satisfied, two systems, involving fluids treated as viscous, may be compared (as regards their effects) even when the motions are unstable; and that if any one of the two systems is in the critical state separating stability from instability, so will be the other.

Last December, Dr. Huggins presented a note on "A Method of Photographing the Solar Corona without an Eclipse," which had so far proved successful, under the unfavourable circumstances in which he had put it in practice, as to lead to the hope that, under better conditions of atmosphere and elevation, the corona might be photographed, from day to day, with so much accuracy as to preserve a clear record of the changes which it undergoes. And, as the photographs taken during the eclipse at Caroline Island show a condition of the corona, intermediate between those exhibited by Dr. Huggins's photographs at periods antecedent and subsequent to the Caroline Island observations, there is reason to believe that this hope is well based, and that a new and powerful method of investigation has been placed in the hands of students of solar physics.

Lord Rayleigh and his sister-in-law, Mrs. Sidgwick, have made a very elaborate determination of the relation between the ohm and the British Association standard of electrical resistance.

With respect to those branches of knowledge on which I may venture to offer an opinion of my own, I may say that, though our records show much useful and praiseworthy work in biological science, the only event which appears to me to call for special remark is the opening of an attack upon a problem of very great interest, one which, in fact, goes to the root of the question of the fundamental unity of the two great embodiments of life—plants and animals.

The well-known phenomena presented by many plants, such as the sensitive plant and the sun-dew, our knowledge of which was so vastly extended by Darwin, abundantly prove that the property of irritability, that is, the reaction of a living part, by change of form, upon the application of a stimulus to that part, or to some other part in living continuity with it, is not confined to animals.

But, in animals, the connection of the part irritated with that which changes its form is always effected by a continuity of more or less modified protoplasmic substance, and reaction takes place only so long as that continuity is unimpaired; while, hitherto, the protoplasmic cell-bodies of plants have appeared to be isolated from one another by the non-protoplasmic cell-walls in which they are inclosed.

It is as if, in the one case, there was a continuous bond of conducting substance between the point of irritation and the point of contraction; while, in the other, there was a chain of pellets of protoplasmic substance, each inclosed in a coat of a different nature.

Now, Mr. Gardiner, in his paper "On the continuity of the Protoplasm through the Walls of Vegetable Cells," brings forward evidence, based chiefly upon the careful use of special reagents, that, in the sensitive cushions of certain plants and in other situations, the vegetable cell-wall is pierced by minute apertures, and that these are traversed by threads of protoplasm, which connect the cell-body of each cell with those of its neighbour, and thus establish, as in animals, a continuity of protoplasmic sub-tance between different parts. Other observers are working at the same subject, and we may hope that, before long, great light will be thrown upon many hitherto puzzling questions in vegetable physiology.

The Committee of the Royal Society, in the hands of which the Lords of the Treasury have placed the administration of the funds devoted to the publication of the work of the *Challenger* expedition, report that, under the careful and vigorous direction of Mr. Murray, this great undertaking is making rapid progress.

Mr. Murray informs me that thirty-eight reports have, up to this time, been published, forming eight large quarto volumes, with 4195 pages of letterpress, 488 lithographic plates and other illustrations. Thirty-four of these memoirs are on zoological, four on physical subjects. Nine reports are now nearly all in type, and some of them partly printed off. These will be published within three months, and will form three zoological volumes, with 230 plates and many woodcuts, and one physical volume, with many diagrams and maps; this latter volume will contain the report on the composition of ocean water, the specific gravity and temperature observations.

A considerable part of the general narrative of the cruise is now in type, and nearly all the illustrations are prepared. The narrative will extend to two volumes, and it is expected they will be ready for issue in May or June, 1884.

The work connected with the remaining forty-two special reports is, in most instances, progressing satisfactorily. Portions of the manuscript for three of the larger memoirs have been received and put in type, and the manuscript of many others is in a forward state. For these memoirs, 386 lithographic plates have been printed off and delivered to the binders; 404 others are now on stone, and the drawings for many more are being prepared. It is estimated that the whole work connected with the Report will be completed in the summer of 1887.

In his Address, last year, the President gave the Society a full account of the changes which had taken place in the administration of the Government Fund—technically termed a grant in aid of this Society—though, as you are aware, the Royal Society, while willingly accepting the burden and the responsibility of administrator of the aid granted by the State to science, is in no sense pecuniarily benefited by the grant.

A somewhat novel and extremely useful employment has been given to part of the fund by deciding to defray the expenses of adequately skilled persons who have undertaken to visit distant countries for the purpose of investigating certain interesting biological questions on the spot, and of procuring and transmitting to observers at home specimens prepared and preserved by those refined modern methods which can be satisfactorily carried out only by persons who are well versed in the practice of such methods.

Mr. Adam Sedgwick has thus been enabled to proceed to the Cape of Good Hope for the purpose of completing our knowledge of the singular genus *Peripatus*, so well studied by Prof. Moseley, and afterwards by our lamented Fellow, Balfour; and Mr. Caldwell, similarly aided, is now in Australia, devoting himself to the elucidation of the embryology of the marsupial quadrupeds of that region, a subject of which at present we know little more than was made known in the *Transactions* of this Society half a century ago by Prof. Owen.

It certainly was high time that British science should deal with a problem of the profoundest zoological interest, the materials for the solution of which abound in, and are at the same time almost confined to, those territories of the Greater Britain which lie on the other side of the globe.

Many years ago the late Mr. Leonard Horner communicated to the Society the results of a series of borings which he had caused to be made in the upper part of the delta of the Nile, with a view of ascertaining the antiquity of the civilisation of Egypt. Since that time Figari Bey, an Italian geologist in the service of the Egyptian Government, made and published the results of a large series of borings effected in different parts of the delta, but his work is hardly on a level with the requirements of modern science.

It has been thought advisable therefore to take advantage o

the presence of our troops in Egypt in order to carry out a series of borings across the middle of the delta, in the full expectation that such borings, if made with proper care and carried down to the solid rock, will afford information of the most important character, and will throw a new light upon the natural and civil history of this unique country. I am glad to say that the representations which the President and Council made to the War Office on this subject were most favourably received, and that instructions were at once sent to the officer commanding the Engineers to undertake the operations which they recommended. I trust that, before long, information will reach us which will be of no less interest to the archæologist than to the geologist.

While I am speaking of Egypt, I may perhaps be permitted to express a regret that the admirable energy of the Government in taking measures to make the recent advances of medical science available during the late outbreak of cholera in that country, was not extended beyond the purely practical side of the matter, or, perhaps, not so far as the practical side in the proper sense; for until we know something about the causes of that terrible disease, our measures for prevention and for cure will be alike leaps in the dark.

Those who have looked into the literature of cholera may, perhaps, be disposed to think that a new search after its cause will add but another to the innumerable wild hypotheses which have been set afloat on that topic; and yet devastating epidemics, like the pebrine of the silkworm, so similar in their fatality and their apparently capricious spread, that careful investigators have not hesitated to institute a detailed comparison of the phenomena of this disease with those of cholera, have been proved by Pasteur to be the work of microscopic organisms; and hardly less fatal epidemics, such as splenic fever, have been traced to similar agencies. In both these cases, knowledge of the causes and of the conditions which limit the operation of the causes, have led to the invention of effectual methods of cure. And it is assuredly, in the present state of science, something more than a permissible hypothesis, that the cause of cholera may be an organic living *materies morbi*, and that the discovery of the proper curative and prophylactic measures will follow upon the determination of the nature and conditions of existence of these organisms.

If this reasoning is just, it is certainly to be regretted that the opportunity of the outbreak of cholera in Egypt was not utilised for the purposes of scientific investigation into the cause of the epidemic. There are able, zealous, and courageous young pathologists in this country who would have been willing enough to undertake the labour and the risk; and it seems a pity that England should leave to Germany and to France an enterprise which requires no less daring than Arctic or African exploration, but which, if successful, would be of a thousand times more value to mankind than the most complete knowledge of the barren ice wastes of the Pole or of the sweltering barbarism of the equator.

It may be said that inquiries into the causation of cholera have been for some years conducted in India by the Government without yielding any very definite result. But this is perhaps rather an argument in favour of, than against, setting fresh minds to work upon the problem.

In December last year the President received from the Lords of the Treasury a letter, addressed to their Lordships by the Lords of the Committee of the Privy Council on Education, recommending to the favourable consideration of the Treasury a memorial from the Solar Physics Committee, suggesting the organisation of an expedition for the purpose of making observations during the solar eclipse of May 5, 1883; and the President was requested to communicate his views upon the subject to the Treasury.

After careful consideration, the President and Council reported in favour of the projected expedition; but they added that they did so on condition of its being possible to find some one, whose position in the scientific world would command the confidence of the public, to take charge of the expedition. Unfortunately, for one reason or another, none of the men of science who fulfilled this condition were able to go; and, at the meeting of Council of January 18, the projected expedition was abandoned. The President was, however, requested to place himself in communication with the American authorities, and to ascertain from them whether a photographer and assistant could be allowed to accompany their expedition to Caroline Island. On doing so, he at once received an invitation for two observers; who were accordingly sent out, their expenses being defrayed, partly by a contribution from the Government grant, and partly by a special sum of 500*l.* provided by the Treasury.

I am indebted to Mr. Lockyer for the following list of photographs taken by the observers:—

1. Six good photographs of the corona, exposures varying from two to sixty seconds, giving coronal detail from near the limb to end of streamers. That the limit of the corona has been photographed is shown by the manner in which the light of the sky has impressed itself on the plate.

2. Three large photographs showing the details of the corona close to the limb.

3. Good photographs of the spectrum of the corona, showing a great number of coronal lines and very faint Fraunhoferic lines.

4. Photographs taken on a moving plate in integrating spectroscope, from one minute before to one and a half minute after totality, showing the most prominent lines of the reversion spectrum. These lines belong mainly to hydrogen.

5. Photographs taken with first-order grating, before, during, and after totality. These show H and K, near the limb, throughout the whole of totality.

6. Photographs taken with a dense prism spectroscope before, during, and after totality. These photographs also give some of the prominent lines of the reversion spectrum.

7. Two photographs taken in the prismatic camera on plates sensitive to ultra-red rays. Results comparatively indifferent on account of the absence of prominences.

The arrangements made for obtaining a series of circumpolar observations in meteorology and magnetism were fully described in the Presidential address of last year. I am glad to be able to report that the English party, under Capt. Dawson, has successfully achieved its mission and has returned to this country. Capt. Dawson speaks very gratefully of the efficient assistance which he received from the Canadian authorities and from the Hudson Bay Company.

The responsibility for the transaction of the ordinary work of the Society rests with the Council and the officers, of whom the President is only one, and I may be allowed to say by no means the most important, the heaviest part of the burden of the executive resting upon the Secretaries. But your President is, in virtue of his office, a member of two public bodies whose functions in relation to science are of great importance; and I follow the excellent precedent set by my predecessor in considering it my duty to acquaint the Fellows of the Society with any occurrence, bearing on the interests of science, which has come under my cognisance, as a Trustee of the British Museum and as a member of the Council and Executive Committee of the City and Guilds Institute.

In the first-named capacity, I am glad to be able to announce that the transference of the vast zoological, botanical, geological, and mineralogical collections from Bloomsbury to the New Natural History Museum is now accomplished; and that it has been effected to the great credit of all concerned, with no greater mishap than the fracture of a bottle or two.

The advantages which will accrue to zoologists, botanists, and mineralogists from the re-arrangement of this vast assemblage of the objects of their studies, in such a manner as to be accessible to every investigator, cannot be over-estimated. The Natural History Museum at South Kensington is, in fact, a library of the works of nature which corresponds in value, in extent, and in the purposes to which it should be applied, to the vast library of the works of men which remains at Bloomsbury.

In making this collection of use to the world of science by the publication of complete catalogues of its contents, and of systematic monographs upon particular groups; and to the nation at large, by the composition of guide books calculated to afford the ordinary visitor an insight into the plan of the mighty maze of nature, the officers in charge of the Natural History collections have before them a task, the due performance of which, whatever their abilities, or their number, or their industry, will tax their energies to the utmost. It is in this way that, in the discharge of their proper duties, they may render services of the highest value alike to pure science and to the diffusion of knowledge among the people, out of whose resources the great institution to which they belong is supported. And I trust that no mistaken view of the functions of the officers of the Museum, which no more embrace oral instruction in science than those of the officers of the Library comprehend oral instruction in literature, may lead to the imposition of duties, foreign to their

proper business, upon the already overburdened staff of keepers and their assistants.

In Francis Bacon's apocalypse of science, the "New Atlantis," the Father of Solomon's House—he, whose countenance was "as if he pitied men,"—declares that the end of that foundation is "the knowledge of causes and secret motions of things, and the enlarging of the bounds of human empire to the effecting of all things possible."

I think that the Chancellor would have acknowledged the New Natural History Museum to be a goodly wing of such a house, devoted to the former of the objects which he mentions; but it may be, that his practical mind, looking always to fruit, and caring for light chiefly as something essential to fruit-bearing, would have been even better satisfied with another building hard by, which has been devoted to the encouragement of those applications of science through which human empire is directly extended, by the well-directed munificence of the City and Guilds of London.

This building, destined for a central institution in which ample provision shall be made for thorough and practical training in so much of the principles and the methods of the physical sciences as is needful for those who aspire to take part in the development of arts and manufactures, has been completed at a cost of more than 70,000*l.*, while 20,000*l.* has yet to be spent upon fittings and appliances, and the working expenses, if the scheme is to be fully developed, cannot be estimated at less than 10,000*l.* a year.

Having already been called upon to take an active part in the deliberations of the committees charged with the carrying out of this great work, I think I am justified in expressing the hope, and indeed the confident expectation, that, before long, this new Technical College will be in full activity; and that, for the first time in our history, there will be called into existence an institution in which, without leaving this country, masters, managers, and foremen of works will be enabled to obtain thorough instruction not only in scientific theory, but in the essential principles of practice; and a machinery will be created, by which the poorest working lad in a manufacturing town, if he have ability and perseverance, may be brought within reach of the best technical education that is to be had.

There can be no doubt that the founders of the Royal Society had prominently before their minds the intention of promoting the useful arts and sciences "that so (in the language of the draft of the preamble to the first charter, which is said to have been drawn up by Sir Christopher Wren) by laying in a stock, as it were, of several arts and methods of industry, the whole body [of the nation] may be supplied by a mutual commerce of each other's peculiar faculties, and, consequently, that the various miseries and trials of this frail life may be, by as many various expedients ready at hand, remedied or alleviated, and wealth and plenty diffused in just proportion to every one's industry, that is, to every one's deserts." It was the wish of King Charles the Second that all patents for inventions should be examined by the Royal Society; and, so late as the reign of George the Second, the Society actually performed this duty. The steam-engine itself may be said to have made its *début* before the Royal Society, when Savery exhibited his working model to the Fellows in 1699.

But the subsequent history of natural knowledge has shown that, as in the moral world, those who seek happiness through well-doing are less likely to obtain that reward than those who try to do well without thinking what may come of it; so, in the world of science, those whose vision is fixed on useful ends are often left poor and bare, while those who strive only after the advancement of knowledge, scatter riches along their path, for the whole world to pick up. The Royal Society has chosen the latter course, and I trust it may never swerve from it. But I think that our warmest sympathy is due to the efforts of those who translate the language of the philosopher into that of the workshop; and by thus ameliorating "the miseries and toils of this frail life," and "diffusing wealth and plenty," are executing that part of the first design of this Society, with which we, as a body, have long ceased to occupy ourselves.

It was not as your President, but as one of the Special Commissioners appointed by the Government, that I had some slight share in another considerable undertaking directed towards the improvement of industry. But the future of the fisheries is so closely connected with the advancement of certain branches of zoological science, that I may be permitted to advert to the great success of the International Fisheries Exhibition; and to express my belief that, in accordance with the intimation contained in the speech of H.R.H. the Prince of Wales at the closing of the Exhibition, there will grow out of it an organisation which will provide for the application of science to the improvement of the fisheries.

In conclusion, gentlemen, I think that it is proper on my own behalf, as it is certainly due to you, that I should advert to the exceptional circumstances which have brought about my present occupation of the Presidential office.

The eleventh section of the sixth chapter of the statutes provides for the occurrence of a vacancy in the Chair, whether by death or by resignation, as follows:—

"Upon any vacancy in the President's place occurring in the intervals of the anniversary elections, the Treasurer, or in his absence one of the Secretaries, shall cause the Council to be summoned for the election of a new President, and the Council meeting thereupon in the usual place, or any eleven or more of them, shall proceed to the said election, and not separate until the major part of them shall have agreed upon a new President."

This statute is substantially, and, to a great extent, verbally, identical with the twelfth section of the seventh chapter of the original statutes of 1663.

Before the present year, five occasions had arisen on which it became necessary to put the provisions of the statute into effect.

Sir Isaac Newton died while President in 1727; the Earl of Morton in 1768; Mr. West in 1772; and Sir Joseph Banks in 1820; while Sir Humphry Davy resigned in 1827. On each of these occasions a new President was at once appointed by the Council, endowed with all the privileges and powers of the office; and, like every other officer, however appointed, he vacated his office on November 30 following, when the Fellows sometimes elected him for the succeeding year, and sometimes did not.

These precedents were strictly followed on the present occasion. A Council had been summoned, in ordinary course of business, for June 28; but, as the President died on the 27th, it was deferred until the following Thursday, when it was supposed the interment would have taken place. In consequence of the delay inseparable from a public ceremony, however, it so happened that the funeral did not take place until noon of July 5; and I have known few sadder scenes than the gathering of the Council, fresh from the unclosed grave of their President, for the performance of the duty, imposed upon them by the statutes, of choosing his successor from their own number, before they should separate.

The Council did me the great honour of selecting me for the office; and now, on this next following St. Andrew's Day, my tenure, like that of the Treasurer and Secretaries, lapses, and it is for the Fellows of the Society to say who shall be their officers until the next Anniversary Meeting.

Having served several years, in another capacity, with three out of four of my present colleagues, and having every reason to believe that the Fellows of the Society, at large, see good reason to set the same high value upon the services of all of them as I do, I do not find myself able to imagine that you will fail to desire that those services shall be continued; but I have not the least difficulty in conceiving that the Fellows of the Society may think many of their number better fitted for the eminent place of the President than myself.

I should be extremely ungrateful to my colleagues of the Council, who have again honoured me by presenting me for election by the Fellows, if I were to let fall even a hint of the extent to which I share that opinion; but I think it may be permitted me to say that, should you think fit to give effect to it, there is no one who will more cheerfully acquiesce in your decision than I shall.

To a man like myself, who neither possesses, nor seeks, any other distinction than that of having done his best to advance knowledge and to uphold the dignity and the authority of science against all comers, the Presidency of this Society is the highest dignity which he can attain, whatever else may befall him.

But, gentlemen, as men of science, you know better than I can tell you, that there are things of more worth than distinction. I am within measurable distance of the end of my career; and I have long looked forward to the time when I should be able to escape from the distractions and perturbations of the multitudinous affairs in which I have been so long entangled, to that student life from which the Fates have driven me, but to which I trust they may, for a little space, permit me to return.

So that I am sure you will neither misunderstand me, nor mislike my directness of speech, when I say that, if it please you to believe that the interests of science and of the Royal Society will be advanced by maintaining me in the very distinguished position which I at present occupy, I will do my best to justify your confidence; but if, as may well be, you think that some other Fellow of the Society will serve these interests better, I shall, with a light heart, transfer to him the honourable burden, which I have already borne long enough to know its weight.

I now proceed to the presentation of the medals which have this year been awarded by the Council.

The number, the variety, and the importance of Sir William Thomson's contributions to mathematical and experimental physics are matters of common knowledge, and the Fellows of the Society will be more gratified than surprised to hear that the Council have this year awarded him the Copley Medal, the highest honour which it is in their power to bestow.

Sir William Thomson has taken a foremost place among those to whom the remarkable development of the theory of thermodynamics and of electricity in the last forty years is due; his share in the experimental treatment of these subjects has been no less considerable; while his constructive ability in applying science to practice is manifested by the number of instruments, bearing his name, which are at present in use in the physical laboratory and in the telegraph office.

Moreover, in propounding his views on the universal dissipation of energy and on vortex motion and molecular vortices, Sir William Thomson has propounded conceptions which belong to the *prima philosophia* of physical science, and will assuredly lead the physicist of the future to attempt once more to grapple with those problems concerning the ultimate construction of the material world, which Descartes and Leibnitz attempted to solve, but which have been sedulously ignored by most of their successors.

One Royal Medal has been awarded to Dr. T. Archer Hirst, F.R.S., for his investigations in pure geometry; and, more particularly, for his researches into the correlation of two planes and into the complexes generated by them.

The other Royal Medal has been awarded to Dr. J. S. Burdon Sanderson, F.R.S., for the eminent services which he has rendered to physiology and pathology; and, especially, for his researches on the electrical phenomena exhibited by plants, and for his investigations into the relation of minute organisms to disease.

In making this award, the Council desire not merely to recognise the merit of Dr. Burdon Sanderson's researches, especially those on the analogy between the electrical changes which take place in the contractile tissues of plants and those which occur in the like tissues of animals; but to mark their sense of the important influence which Dr. Sanderson has exerted upon the study of physiology and pathology in this country.

The Davy Medal has this year been again awarded in duplicate, the recipient being M. Marcellin Berthelot, Member of the Institute of France, and Foreign Member of the Royal Society, and Prof. Julius Thomsen, of Copenhagen.

The thermo-chemical researches of Berthelot and Thomsen have extended over many years, and have involved an immense amount of work, partly in the application of established methods to new cases, partly in devising new methods and applying them to cases in which the older methods were not applicable. Chemists had identified a vast variety of substances, and had determined the exact composition of nearly all of them, but of the forces which held together the elements of each compound they knew but little. It was known that certain elements combine with one another with great evolution of heat-forming products in which they are firmly united; while other elements combine but feebly, and with little evolution of heat. But the materials for forming any general theory of the forces of chemical combination were but scanty and imperfect.

The labours of Messrs. Berthelot and Thomsen have done much towards supplying that want, and they will be of the utmost value for the advancement of chemical science.

THE JAVA DISASTER

THE following letter from the Liverpool *Daily Post*, received from Capt. W. J. Watson, of the British ship *Charles Bal*, contains a graphic and interesting account of the recent terrible volcanic outburst in Sunda Straits. Capt. W. J. Watson was himself an eye-witness of what he describes. His vessel was actually within the Straits, and not far from Krakatoa when that island had become an active volcano:—

"*August* 22, 15° 30' S., 105° E.—About 7 p.m. the sea suddenly assumed a milky-white appearance, beginning to the east of us, but soon spreading all round, and lasting till 8 p.m. There were some clouds (cumulus) in the sky, but many stars shone, and in the east to north-east a strong, white haze or silvery glare. This occurred again between 9 and 10 p.m., the clouds also appearing to be edged with a pinkish coloured light, the whole sky also seeming to have extra light in it, similar to when the aurora is showing faintly. On the 24th, in 9° 30' S., 105° E., we had a repetition of the above. On the night of the 25th, standing in for Java Head, the land was covered with thick, dark clouds and heavy lightning. On the 26th, about 9 a.m., passed Prince's Island, wind south-west, and some heavy rain; at noon, wind west-south-west, weather fine, the Island of Krakatoa to the north-east of us, but only a small portion of the north-east point, close to the water, showing; rest of the island covered with a dense black cloud. At 2.30 p.m. noticed some agitation about the Point of Krakatoa; clouds or something being propelled from the north-east point with great velocity. At 3.30 we heard above us and about the island a strange sound as of a mighty, crackling fire, or the discharge of heavy artillery at second intervals of time. At 4.15 p.m., Krakatoa north half east, ten miles distant, observed a repetition of that noted at 2.30, only much more furious and alarming, the matter, whatever it was, being propelled with amazing velocity to the north-east. To us it looked like blinding rain, and had the appearance of a furious squall of ashen hue. At once shortened sail to topsails and foresail. At five the roaring noise continued and increased; wind moderate from south south-west; darkness spread over the sky, and a hail of pumice-stone fell on us, many pieces being of considerable size and quite warm. Had to cover up the skylights to save the glass, while feet and head had to be protected with boots and southwesters. About six o'clock the fall of larger stones ceased, but there continued a steady fall of a smaller kind, most blinding to the eyes, and covering the decks to three or four inches very speedily, while an intense blackness covered the sky and land and sea. Sailed on our course until we got what we thought was a sight of Fourth Point Light; then brought ship to the wind, south-west, as we could not see any distance, and we knew not what might be in the Straits, the night being a fearful one. The blinding fall of sand and stones, the intense blackness above and around us, broken only by the incessant glare of varied kinds of lightning and the continued explosive roars of Krakatoa, made our situation a truly awful one. At 11 p.m., having stood off from the Java shore, wind strong from the south-west, the island, west-north-west, eleven miles distant, became more visible, chains of fire appearing to ascend and descend between the sky and it, while on the south west end there seemed to be a continued roll of balls of white fire; the wind, though strong, was hot and choking, sulphureous, with a smell as of burning cinders, some of the pieces falling on us being like iron cinders, and the lead from a bottom of thirty fathoms came up quite warm. From midnight to 4 a.m. (27th) wind strong, but very unsteady, between south-south-west and west-south-west, the same impenetrable darkness continuing, the roaring of Krakatoa less continuous, but more explosive in sound, the sky one second intense blackness and the next a blaze of fire, mastheads and yardarms studded with corposants and a peculiar pinky flame coming from clouds which seemed to touch the mastheads and yardarms. At 6 a.m., being able to make out the Java shore, set sail, passing Fourth Point Lighthouse at 8; hoisted our signal letters, but got no answer. Passed Anjer at 8.30, name still hoisted, close enough in to make out the houses, but could see no movement of any kind; in fact, through the whole Straits we have not seen a single moving thing of any kind on sea or land. At 10.15 a.m. passed the Button Island one-half to three-quarters of a mile off; sea like glass round it, weather much finer looking, and no ash or cinders falling; wind at south-east, light. At 11.15 there was a fearful explosion in the direction of Krakatoa, now over thirty miles distant. We saw a wave rush right on to the Button Island, apparently sweeping right over the south part, and rising half way up the north and east sides. This we saw repeated twice, but the helmsman says he saw it once before we looked. The same wave seemed also to run right on to the Java shore. At the same time the sky rapidly covered in; the wind came strong

from south-west by south; by 12.30 we were inclosed in a darkness that might almost be felt, and at the same time commenced a downpour of mud, sand, and I know not what; ship going north-east by north, seven knots per hour under three lower topsails; put out the side-lights, placed two men on the look-out forward, while mate and second mate looked out on either quarter, and one man employed washing the mud off binnacle glass. We had seen two vessels to the north and north-west of us before the sky closed in, adding much to the anxiety of our position. At noon the darkness was so intense that we had to grope our way about the decks, and although speaking to each other on the poop, yet could not see each other. This horrible state and downpour of mud, &c., continued until 1.30, the roarings of the volcano and lightnings being something fearful. By 2 p.m. we could see some of the yards aloft, and the fall of mud ceased. By 5 p.m. the horizon showed out in the north and north-east, and we saw West Island bearing east and north, just visible. Up to midnight the sky hung dark and heavy, a little sand falling at times, the roaring of the volcano very distinct, although in sight of the North Watcher, and fully sixty-five or seventy miles off it. Such darkness and time of it in general few would conceive, and many, I dare say, would disbelieve. The ship, from truck to water-line, is as if cemented; spars, sails, blocks, and ropes in a terrible mess; but, thank God, nobody hurt or ship damaged. On the other hand, how fares it with Anjer, Merak, and other little villages on the Java coast?"

UNIVERSITY AND EDUCATIONAL INTELLIGENCE

OXFORD.—The Natural Science Scholarships at Christ Church have been awarded after examination to Mr. R. E. Scholefield, of Leeds Grammar School, and Mr. H. Bankes Price, of Christ's College, Brecon. The Brakenbury Natural Science Scholarship at Balliol College has been awarded to Mr. R. P. Baker, of Clifton College. The following gentlemen were distinguished in the examination:—Mr. W. H. Littleton, Royal School of Mines, Mr. T. H. J. Watts, of Llandovery School, and Mr. C. E. Rice, of Derby Grammar School.

An examination will be held on January 29 at Queen's College for the election of a scholar in Natural Science.

CAMBRIDGE.—The Special Board for Mathematics, in publishing, after the lapse of two-thirds of the present term, a list of professorial lectures on Mathematics, with a list of College lectures open to all members of the University, states that six associated Colleges, Peterhouse, Pembroke, Corpus, Queens', St. Catharine's, and Downing, provide no lectures on higher Mathematics this term, while none will be given during the year at Jesus, Trinity Hall, Magdalen, Sidney, Cavendish, and Selwyn. St. John's does not as yet open any of its advanced lectures to other than its own students. Trinity, on the contrary, has five advanced courses this term open to the University, viz. Mr. Thomson on Electrostatics and on Statics and Attractions, Mr. Ball on Higher Differential and Integral Calculus, Mr. Glazebrook on Geometrical Optics, and Mr. Glaisher on Elliptic Functions. At King's Mr. Stearn is lecturing on Electrostatics, at Christ's Mr. Hobson on Magnetism, at Clare Mr. Mollison on Fourier's Theory and Heat. Several subjects in higher Mathematics are unrepresented by lectures this year, such as Differential Equations, Calculus of Finite Differences, Calculus of Variations, Theory of Probability, Lagrange's and Bessel's Functions, Higher Dynamics, Newton's "Principia," Planetary Theory, and Precession. The Board regret that no conference of mathematical lecturers has been held, and that there is no uniformity of procedure between the different Colleges. In all the other chief departments of study, programmes of advanced lectures for the whole year were published last June. It is somewhat of a reproach to Cambridge mathematicians that no such list is published in regard to what was once so distinctively the characteristic study of Cambridge.

The following are the examiners for the Natural Sciences Tripos of 1884:—Prof. A. M. Marshall (zoology), Dr. F. Darwin (botany), Mr. Langley (physiology), Dr. R. D. Roberts (geology), Mr. L. Fletcher (mineralogy), Mr. W. N. Shaw (physics), Mr. A. Hill (human anatomy), Mr. Pattison Muir (chemistry).

The recommendations of the General Board of Studies as to the Professor of Pathology, new readers, University lecturers, demonstrators, grants for apparatus, &c., will be voted on December 6 at noon.

Prof. Foster has been appointed on the University Library Syndicate; Prof. Foster and Dr. Vines, the Botanic Garden Syndicate; Revs. Coutts Trotter and E. Hill, the Museums and Lecture Rooms Syndicate; Messrs. H. Darwin and J. J. Thomson, the Observatory Syndicate; Prof. Cayley, the University Press Syndicate; Dr. Gaskell and Mr. A. S. Lea, the Oxford and Cambridge Examinations Syndicate; Prof. Foster, the State Medicine Syndicate; Prof. Stuart and Mr. J. Ward, the Teachers' Training Syndicate.

The following appointments on Special Boards have been made:—Mr. A. S. Lea (medicine), Dr. Ferrers (mathematics), Prof. Stokes (physics and chemistry), Mr. J. E. Marr (biology and geology).

Prof. Macalister has been appointed Examiner in the 2nd M.B. in place of the late Mr. James Shuter.

Mr. W. Gardiner of Clare College has been approved as a Teacher of Botany for the purposes of medical study.

SCIENTIFIC SERIALS

THE *Journal of Anatomy and Physiology*, vol. xviii. part 1, October, 1883, contains:—On the development of the suspensory ligament of the fetlock in the fœtal horse, ox, roe deer, and sambar deer, by Prof. Dr. J. Cunningham, M.D. (plate 1).—On the action of infused beverages on peptic digestion, by Dr. J. W. Frazer (plate 2).—On a method of promoting maceration for anatomical museums by artificial temperature, by Prof. Struthers, M.D.—On the wax-like disease of the heart, by Prof. D. J. Hamilton, M.D. (plate 3).—On the relations of the dorsal artery of the foot to the cuneiform bones, by A. Hensman.—Researches into the histology of the central gray substance of the spinal cord and medulla oblongata, by Dr. W. Ainslie Hollis, part 2 (plate 4).—On some points in the anatomy of the chimpanzee, by J. B. Sutton.—Observations upon the osteology of *Podocys montanus*, by Dr. R. W. Shufeldt (plate 5).—Short notes on the myology of the American black bear, by Prof. F. J. Shepherd, M.D.—Total absence of the left lobe of the thyroid body, by Dr. W. J. Gow.—Note respecting the course of the flexor longus digitorum pedis, by Dr. Sinclair White.—On the os centrale in the human carpus, by Prof. W. Gruber.

THE *Quarterly Journal of Microscopical Science* for October, 1883, contains:—Observations on the genus Pythium, by H. Marshall Ward, M.A. (plates 34 to 36).—On budding in Polyzoa, by Prof. A. C. Haddon, M.A. (plates 37, 38).—On the structure and relations of Tubipora, by Sydney J. Hickson, B.A., B.Sc. (plates 39, 40).—On the malleus of the Lacertilia and the malar and quadrate bones of the mammalia, by M. L. Dollo (plate 41).—Notes on Echinoderm morphology, No. 6; on the anatomical relations of the water-vascular system, by P. Herbert Carpenter, M.A.—Recent researches upon the origin of the sexual cells in hydroids, review by A. G. Bourne, B. sc.—On the osteology and development of *Syngnathus peckianus* (Storer), by J. Playfair McMurrich, M.A. (plates 42, 43).

THE *American Journal of Science*, November, 1883.—Results of some months' examination of the spectra of sunspots with an instrument of high dispersion, by Prof. C. A. Young.—On the meteoric iron mass found by F. M. Anderson near Dalton, Whitfield County, Georgia, in 1879 (two illustrations), by Charles Upham Shepard, sen. The analysis gave iron 94·66, nickel 4·80, cobalt 0·34, with traces of phosphorus, chromium, and manganese.—Notice of some varieties of corundum recently found at Sungchang, Zanskar district, Western Himalayas, by the same author.—Phenomena of the Glacial and Champlain periods about the mouth of the Connecticut Valley, that is, in the New Haven region (two maps), by James D. Dana. The author concludes that two simultaneous movements existed in the glacier ice—a lower along the valley, an upper crossing it obliquely; that both transported drift material, and that on reaching Long Island Sound the lower changed its own direction of flow for that of the general glacier mass across the Sound and Long Island.—On a variety of descloizite from Zacatecas, Mexico, by Samuel L. Penfield.—On Hybocrinus, Hoplocrinus, and Bærocrinus (two illustrations), by Charles Wachsmuth and Frank Springer.—Note on Mr. Nipher's papers on the evolution of the American trotting horse (one illustration), by W. H. Pickering. The author holds that we may foretell the speed attained for a few years in advance, but not the

ultimate speed, nor when it will be reached.—On the discovery of Utica slate graptolites on the west side of the Hudson River, a few miles north of Poughkeepsie, by Henry Booth.—On Becraft's Mountain, near Hudson, Columbia County, New York (one illustration), by William Morris Davis. After describing the district formations, and their relative and absolute positions, the author deals with the question of nonconformity between the Lower and Upper Silurian systems of the locality and the relations of these systems elsewhere. In another communication he discusses the question of nonconformity at Rondout, New York.—Notice of agricultural, botanical, and chemical results of experiments on the mixed herbage of permanent meadows, conducted for more than twenty years in succession on the same land, by D. P. Penhallow. The results are tabulated, and are valuable as showing the influence of different fertilisers upon the character of vegetation and the total produce.—Note on Mr. Backhouse's observations on physiological optics, by W. Le Conte Stevens.

Bulletin of the Belgian Académie Royale des Sciences, des Lettres, et des Beaux Arts, August 5, 1883.—Report on M. Gravis' anatomical researches on the vegetative organs and structure of the *Urtica dioica*, by MM. Ed. Morren and Gilkinet.—Report on M. Paul Albrecht's work on the pelvisternum of the Edentates, by MM. P. J. Van Beneden and Van Bambeke.—Note on a thunderbolt which fell near Gougnies on July 11, 1868, by M. D. Van Bastelaer.—Report on M. Delaey's steam engine of universal application, by M. Maus.—Remarks on some new fossils found in the Belgian Tertiary formations, by M. P. J. Van Beneden.—Note read to the Academy on presenting the two first parts of his work on the theory of the diurnal, annual, and secular movements of the axis of the globe, by M. F. Folie.—Observations on a recent note by M. P. J. Van Beneden, touching the discovery of the Bernissart fossil iguanodons, by M. E. Dupont.—Note on the influence of respiration on blood-pressure, by MM. Em. Legros and M. Griffé.—Report on M. G. Tiberghien's philosophic dissertation on time, by M. A. Le Roy.—Note on M. de Sonnaz's historical studies on the county of Savoy, by M. Rivier.—Communication on some autographs of Gretry, by M. Stanislas Bormans.

Archives Italiennes de Biologie, tome iv. fasc. 1, October 31, 1883, contains:—On the zoological station at Naples, by C. Emery.—On le charbon in birds, by E. Perroncito.—On a true diffused kidney in certain mollusca, by S. Trinchese.—On the optic lobes of birds, by J. Bellonci.—On the oscillations of the typhoid fever epidemic at Paris in connection with the rainfall and sewage of that city, by L. Pagliani.—On paraldehyde as antagonistic to strychnine, by V. Cervello.—On the active properties of *Nigella sativa*, by P. Pellacani.—On the genesis of Ptomaines, by F. Coppola.—Researches as to the poison of *Triton cristatus*, by A. Capparelli.—Embryological researches as to the mammalian kidney, by C. Emery.—Histological researches as to the nervous centres, by C. Golgi.—Obituary notices of P. Pacini, N. A. Pedicino, and Victor Colomiatti.

Zeitschrift für wissenschaftliche Zoologie, Bd. xxxix., Heft 1, September 28, 1883, contains:—Researches on the interstitial connective tissue in mollusca, by Dr. J. Brock (plates 1 to 4).—On the germinal layers of the tail end of *Lumbriculus variegatus*, with a contribution to the anatomy and history of this worm, by Dr. C. Bulow (plate 5).—On the histogenesis of the bones in Teleostei, by Carl Schmid-Monnard (plates 6 to 9).—Remarks concerning the blood lacunæ and the connective tissue in Najadæ and Mytilidæ, by W. Flemming.—Contributions to the histology of the Echinoderms, No. 1, the Holothuria (Pedata) and the nervous system of the Asteridæ, by Dr. Otto Hamann (plates 10 to 12).

SOCIETIES AND ACADEMIES

LONDON

Linnean Society, November 15.—Sir John Lubbock, Bart., F.R.S., president, in the chair.—Messrs. Philip Crowley and J. Murray were elected Fellows of the Society.—Mr. Charles B. Plowright exhibited a young pear tree showing *Ræstelia cancellata*, Jacq., produced from *Podisoma sabinæ*, therefore supporting the observations of A. S. Œrsted in *Botaniska Notiser* for 1865; also examples of *Puccinia graminis* on wheat produced from Œcidium on *Mahonia aquifolia*; the Œcidiospores were sown June 2, 1883, the Uredospores were sown June 10, and the ripe *P. graminis* was gathered September 10, 1883. He likewise called attention to examples of *Œcidium rumicis* on *Rumex obtusifolius*, *R. hydrolapathum*, *R. conglomeratus*, and *Rheum officinale*, the same being produced from *Puccinia phragmitis*.—Prof. P. Martin Duncan showed a specimen of coral (*Desmophyllum crista-galli*) which had grown upon an electric telegraph cable off the shores of Spain; it possessed radicles, apparently due to the presence of a worm close beneath the base of the coral.—Mr. E. P. Ramsay exhibited a series of rare New Guinea birds, and Mr. R. B Sharpe made remarks thereon.—Mr. T. Christy exhibited a fine living and healthy specimen of *Trevesia sundaica*, Miq. (the so-called *Gastonia palmata*), or probably a new species. This peculiar and handsome plant has rarely been seen in this country, and of late years almost been lost sight of.—Dr. J. Murie showed and made remarks on specimens of *Ascaris bicolor* from the living walrus at the Westminster Aquarium.—Mr. F. I. Warner drew attention to a series of specimens of *Orchis incarnata* from Hampshire.—A paper was read by Mr. A. W. Bennett, on the reproduction of the Zygnemaceæ, as a solution of the question, Is it a sexual character? De Bary twenty-five years ago, and since then Wittrock, have instanced what they have deemed sexual differences between the conjugating cells, though most later writers rather ignore essential physiological distinctions. Mr. Bennett has directed his investigations chiefly to the genera *Spirogyra* and *Zygnema*, and from these he supports the inference of the abovementioned authors. He finds there is an appreciable difference of length and diameter in the conjugating cells, that deemed the female being the larger. The protoplasmic contents he also finds pass only in one direction, and change first commences in the chlorophyll bands of the supposed male cells, with accompanying contraction of the protoplasmic material. The genera *Mesocarpus*, *Staurospermum*, and the doubtful form *Craterospermum* have likewise been examined, and, though showing differences, yet on the whole substantiate the view above enunciated of cell sexuality.—There followed the reading of notes on the antennæ of the honey bee, by Mr. T. J. Briant, in which he describes the minute structure of the segments, the joints and certain rod and cone like organs, previously referred to by Dr. Braxton Hicks, of highly sensitive function.—A paper was read on the Japanese Languriidæ, their habits and external sexual characteristics, by Mr. G. Lewis. He remarks that a representative of the family has been found in Siberia, lat. 46° (*L. menetriesi*); there are none in Europe, and one is known from Egypt. Others inhabit the Malay Archipelago, Ceylon, and the American continent. The author infers from the geographical distribution of these beetles that they have emanated from a tropical area. Some in the imago state cling to the stems of brushwood; others sit on the leaves of the moist shade-loving plants in the forests, while still others frequent debris on hill sides. Their colours are all dull, their bodies elongate and not structurally adapted for boring. The sexes show peculiar differences in size, and monstrous enlargement and obliquity of the head, volume of tibia, &c.—A paper was read by Prof. P. Martin Duncan on the replacement of a true wall or theca by epitheca in some Serial Coralla, and on the importance of the structure in the growth of incrusting corals. After alluding to the discussions which have taken place regarding the value of epitheca in classification, the author states that one form of this structure is simply protective, and that another form is of high physiological value, for it replaces entirely the usual theca or wall. The anatomy of the hard structures of a Ceoloria illustrates the second proposition, for the broad base is covered by an epitheca, within which is no wall or "plateau commun," the septa, remarkable nodular walls (described in detail), and the columellæ arise from the epitheca directly, and it limits the interseptal loculi inferiorly. In a Leptoria the the same replacement of a wall by epitheca is seen. In incrusting Porites and such Astræidæ as Leptastræa the majority of the corallites of the colony arise from this basal epithecate structure, and grow upwards, budding subsequently from their sides.

Royal Meteorological Society, November 21.—Mr. J. K. Laughton, F.R.A.S., president, in the chair.—The Earl of Dalhousie, K.T., T. H. Davis, D. C. Embleton, J. Hargreaves, and J. L. Lewington were elected Fellows of the Society.—The following papers were read:—Report on temperatures in two different patterns of Stevenson screens, by E. Mawley, F.R.Met.Soc. The screen employed were an ordinary Stevenson screen obtained from Casella, and a new Stevenson screen made in accordance with the recommendations of a committee appointed by the Council of the Society. The new screen is two

inches wider and deeper than the old screen. It has also an upper sloping roof, and, at a little distance below, a flat, inner roof pierced with holes for ventilation; while the old screen has a single flat roof with only a narrow slit beneath on each side for ventilation. Observations were made during the three months July to September, and the results are given in the paper. From these it appears that the new screen is, of the two, slightly cooler and better ventilated, and retains the heat of the sun for a less time than the old screen; also, having a double roof and overlapping boards below, it is bettter suited for extreme climates.—On the storm which crossed the British Isles between September 1 and 3, 1883, and its track over the North Atlantic, by C. Harding, F.R.Met.Soc., of the Meteorological Office. This storm caused considerable havoc in the south-west and south of England, owing not only to its exceptional violence, but also to its occurrence before the completion of the harvest. The storm is traceable, in the first instance, to two centres of disturbance, one being first shown at about 450 miles to the south of Bermuda on August 26, and the other to the east of the Rocky Mountains on the 27th; these two disturbances afterwards merged on the 29th, at about 300 miles to the north of Bermuda, and formed one great and destructive gale, which continued to grow in violence as it crossed the Atlantic until it reached the coasts of the British Islands. The average speed at which this storm crossed the Atlantic was fully forty miles an hour, which is more than double the usual speed of storms which traverse that ocean.—On the influence of the moon on the height of the barometer within the tropics, by Robert Lawson, Inspector-General of Hospitals.—The great ice-storm of July 3, 1883, in North Lincolnshire, by J. Cordeaux. The direction of the storm was nearly south-east to north-west, and travelled from Caistor along the higher ridges of the hills to Barton-on-Humber. The storm commenced at about 9.20 p.m. with heavy drops of rain, and increased to a downpour, speedily followed, amidst the blaze of lightning and the constant roll of thunder, by the rush of hail, or rather lumps of ice. An eye witness remarked that they were not like hailstones, but "salt-cellars"; another that they resembled "ducks' eggs"; in fact they were solid lumps of ice of every shape and size, weighing from two to six ounces, and some were measured six inches in circumference. The injury done to the growing crops cannot be estimated at less than 20,000*l*.

Physical Society, November 24.—Prof. R. B. Clifton in the chair.—Prof. Reinold read a paper by Mr. J. W. Clark, on the purification of mercury by distillation in vacuo. The advantages of Mr. Clark's apparatus are—the small quantity of mercury in use at a time, and the fact that no auxiliary Sprengel pump is required. This is avoided by having a movable reservoir of mercury, on raising which the distiller is filled with mercury. The apparatus was described in detail, and illustrated by a figure. It is probable that zinc, cadmium, magnesium, &c., may be distilled and thus purified by the same apparatus.—Mr. A. P. Chattock then read a paper on a method of determining experimentally the constant of an electrodynamometer. In existing methods it is necessary to measure the areas of the coils, which is a difficult matter to do with a finished instrument; by the new method this is unnecessary. It depends on the accurate determination of the speed of the movable coil. Mr. Chattock exhibited an instrument whose constant had been determined by him in the laboratory of Prof. Foster, University College, with the assistance of Mr. Grant.—Prof. G. C. Foster then took the chair, and Prof. R. B. Clifton, president, read a paper on the measurement of the curvature of lenses. With very small lenses the spherometer cannot be used, and the author's method is based on the Newton's rings formed between the lens and a plane surface, or a curved surface of known radius. From the wave-length of the light employed in observing, and the diameter of a ring, the radius of curvature can be determined. He places the lens on a plane or curved surface under a microscope, and lights it by the sodium flame (wave-length 5892×10^{-7}); he measures the approximate diameters of two rings a distance apart (in practice the tenth and twentieth rings are found convenient), takes the difference of their squares, and divides it by the wave-length, and the number of rings in the gap between to find the radius of the lens. The formula is—

$$\rho^1 m\lambda = \left(x^2_{m+n} - x^2_n\right)$$

where x_{m+n} and x_n are the diameters of the nth and $(m+n)$th rings; λ is the wave-length of the light, and ρ^1 the radius of curvature of the lens. The method with proper care gives accurate results. Prof. Clifton has also used it to determine the refractive index of liquids in small quantities; Mr. Richardson having found it for water = 1·3335 by this method, which is usually correct to two places of decimals. It can also be used to determine if the lens is uniformly curved and spherical. Prof. Perry suggested that it might be also used to measure a surface without touching it, say the surface of a water drop, or a strip of glass when bent. In this way it might throw light on the laws of capillarity or bending.

Manchester

Literary and Philosophical Society, October 2.—H. E. Roscoe, F.R.S., president, in the chair.—On the change produced in the motion of an oscillating rod by a heavy ring surrounding it, and attached to it by elastic cords, by James Bottomley, F.C.S.

October 16.—H. E. Roscoe, F.R.S., president, in the chair.—On the leaves of *Catha edulis*, by C. Schorlemmer, F.R.S.—Dr. Schuster, F.R.S., gave an account of meteoric dust, and exhibited some specimens found in Himalayan snow.—On the duality of physical forces, by James Rhodes, M.R.C.S.

October 30.—J. P. Joule, F.R.S., vice-president, in the chair.—On the action of water upon beds of rock salt, by Thomas Ward.

Cambridge

Philosophical Society, October 29.—On the structure of the cells of secretory glands, by Mr. J. W. Langley.—Note on the fibrin-ferment, by Messrs. A. S. Lea and J. R. Green.—On the structure of the epidermis of the ice-plant (*Mesembryanthemum crystallinum*), by Mr. M. C. Potter.—On the physiological significance of water-glands, by Mr. Walter Gardiner.

Paris

Academy of Sciences, November 26.—M. Blanchard, president, in the chair.—On the treatment of plague-stricken swine by vaccination with the fatal virus itself in an attenuated form, by M. Pasteur and the late M Thuillier.—On the hydratation of crotonic aldehyde, by M. Ad. Wurtz.—Propagation across the Indian and Atlantic Oceans of the great earthquake wave caused by the recent disturbances at Java, by M. de Lesseps. From the observations taken at Colon by the engineers engaged on the Panama Interoceanic Canal, the wave would appear to have made its way in about thirty hours from Java, round the Cape of Good Hope to the east coast of Central America.—Theoretical considerations on the action of floats kept in tow at divergent angles, by M. E. de Jonquières.—On the secular variation in the direction of the terrestrial magnetic force at Paris, by M. L. Descroix.—On the successive parthenogenetic reproduction of phylloxera for nine generations, and on the results obtained by various methods of treatment of vines attacked by phylloxera made by M. P. Boiteau.—Observations of the planets 233 and 234 at the Paris Observatory (equatorial of the west tower), by M. G. Bigourdan.—On a formula of M. Tisserand connected by the celestial mechanism, by M. O. Callandreau.—On the algebraic integration of linear equations, by M. H. Poincaré.—On an induction magnetic needle, by M. Mascart.—On the electric synchronism of two relative movements, and its application to the construction of a new electric compass, by M. Marcel Deprez.—A study of earth-currents, by M. E. E. Blavier.—Measurement of the differences of potential of electric layers on the surface of two liquids in contact (four illustrations), by MM. E. Bichat and R. Blondlot.—Wave-lengths of the optical rays A and *a*, by M. W. de W. Abney.—Description of a micro hermometer for gauging very slight variations of temperature, by M. F. Larroque.—Studies on the chemical action of light; decomposition of oxalic acid by the perchloride of iron (three illustrations), by M. G. Lemoine.—Dissociation of the anhydrous carbonate of ammonia caused by excess in one or other of its elements, by M. Isambert.—On the fusibility of salts; nitrates, by M. E. Maumené.—On hydronicotine and oxytrinicotine, by M. A. Etard.—On the relative velocity of the sensations of sight, hearing, and touch, by M. A. Bloch. This paper consists of three distinct parts, each dealing with the comparison of two sensations—(1) hearing and touch; (2) hearing and sight; (3) sight and touch. The author concludes that of the three sensations sight is the most rapid; then hearing, the transmission of which sensation lasts 1/72 of a second longer than that of

sight; lastly, touch, the transmission of which takes 1/21 of a second more than sight.—On the nervous system and the classification of the Phyllodoceæ, a hitherto little-studied family of Annelidæ, by M. G. Pruvot.—On the axis of *Œnanthus crocata* and *fistulosa*, and on abnormal vegetable productions in general, by M. R. Gérard.—On the propagation of the earthquake waves caused by the late volcanic eruption at Java, by M. Bouquet de la Grye.—A contribution to the volcanic theory, by M. Stan. Meunier.

BERLIN

Physiological Society, November 9.—Dr. Friedländer two years ago had communicated to the Society how in eight different cases of genuine croupous pneumonia, which ended fatally on the disease reaching its height, he had constantly found in the lungs a micrococcus, mostly in the form of diplococcus, which seemed to be a characteristic of genuine pneumonia. Since then the cases of croupous pneumonia he had examined amounted to over fifty, and with but very few exceptions the same description of cocci had been found in all the lungs affected. The few cases in which pneumonic cocci failed to show themselves were regularly such in which death had set in after the eighth day of the disease, that is after the disease had finished its course. In all other kinds of pneumonia, such, for example, as follow in the train of typhus, or attack old persons, &c., diplococci did not appear. It was beyond doubt, therefore, that they were a characteristic of genuine croupous pneumonia alone. That micrococci had not been perceived by many observers in the case of genuine pneumonia was owing to the fact that it was difficult to make them visible in the tissues; for only when they were highly coloured while the surrounding tissue remained colourless did they become distinctly visible. To render them apparent it was of advantage to colour thin sections of the lungs with methylic-violet or gentian-blue, and then to apply a diluted solution of iodine by means of which the tissues which were at first also coloured would become clear and so bring out the strongly-coloured cocci. Quite recently two cases had been published in which pneumonic cocci had been found *intra vitam*—one case by Prof. Leyden, the other by Dr. Günther. The latter observer invariably found the cocci inclosed in a pale and sharply-defined envelope, which, on the application of colouring-matter, likewise became highly coloured. Cocci having in both the cases referred to been obtained by means of punction, and thus their presence in the fluid of the lungs demonstrated, Dr. Friedländer set himself also to examine the fluid of the lungs in the bodies of persons who had died from pneumonia, and found there large quantities of pneumonic cocci, which were particularly well adapted for examination, being in a free state. He was now in a position to prove that they all possessed envelopes, which, by their reactions (they came out most distinctly on being subjected to acids, and disappeared under distilled water or an alkali), appeared to consist of mucin, and to be very essential to the life and activity of the cocci. According to the experience acquired down to the present date, the pneumonic cocci were the only ones which possessed this kind of slimy capsule. The problem now presented was, by means of experiments in the way of cultivation and inoculation, to determine the distinguishing characteristics and the pathogenic nature of these cocci. This task Dr. Friedländer, in conjunction with Dr. Frobenius, had undertaken with positive results. According to the methods of Prof. Koch, the cocci taken from the lungs of persons who had died from genuine pneumonia were disseminated on stiffened gelatine (consisting of gelatine, an infusion of flesh and common salt). From these proceeded invariably and in all generations perfectly characteristic organisms distinguished from all other fungous products of cultivation by their peculiar nail-like shape. No other kind of micro-organism showed the same nail-like form under cultivation as did that taken from persons pneumonically affected who had died on the disease reaching its acme, and whose lungs were afterwards examined; nor did any other species of pneumonia ever yield this form of cultivated organism. Experiments in the way of inoculation had been made on mice, guinea-pigs, rabbits, and dogs. The mice were subjected to injections either of cultivated cocci which had been obtained by dissemination of fresh lung-fluid containing cocci. Almost all these mice died after twenty to twenty eight hours, under symptoms of violent dyspnœa; and on a section being made, extensive pleurisy and pneumonia were observed in each case; in the blood, likewise, diplococci were found to be very abundant, as also in the pleural exudations and in the tissues of the lungs. Were the cocci thus found disseminated on gelatine, they then yielded the nail-like cultivated organisms already referred to, exactly in the same way as did the cocci of genuine pneumonia in the case of man. Were again these cultivated cocci injected into other mice, these mice died of pneumonia on the second day after the inoculation. If, however, the fluid containing cocci were heated to about 70° C. before being injected into the mice, it was thereby rendered inefficacious, and the mice received no harm from it. On the pleural cavity of the mice being examined, many cocci were indeed still found in the fluid, but when these were strewn on gelatine they either remained sterile or developed other than the nail-like cultivated organisms. Not only, however, by injection of pneumonic cocci through Pravaz's syringe could pneumonia be produced in mice, but likewise also by means of inhalation. If mice, shut up in a chest, were compelled to breathe an atmosphere saturated by means of a spray with pneumonic cocci, then did a number of the mice die under the same symptoms as followed injection, though in this case not till the fourth or fifth day after the operation; the blood in the lungs of those mice who had died from experimental genuine pneumonia also contained characteristic pneumonic cocci. The results obtained from analogous experiments in inoculation with guinea-pigs were less decisive. About a half of the guinea-pigs inoculated by means of injection of pneumonic cocci remained in a perfectly healthy state, showing that they were proof against cocci. The other half, however, perished of dyspnœa, and their blood, lungs, and pleural exudations were found to contain double micrococci, which being sown on gelatine produced the characteristic nail-like organisms, and on being injected gave rise to pneumonia in the creatures so inoculated. The same experiments were next tried on five dogs. Four of them remained unscathed, but one sickened and died of dyspnœa. On a postmortem being made, this last dog showed symptoms of pneumonia and the presence of the characteristic diplococci in its blood and lungs. In the four healthy dogs, on the other hand, the injected cocci had all suffered destruction. In the case of the rabbits the experiments in inoculation were wholly without effect. They showed themselves completely proof against pneumonic cocci, and the cocci injected into their lungs were, after a few days, no longer traceable. From the invariable discovery of diplococci in the lungs of bodies that had died of genuine pneumonia before the disease had run its full course, and from the experiments with cultivated cocci, as also by inoculation of mice, Dr. Friedländer drew the conclusion that the cocci found by him were the cause of the genuine croupous pneumonia which had also before been recognised as infectious. On a future occasion Dr. Friedländer will again take up this subject, so important both from a scientific and a practical point of view.

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THURSDAY, DECEMBER 27, 1883

VORTEX RINGS

The Motion of Vortex Rings. By J. J. Thomson. (London: Macmillan and Co., 1883)

BOTH as regards the interest of the subject and the treatment it has received at the hands of the author we do not doubt that the essay before us is destined to take a foremost place amongst the essays which have been called forth, or at all events distinguished, by the Adams Prize.

The fact that these essays are upon set subjects precludes the possibility of the prize being awarded for a distinctly original conception. It is almost a necessity that the subjects chosen should involve the extension of some mathematical investigation which has already been carried a certain length.

The subject of the present essay is distinctly of this class; it involves an extension of the investigation of the theory of vortex motion in an ideal fluid, founded by Helmholtz and continued chiefly by Sir William Thomson.

At the time Helmholtz conceived the fundamental principle, ideal hydrodynamics had no other interest, besides its mathematical interest, than it derived from the somewhat casual explanations it affords of the phenomena met with in the motion of actual fluids. Helmholtz's investigation had some relation to the observed phenomena of actual vortices, particularly to the phenomena of smoke rings, of which it afforded a general explanation. But between the fundamental equations which Helmholtz gave and their application to an actual vortex ring certain integrations were necessary, and these integrations presented mathematical difficulties. If we consider the line of smoke which forms the ring as indicating the portion of air in which vortex motion exists, we may say that the difficulties of integration at which Helmholtz stopped arise from the thickness of this line of smoke, or, calling this the circular core of the ring, from the finite area of the section of this core. Helmholtz contented himself with applying his theory to an indefinitely thin core; and the fact that the results of a theory based on a frictionless fluid would only have an imperfect relation to the motions of viscous fluids, together with the fact that such rings, although they may be produced by artificial apparatus, are short-lived, and have no existence in the general motion of fluids, offered but little inducement for farther prosecution of the subject. The case however was altered when it was conceived by Sir William Thomson that the atoms of matter may be such rings moving in a perfect universal fluid. Smoke rings, although their behaviour seems to have suggested the idea, could not, owing to the viscosity of the air, by any means be made to afford an experimental verification of the capabilities of such an hypothesis. The only way was to integrate Helmholtz's equations, and thus arrive at the theoretical behaviour of such rings. Unfortunately the mathematical difficulties are such that there is little hope of obtaining a complete theory of vortex rings having cores of any finite area. Sir William Thomson, however, started an approximate theory as a step towards this; he succeeded in approximately integrating the equations for rings the cores of which had sections finite but small compared with the openings of the rings, and with such rings it appears that his theory can be tested as regards matter in the gaseous state.

To do this, however, it is necessary to do more than work out the theory of a single circular ring having a core of circular section. The phenomena of gases depend on the internal vibration of the atoms and on the influence which they exert on each other by collisions or otherwise. It was necessary therefore to obtain the theory of the vibrations of these rings, also of the effect of what may be called collisions.

Sir William Thomson took many steps towards the theory of vibrations. But the theory of collisions was left for Mr. J. J. Thomson.

Mr. Thomson has not, however, confined his attention to the point set for the prize, but, starting from the foundation laid by Helmholtz, has recast the theory to his own method.

Having deduced general expressions for the momentum, moment of momentum, and energy in a mass of fluid in which there is vortex motion, which expressions are better adapted for his purpose than any previously obtained, he proceeds to the theory of a solitary vortex ring subject to the same limitation as that treated by Sir William Thomson, *i.e.* the diameter of the core small compared with the opening of the ring, but of more general shape, in that it may have any small deviation from the circular form. He obtains results which, where they correspond, agree very approximately with those previously obtained by Sir William Thomson.

The author then proceeds to the immediate subject of the essay—the action upon each other of two rings.

In dealing with this subject he introduces another important limitation, *i.e.* that the rings shall not approach each other by a distance which is large compared with the openings of the rings.

With this limitation, by means of a very powerful piece of mathematical work, the theory of the mutual action of such rings is deduced, both as regards mean motion and vibration; and he has thus carried the theory of vortex atoms to such a stage that in certain general respects it can be applied to the theory of gases.

The essay, however, does not end here, for, although outside the set subject, the author proceeds to consider the theory of "linked rings." This term does not seem well chosen, for it conveys the idea of rings linked as in a chain, whereas what it is used to express is a ring of which the core is compounded of several separate cores wrapped in a spiral manner round each other like a ring composed of twisted wire.

In the treatment of this branch of his subject he has been no less successful than in the earlier parts.

From the general scheme of his essay it is clear that the author has had in his mind as a general object the verification of the vortex atom theory; and although he avowedly refrains from going at length into such a vortex atom theory of gases as might be built upon his work, he adds a chapter at the end in which he discusses certain results of his work, which may be applied without further calculation to the vortex atom theory of gases.

It is this chapter which will excite the most general interest, for although the fact of this still very incomplete theory being found consistent with observed gaseous phenomena would not afford a crucial test of its fitness to explain the phenomena of solids and liquids, still its failure to explain the phenomena of gases would appear to be crucial as regards its unfitness as an atomic theory.

The fair and cautious spirit in which Mr. Thomson discusses his results cannot be too much admired, although we may not be quite able to realise the truth of his reasoning.

The most general and important phenomenon of gases is that sometimes called Boyle's law—that the product of the volume and pressure of any fixed weight of gas varies directly as the amount of heat, *i.e.* kinetic energy, in a gas.

Accordingly Mr. Thomson calculates the product of the pressure and volume which would result in the case of a vortex atom gas. This he finds equal to two terms, one being the kinetic energy multiplied by a constant, the other a certain quantity which involves the squares of the velocity of the medium at the boundary surface. To fit Boyle's law this second term must vanish or nearly so. Mr. Thomson argues that it does so vanish, because the surface being at rest the velocity of the fluid at it must be small. This argument we entirely fail to follow, possibly owing to some misapprehension on our part; but it seems to us that a vortex being near a solid surface is no reason for supposing the tangential velocity of the fluid small, while if the gas consists of vortex atoms so must the solid surface, and there is nothing to show that the mean square of the velocity within the solid and at its surface will be less than in the gas.

Passing on from Boyle's law, with the explanation of which he is satisfied, the author next turns to the phenomena depending on the velocity of the gaseous molecules. As this seems to us the most interesting part of the discussion, we quote the passage in full:—

"According to the vortex atom theory, as the temperature rises and the energy increases the mean radius of the vortex rings will increase, but when the radius of a vortex ring is increased its velocity is diminished, and thus the mean velocity of the molecules decreases as the temperature increases; thus it differs from the ordinary kinetic theory, where the mean velocity and the temperature increase together. It ought to be remarked, however, that though in the vortex atom theory the mean velocity decreases as the temperature increases, yet the mean momentum increases with the temperature.

"The difference between the effects produced by a rise in temperature on the mean velocity of the molecules will probably furnish a crucial experiment between the vortex atom theory and the ordinary kinetic theory of gases, since all the laws connecting the phenomena of diffusion with the temperature can hardly be the same for the two theories. In fact, if we accept Maxwell's reasoning about the phenomenon called 'thermal effusion' we can see at once an experiment which would decide between the two theories.

"The phenomenon is this, if we have a porous diaphragm immersed in a gas, and the gas at the two sides of the diaphragm at different temperatures, then when things have got into a steady state the pressures on the two sides of the diaphragm will be different, and Maxwell, in his paper 'On Stresses in Rarefied Gases' (*Phil. Trans.* 1879, part i. p. 255), gives the following reasoning to prove that, according to the ordinary theory of gases, the pressures on the two sides are proportional to the square root of the absolute temperatures of the sides. He says:—

"'When the diameter of the hole and the thickness of the plate are both small compared with the length of the free path of the molecule, then, as Sir W. Thomson has shown, any molecule which comes up to the hole on either side will be in very little danger of encountering another molecule before it has got fairly through to the other side.

"'Hence the flow of gas in either direction through the hole will take place very nearly in the same manner as if there had been a vacuum on the other side of the hole, and this whether the gas on the other side of the hole is of the same or of a different kind.

"'If the gas on the two sides of the plate is of the same kind but at different temperatures, a phenomenon will take place which we may call *thermal effusion*. The velocity of the molecules is proportional to the square root of the absolute temperature, and the quantity which passes out through the hole is proportional to this velocity and to the density. Hence, on whichever side the product of the density into the square root of the temperature is greatest, more molecules will pass from that side than from the other through the hole, and this will go on till this product is equal on both sides of the hole. Hence the condition of equilibrium is that the density must be inversely as the square root of the temperature, and since the pressure is as the product of the density into the temperature, the pressure will be directly proportional to the square root of the absolute temperature.'

"If we were to apply the same reasoning to the vortex atom theory, we should no longer have the velocity proportional to the square root of the absolute temperature, but to some inverse power of it, and the above reasoning would show that if p and p' be the pressures, t and t' the temperatures on the two sides of the plate, $p/p' = (t/t')^m$, where m is a quantity greater than unity. Thus accurate investigations of the phenomenon of thermal effusion would enable us to decide between the vortex atom and the ordinary kinetic theory of gases. These experiments would, however, be difficult to make accurately, as we should have to work with such low pressures to get the mean path of the molecules long enough that the pressure of the mercury vapour in the air-pump used to rarefy the gas might be supposed sensibly to affect the results. In the theoretical investigation, too, the effects of the bounding surface in modifying the motion of the gas seem to have scarcely been taken sufficiently into account to make the experiment of the crucial test of a theory; and it is probable that the theory of the diffusion and viscosity of the gases worked out from the laws of action of two vortex rings on each other, given in Part II. of this essay, would lead to results which would decide more easily and more clearly between the two theories.

"The preceding reasoning holds only for a monatomic gas which can only increase its energy by increasing the mean radius of its vortex atoms; if, however, the gas be diatomic, the energy will be increased if the shortest distance between the central lines of the vortex cores of the two atoms be diminished, and if the radius of the vortex atom is unaltered the velocity of translation of the molecule will be increased as well as the energy; thus for a diatomic molecule we cannot say that an increase in the energy or a rise in the temperature of the gas would necessarily be accompanied by a diminution in the mean velocity of its molecules."

With the argument here used we have no fault to find, but it does seem to us that the author has fallen into some confusion between the experimental phenomenon of thermal transpiration through porous plugs and the theoretical idea of "thermal effusion." It has probably escaped Mr. Thomson, but the experiment he suggests

was included in the general investigation, made by the writer of the present review,[1] by which the phenomenon of thermal transpiration was discovered, and although it still appears that these are the only experiments on this subject, yet they conclusively prove that the difference of the pressure on the two sides of the plate is proportional to the square roots of the absolute temperatures. So far then it would seem that the crucial experiment has been made and that the verdict is against the vortex atom theory; but this is not so, for, although the experiment Mr. Thomson suggests has been made, it is definitely and experimentally shown in the same investigation that the action of the porous plug is entirely different from that which Maxwell calls thermal effusion, being due entirely to the tangential action of the walls of the passages, and further this tangential action is in strict accordance with the present dynamical theory of gases. This experiment with the porous plug, then, affords no test whatever in the way suggested by Mr. Thomson. Mr. Thomson has, we think, been unfortunate in his choice of tests; and we would suggest *the velocity of sound* as affording a crucial test for which the experimental work is already done. It appears to be an almost obvious deduction from the vortex atom theory that the velocity of sound must be limited by the mean velocity of the vortex atoms; and since Mr. Thomson has shown that this mean velocity diminishes with the temperature, while experimentally it is found that the velocity of sound increases as the square root of the temperature, it appears that the verdict must be against the vortex atom theory. However the vortex atoms are very slippery things, and we should like to hear Mr. Thomson's opinion before adopting one of our own.

Besides discussing the theory of gases, Mr. Thomson goes somewhat fully into a vortex atom theory of chemical combinations; in this he raises many points which will doubtless be of great interest should the hypothesis survive the crucial test by the theory of gases which this essay now for the first time renders possible.

Of the mathematical interest of the essay we can only say that to those who can appreciate it this will be found to be very great. OSBORNE REYNOLDS

OUR BOOK SHELF

Krystallographische Untersuchungen an homologen und isomeren Reihen. Von Dr. A. Brezina. I. Theil. Methoden. (Wien, 1884.)

THIS very useful volume forms an introduction to the author's crystallographic investigations which earned the prize of the Vienna Academy. It deals exclusively with the principles and the methods employed in those investigations, and constitutes a complete storehouse of the formulæ required in the study of crystals, and of the best means of applying those formulæ. The following subjects are successively treated: the optical principles involved in the goniometer; the practical use of the instrument, and the errors to which it is liable; the criticism of probable errors of observation; stereographic projection; all possible cases of trigonometrical calculation, including the method of least squares; and a slight sketch of the use of the polarising apparatus.

An important feature of the book is the illustration of methods by the actual measurement of seven crystals of a triclinic substance. The readings of the goniometer scale are first given, and from these the reader is led through the entire series of processes: stereographic projection, assignment of indices, calculation of elements, and recalculation of angles, each given in its place as an example of the principles and formulæ employed. This practical illustration is a far more effectual means of recommending the methods to the reader than mere verbal description.

It will probably be found that these methods of calculation are the most valuable part of the book; they are so systematically arranged and tabulated that the various steps may be distinguished at a glance, and any numerical error must be detected at once, while much labour is saved by the methodical order in which the operations are conducted.

It is to be presumed that the laborious process of calculating the angle between each pair of faces from the elements by means of the general formula is given as an exercise in the method of least squares rather than as an example of the course to be actually adopted in any but rare cases.

One subject, however, of some importance is barely touched upon; namely, the criticism of images obtained from crystal faces on the goniometer, and their interpretation. Both in the descriptive paragraphs and in the above-mentioned illustration, all measurements of the same angle upon different crystals are assumed to be equally good, so that their arithmetic mean is adopted as the observed value, whereas the difficulties presented by multiple images seem to deserve treatment in a book which deals so exhaustively with the practical side of the subject. It is to be regretted also that the discussion of optical properties and measurement has been almost crowded out of the work. H. A. M.

LETTERS TO THE EDITOR

[*The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, or to correspond with the writers of, rejected manuscripts. No notice is taken of anonymous communications.*

[*The Editor urgently requests correspondents to keep their letters as short as possible. The pressure on his space is so great that it is impossible otherwise to insure the appearance even of communications containing interesting and novel facts.*]

The Remarkable Sunsets

SPEAKING of Virginia City, the great silver mining centre of Nevada State, I said, in "An Engineer's Holiday," that it "lies among the foothills of the Sierra, at an elevation of 6200 feet, on the eastern face of Mount Davidson . . . surrounded by innumerable interlocked mountains, conical in outline, red-brown in colour, and perfectly bare of all vegetation. These stretch, as far as the eye can reach, to where the snowy tops of the Humboldt peaks stand against the sky, and the terrible sterility of the scene is enhanced rather than relieved by the thin meanderings of the Carson River, whose course is marked by a narrow green line. This is the only sign of water visible in the arid panorama, whose bare, red cones are steeped all day in dust-haze, and lighted for a few minutes at sunset by an 'Alpenglow' which dyes the countless peaks in as countless gradations of rosy light."

It certainly did not occur to me, when I wrote the above three years ago, that the finer and higher particles of the dust-haze which obscures the dry air of the American desert may have been concerned in producing the splendid sunset effects which I witnessed at Virginia City; but this, after our recent experiences, seems very probable. D. PIDGEON

Holmwood, Putney Hill, December 22

I HAVE received a letter, dated December 5, from Mr. Joseph Moore, of New Garden, North Carolina, U.S.A., in which he informs me that "the phenomena at both sunset and sunrise have been unusual in more than a dozen instances here during the autumn. Only the night before last we had an extraordinary sunset. The sky bore all the tints of which you speak, but I do

[1] "Certain Dimensional Properties of Matter in the Gaseous State," *Phil. Trans.* 1879, Part II.

not remember to have noticed the cirrus cloud in more than one instance. The sunsets have been subject for remark in quite a number of the papers." I inclose also a newspaper, the *Olive Branch*, of Hancock, Minnesota, U.S.A., which has been forwarded to me by another correspondent, containing a notice of the sunset of November 10.

Richmond, Surrey, December 22 F. A. R. RUSSELL

IN a letter dated Tokio, October 3, describing a tour in the interior of Japan, Prof. James Main Dixon writes:—"During the two or three days at the end of August we enjoyed fine dry weather, but the sun was copper-coloured and had no brightness. It was capital weather for travelling, but rather inexplicable. When we got to Nikko, the people came to us to inquire if some catastrophe were impending, for the appearance of the sun foreboded evil. We laughed at their fears, and assured them all was right. However it seems that if the appearance of the sun foreboded no evil, it was a wonderful sign of the greatest earthquake and volcanic catastrophe on record. The fearful explosion of Krakatoa, in the Straits of Sunda, took place on August 26, and there seems little reason to doubt that the monsoon had carried the volcanic dust along with it, the dust obscuring the sun. The distance is nearly 3000 miles."

LEWIS CAMPBELL

St. Andrews, December 22

Peripatus

DR. VON KENNEL, in a note on the "Development of Peripatus," which appeared in a recent number of the *Zoologischer Anzeiger*, and has been translated and printed in your columns, has thrown some doubt on the accuracy of the observations recorded in the late Prof. Balfour's memoir on the "Anatomy and Development of *Peripatus capensis* (*Quart. Journ. Micro. Sci.*, April, 1883). We trust that you will give us, as the editors of that memoir, this opportunity of making a few brief statements in reply to the somewhat unusually outspoken criticisms contained in his preliminary note.

Dr. von Kennel entirely omits to mention in his paper that Prof. Balfour's researches refer to a Cape species of Peripatus (*P. capensis*), whilst the species which he has worked at are West Indian, and differ considerably from *Peripatus capensis*.

Considering the fact, well known to embryologists, that there are numerous instances of great discrepancies in the embryonic history of closely-allied forms, it seems to us strange that the only explanation, suggested by Dr. von Kennel, of the differences between his results and those recorded in Prof. Balfour's memoir should be that the latter are absurdly erroneous.

The remarkable attitude which Dr. von Kennel has assumed in this matter must have been obvious to all competent zoologists. We offer these remarks mainly because his statements have appeared in a journal which has a wide circulation amongst readers who are not so well able to judge of the merits of the case.

We are able to state in conclusion that the results enumerated on pp. 256, 257 of Prof. Balfour's memoir have been confirmed by Mr. Sedgwick on a large number of fresh and well-preserved embryos of Peripatus from the Cape, obtained since the publication of the memoir.

H. N. MOSELEY
A. SEDGWICK

[THE translator of Dr. von Kennel's "Note on the Development of Peripatus," to whom we submitted the above letter, writes to us that, "though with a large experience in such matters, he is quite unable to see anything 'unusually outspoken' in Dr. von Kennel's criticisms; had any such occurred, he would have passed them over; nor does he find any foundation for the statement that Dr. von Kennel explains the results of Prof. Balfour's memoir as 'absurdly erroneous.' Dr. von Kennel, at the beginning of his note, only asserts that his observations *cast some doubt* on those of Balfour, apologetically adding that his material was immensely richer than Balfour's, and at the conclusion of his Note he simply calls attention to the discrepancies between his observations and Balfour's illustrations." At the translator's request we quote the original of the two critical paragraphs with the translations, so that the many competent zoologists who are amongst our readers can judge whether the latter adds to or takes from the spirit of the former.—ED. NATURE.

"Ich thue dieses hauptsächlich deswegen, weil die durch Moseley und Sedgwick publicirte Abhandlung aus dem Nachlass Balfour's einige Abbildungen von Embryonen und Schnitten durch solche enthält, deren Genauigkeit ich nach meinem reichlichen und ausgezeichnet conservirten Material und nach den Beobachtungen am frischen Objecte etwas anzweifeln muss, deren Deutung vollends die Probe nicht hält."

"I do this chiefly because the treatise published by Moseley and Sedgwick from the posthumous notes of Balfour contains some representations of embryos and cross-sections of the same, upon whose accuracy in details I, with my rich and well-preserved collection of specimens, and observations on fresh objects, must cast some doubt, and the interpretation of which does not bear investigation."

"Ich enthalte mich hier, um nicht weitläufig zu werden, jeder Discussion, muss jedoch noch einmal darauf hinweisen, wie wenig Balfour's Abbildungen und die Schilderungen der Herausgeber mit den hier mitgetheilten Thatsachen stimmen."

"I here abstain for the sake of brevity from all discussion, but must, however, call attention to the fact how little Balfour's illustrations and the descriptions of the Editors agree with the facts as they are here given."]

A New Rock

DURING my visit last summer to Lake Sagvand, in the Balsfjord, near the city of Tromso, I discovered a new enstatite-bearing rock, which forms entire little hills. It is composed of light yellow-green enstatite, mixed with magnesite. The magnesite, which is entirely free from lime, is partly white, partly dirty grey in colour, in which latter state it contains a little oxidulated iron, and appears then distinctly crystalline, with rhomboidal planes of cleavage. The rock is greatly interspersed with little grains of chromite, which are found in the enstatite as well as the magnesite. Here and there small grains of pyrite also appear. The substance is perfectly free from olivine, at all events neither olivine nor serpentine has been discovered under microscopical analysis.

The rock must be considered a new petrographical species. I have named it "Sagvandite," from the place where it was first discovered. It appears with a strong reddish-brown colour on its uneven surface, where the magnesite is completely washed out, so that the enstatite alone remains. The rock is not slaty, and must so far be said to be of massive structure.

When I have had an opportunity of thoroughly analysing the new substance, I propose to give a complete description of it in NATURE.

KARL PETTERSEN

Tromso Museum, Finmarken, Norway, December

Diffusion of Scientific Memoirs

IN his notice of the Reprint of Prof. Stokes' papers in NATURE for Dec. 13 (p. 145), Prof. Tait, with characteristic incisiveness, speaks of the "almost inaccessible" volumes of the *Cambridge Philosophical Transactions*, and proceeds to offer an "easy cure" for that simple though grave malady. I think if Prof. Tait had taken the trouble to make the inquiry he would have found that very few societies are so liberal in the free dissemination of their publications, and that the number of universities, prominent societies, or libraries which do not receive them gratis, or merely in exchange, is very small.

December 14 W. M. HICKS

THE question so pointedly at issue between Mr. Hicks and myself is one which can be settled by statistics only. NATURE would do a real service to science by collecting statistics as to the *numbers* of different centres (home, and foreign, separately) at which the *Transactions* of various scientific Societies were freely accessible in 1883 (say); and also the corresponding numbers in 1853. The Royal Society regularly publishes such information in its *Transactions*, so does the Royal Society of Edinburgh.

I have been a Fellow of the Cambridge Philosophical Society for about 30 years; and, during that time, I have received from the Society some fasciculi (of *Proceedings* only) certainly not amounting to a dozen in all:—and I am not aware that my case is an exceptional one.

Mr. Hicks writes as if he thought I was bringing an accusation. Surely the figure, of *malady*, which I was careful to employ, cannot be so construed.

P. G. TAIT

THE "TALISMAN" EXPEDITION[1]

AT the public meeting of the five Academies on October 29, 1882, I had the honour of reporting on the explorations of the *Travailleur*, and I announced that this year a new scientific campaign would be undertaken in the Atlantic. The Minister of Marine, responding to the desire expressed by his colleague, the Minister of Public Instruction, and by the Academy, had, in fact, issued the necessary orders to have the *Talisman* equipped for this purpose. The *Talisman* is an excellent screw steamer, provided with a good spread of canvas, sufficient to make good way without the aid of its engines. For several months it was placed in dock at the Rochefort Arsenal, where the naval engineers undertook to refit it for the service to which it had been appointed. The old hempen ropes intended for raising the dredges were replaced by a steel cable of great strength and flexibility, capable of a strain of about 4500 kilogrammes, and worked by two steam-engines. One of these set in motion the enormous bobbin on which the cable was wound. The other, a still more powerful engine, was intended for raising the dredges.

Large bag-nets, or trawls, with an opening of two or three yards, advantageously replaced the heavy drags we had formerly used. The soundings were executed by means of an apparatus perfected by M. Thibaudier, naval engineer, and so disposed as to prevent the motions of the vessel from in any way affecting the tension of the steel cable, which was arrested by an automatic break as soon as the sounder touched the bottom.

In order to gauge the temperature at great depths I had an apparatus constructed by which a mercurial thermometer (Negretti and Zambra) could be turned over at any moment. At the same time the capillary extremity of a glass tube, where a vacuum had been made, and into which the sea water then rushed, broke, supplying perfectly pure specimens, capable of being preserved for any length of time by soldering the tubes. Our friend, Colonel Perrier, had kindly lent me a Gramme machine, which generated the electricity for some Edison lamps, so disposed as to light up our apparatus, or, when needed, to penetrate to depths not exceeding 35 metres. At my request the command of the *Talisman* had been intrusted to M. Parfait, frigate captain, who had held the same position the year before on board the *Travailleur*.[2] I may here be permitted to express to the officers of the *Talisman* the feelings of gratitude inspired in us by their devotion. They cooperated with us with unflagging zeal, and for whatever success attended our mission we are indebted to them.

On May 30, the scientific mission[3] met at Rochefort, and on June 1 the *Talisman* set sail. The voyage of 1883 may be divided into several distinct stages. Our object was to study the coast of Africa as far as Senegal, then the waters of the Cape Verde, Canary, and Azores Archipelagos, volcanic lands which could not fail to supply us with interesting materials. Lastly, we hoped to be able to devote our attention to the Sargassum Sea, its fauna, and the nature of its bed.

The sea bed stretching westward of Morocco and the Sahara is extremely uniform, no longer presenting those rugged reliefs that had so impeded our operations on the coast of Spain. On the contrary, the slope is here so gentle that at greater or less distances from the land it was always possible almost infallibly to light upon the needed depths. In these waters we made about 120 dredgings, and in a few days we had determined the bathymetric distribution of the local fauna with sufficient accuracy to enable us to indicate the levels explored from the contents of our nets.

At 500 or 600 metres live numerous fishes, such as Macrurus, Malacocephalus, Hoplostethus, Pleuronectes, as well as prawns of the genus Pandalus, belonging to a new species with a rostrum pointed like a sword; some Peneæ, Pasiphaæ, a few small crabs (Oxyrhynchidæ, Portunidæ, Ebalidæ), pink Holothurians, some rare specimens of Calveria, that soft Echinoderm discovered in our waters by the naturalists of the *Porcupine*, and previously known in the fossil state; several very large sponges, such as Askonema and Farrea.

At greater depths, from 1000 to 1900 metres, fishes still abound,[1] and often formed the bulk of our captures. They were generally of a dull colour, with gelatinous flesh, and their skin covered with a thick mucous coating. Several had phosphorescent spots, serving to give them light in the dark regions they inhabit. Here Pandali give place to the new genus Heterocarpus, and to gigantic blood-red prawns with enormously long antennæ, which were new to science and may be placed in the genus Aristeus. The Nephropsis make their appearance at this level. They are blind, coral-tinted Crustaceæ, who seem to be distributed over a wide geographical range, for they have been found on the other side of the Atlantic in the Caribbean Sea, and a closely allied species has been fished up at a great depth near the Andaman Islands. The blind Polycheles, which in the present epoch represent the Jurassic Eryons, burrow in the mud, leaving nothing visible except their long hooked nippers, adapted for seizing the passing prey. Some crabs are still found, such as Maiadæ (Scyramathia, Lispognathus), a new species of Homolia, and Lithodes, hitherto supposed to be peculiar to Arctic and Antarctic seas. Lastly, numerous forms were also observed of the genus Galathea, several of which have their eyes transformed to spines. Sponges are extremely common, most of them with siliceous skeletons. We brought up great numbers of Rosella, Holtenia of several species, the rock crystal-like beards white as snow were buried in the mud, the sponge mass alone emerging; some Aphrocallistes, with solid skeletons of the most elegant form. Calveria became more numerous; Holothurians of the genus Loetmogone, and other species of the same family, crawled on the bottom in the midst of Asteria, Ophiuria, and Brisinga. The nets often returned filled with so much treasure that they could not all be classed within the day.

While rounding Cape Ghir and Cape Nun, some 120 miles from the coast, the *Talisman* spent several days in exploring a very regular bank at a depth of about 2000 to 2200 metres. It was on this ground that on Aug. 2, 1882, the *Travailleur* had captured the curious fish described by M. Vaillant under the name of *Eurypharynx pelecanoides*, and two specimens of which were taken this year.

Our prizes were again of great value. Magnificent sponges, allied to those that have been described under the name of *Euplectella suberea* were here found mingled with large violet Holothurians of the genus Benthodytes, and with other species of the same genus, remarkable for their dorsal appendices. A Calveria, distinct from those found at lesser depths, some Brisingæ, Polyps of rare beauty (Flabellum, Stephanotrochus), a Democrinus and a Bathycrinus, not yet described, very numerous Crustaceæ, nearly all new to us and belonging to the group of the Galatheæ (Galathodes, Galacantha, Elasmonotus), completed the list of invertebrates. The fishes were very varied, and their study will furnish new facts of the greatest interest to science. Amongst the most remarkable I may mention *Melanocetus johnsoni*, Bathy-

[1] Preliminary Report on the *Talisman* Expedition to the Atlantic Ocean. By M. Alphonse Milne-Edwards, President of the Submarine Dredging Commission. Communicated by the author.

[2] The staff consisted of M. Antoine and M. Jacquet, lieutenant; of MM. Gibory and Bourget, midshipmen, of M. Vincent, doctor of the first class, of M. Huas, assistant doctor, and of M. de Plas, chief mate.

[3] The mission consisted of M. A. Milne-Edwards, Member of the Institute, President, of M. de Folin, MM. Vaillant and Perrier, professors in the Museum, MM. Marion and Filhol, professors in the Faculty, M. Fischer, assistant naturalist in the Museum, MM. Ch. Brongniart and Poirault, added as assistants.

[1] To Macrurus are here added the following genera: Bathynectes, Ceryphænoides, Malacocephalus, Bathygadus, Argyropelecus, Chauliodus, Bathypterois, Stomias, Malacosteus, Alepocephalus.

trochtes, a Stomias with phosphorescent spots, and several Malacostei.

Between Senegal and the Cape Verde Islands our trawls reached depths varying from 3200 to 3699 metres, and brought up most of the preceding species besides many others (Crustaceans, Mollusks, Zoophytes, Sponges) which had never elsewhere been met.

These last takes brought to a close the first part of our programme, and on July 20, after ninety-one days of navigation, we cast anchor in the Bay of La Praia, at Santiago in the Cape Verde Archipelago. This volcanic group detained us a few days, and while zoological, botanical, and geological excursions were being made ashore, the *Talisman* was searching the irregular beds on the coasts for marine animals, and especially for the red coral, which for some years back has formed the object of an active trade in these islands. I will not dwell on these in-shore explorations, nor on those of the islet Blanco, where we were able to study on the spot the large Saurians (*Macroscincus coctei*) which seem limited to this isolated rock.

All these details are recorded in the report which I have addressed to the Minister and which will soon be published.

In the deep waters of the Cape Verde Archipelago life displays a surprising energy. Our nets came up overflowing with specimens after a single plunge. We captured at one take more than 1000 fishes belonging mostly to the genus Melanocephalus, about 1000 Pandali, 500 prawns of a new species of the genus Nematocarcinus, with disproportionately long claws, as well as many other species.

On the evening of July 30 the *Talisman* took a northwesterly course in the direction of the Sargassum Sea. I need not enter into details on this part of our journey, and it will suffice to say that we nowhere met those dense floating masses of vegetation mentioned by the old navigators. The Gulf weed was seen in isolated patches drifting either with the marine or atmospheric currents, and harbouring a whole pelasgic population, whose colours harmonised admirably with those of the algæ that afforded them a refuge. Our naturalists made a careful study of these forms.

The soundings of the *Talisman* in this region show in a general way that, starting from the Cape Verde Islands, the marine bed falls regularly as far as about the 25th parallel, where it attains a depth of 6267 metres. Then it gradually rises towards the Azores and the 35th parallel, where it is about 3000 metres. These results are far from agreeing with the curves indicated on the most recent bathymetric charts. The bed of the Sargassum Sea seems formed of a thick layer of a very fine mud of a pumice nature, covering fragments of pumice and volcanic rocks. Here there would appear to stretch, at over three miles from the surface of the ocean, a vast volcanic chain parallel with the African seashore, and of which the Cape Verde Islands, the Canaries, Madeira, and the Azores are the only parts not submerged. The submarine fauna is poor, consisting of few fishes, some Crustaceans, such as Paguri, which lodge in colonies of Epizoanthus, prawns of the genus Nematocarcinus, Pasiphaæ, a few mollusks (Fusus, Pleurotoma, and Leda), which scarcely sufficed to repay the time required for such deep dredgings. Not that our captures did not again become abundant towards the northern limit of the Sargasse Sea, when the depths shrank to 3000, 2000, and 1500 metres. It was here that we took the giant of the family of the Schizopodes, a Gnathophausia of a blood-red colour measuring nearly 25 centimetres in length.[1]

A short delay at Fayal, and again at San Miguel in the Azores, enabled us to compare the volcanic phenomena still active at certain points with those we had studied on the summit of the Peak of Teneriffe. The analogy is very striking between the rocks, the gaseous products, and the sulphur deposits of the two islands. From what is now taking place on the surface of the ground, an idea may be formed of the submarine convulsions which have covered the bed of the Sargassum Sea with pumice and igneous rocks.

The return voyage from the Azores to France was effected under the most favourable conditions, and we were able to make daily dredgings in depths of from 3000 to 5000 metres. These difficult operations, very skilfully carried out by Captain Parfait, brought us an extremely valuable harvest. Under this tremendous pressure, in perfect darkness, and without a trace of vegetation, animal life is still vigorous. Large fishes of the genus Macrurus, as well as some Scopeli and Melanoceti seem to be here far from rare. Some Pagures and Galatheæ of new form, a gigantic Nymphon of the genus Colossendeis, some unknown Ethusæ, besides Amphipods and Cirrhipeds represent the Crustacean group. But this abyssal fauna owes its peculiar physiognomy to the number, variety, and size of the Holothurians.

The marine bed is carpeted throughout this region with a thick white mud, composed almost exclusively of Globigerini, and covering pumice deposits and fragments of various kinds of rocks. Some of these rocks brought up in our nets bore the impress of fossils, amongst others of Trilobites. But what still more surprised us was to find at a distance of over 700 miles from the European coast pebbles polished and striated by the action of ice. The sharpness of the striæ excludes the supposition of transport by the currents. The presence of these pebbles is probably due to the action of the icebergs, which in the Quaternary epoch advanced further southwards than at present, and which, by melting in the region of the Atlantic comprised between the Azores and France, deposited on the bottom of the sea the stones carried off from the glacier beds and conveyed to this distance from Europe.

On August 30 we dredged for the last time on the steep slope by which the oceanic depths are connected with the Bay of Biscay, and our captures added to the fauna of the French waters a large number of new or interesting species.

It was high time to return to Rochefort. Our casks and cases were full, our alcohol exhausted. This voyage has furnished us with unrivalled materials for study, materials which must now be put in order. The Minister of Public Instruction has recognised their importance, and has supplied me with the means of beginning the publication of the results. It is my intention to place before the public the collections that have been made during the explorations of the *Travailleur* and *Talisman*. These treasures will be exposed in a special exhibition, which will be held in one of the halls of the museum towards the beginning of January.

[1] *Gnathophausia goliath*, new species.

MUSIC AND SCIENCE[1]

IT would seem that Science, like History, may at times repeat itself: for in this bright little pamphlet we have a revival of the Old World controversy, which dates from the days of Pythagoras, Plato, Aristotle, and Euclid. The author takes, however, for its text, a somewhat declamatory and *ad captandum* modern passage from the *Revue de Paris*, which declares, with an emotional warmth totally uncalled for under the circumstances, that harmony is not a science, and that music is an art, "but a divine art." To appreciate thoroughly the question in debate it is necessary to go back to the sense of the original Greek words—*ἁρμονία* and *μουσική*. The former means "mathematical agreement"; the second "artistic culture." It is with their "second intentions," or acquired and more limited meanings, that we now have

[1] "La Musica è una Scienza." Saggio Acustico fisiologico Del Dott. Primo Crotti. Pp. 55. Luigi Battei Editore. (Parma, 1883.)

to deal. Is music, in the English sense of the word, which no wise differs from the Italian, an art or a science? It is clearly both; but the art, *μουσίκη*, so far predominates in public acceptance and cultivation over the science, *ἁρμονία*, that the latter is, and has been for many centuries, in danger of succumbing altogether. Indeed, though excellently begun by Euclid in his "Sectio Canonis," it remained all but unadvanced until the recent researches of Helmholtz. It is to Aristotle that we owe the general test by which to distinguish an art from a science; a test so satisfactory and so neat, that it produces the effect on the mind of a mathematical demonstration; a form of proof which is too often only a roundabout way of restating a self-evident proposition. Aristotle said that art at its best only works by "rule of thumb"; and states that *τέχνη* is governed by rules. When these rules are found to rest on recognised laws, the art becomes an *ἐπιστήμη*, or science. This observation, made two thousand years ago by the shrewdest of all shrewd observers, remains as true and as fresh as on the day when it was promulgated. To no branch of human learning does it apply with such force and directness as to music. For perfection in this art has always been, is now, and must continue to be, confined to a few sensitive, delicate, finely-strung natures, which differ from those of their fellow-creatures in possessing a peculiar technical power and organisation such that they instinctively reproduce, and as it were consonate to the musical conceptions of other minds. In all other respects they may be self-indulgent, unbusinesslike, unpractical; even, as indeed not uncommonly they are, over-sensitive and disagreeable. Types of this class are Beethoven, Cherubini, Mozart, Weber, and Berlioz. In them, in fact, the full development of artistic perfection has eaten up all other good qualities, and left no time or inclination for what Plato calls "the practice of virtue." The world at large, secretly conscious of its special inferiority, and always willing to discharge itself of an unwelcome responsibility, too commonly looks upon these exceptional natures as representing the whole, and not only the artistic and executive side of music. But the other exists notwithstanding; and its fuller cultivation will tend much to restore the balance so disturbed. In this respect the little book of Dottore Crotti has special value. It deals with the foundation of rhythm and of music, and with the strange and hitherto unexplained emotional difference between the major and minor scales, which in the Italian are prettily and correctly named *Gaia* and *Triste* respectively. The ratios of musical intervals and their combination are fully treated, and with some features of novelty, especially as concerns their physiological effects on the ear. The great fact, so much forgotten in this century since the brilliant jigs of the Rossinian school have become popular, that it is the bass, and not the treble or melody, which is fixed and fundamental, is stated with abundant emphasis, and distinction is made between the characters of repose and of movement in different kinds of music. The assumption that the scale is founded principally on the fractions representing the major and minor tones with only a simple semitone of $\frac{15}{16}$ seems hardly sufficient to meet theoretical requirements; but otherwise there is much of interest comprised within the 55 pages of which the pamphlet consists. It has the merit, moreover, beyond the historical point already noted, of bearing out its title of "acoustico-physiological," and of adverting to the mental or receptive side of musical impressions more than occurs in some modern treatises. W. H. STONE

THE REMARKABLE SUNSETS

THE following letter has been sent to Mr. Norman Lockyer:—

The remarkable sunsets which have been recently witnessed upon several occasions have brought to my recollection the still more remarkable effects which I witnessed in 1880 in South America, during an eruption of Cotopaxi; and a perusal of your highly-interesting letter in the *Times* of the 8th inst. has caused me to turn to my notes, with the result of finding that in several points they appear to have some bearing upon the matter which you have brought before the public.

On July 3, 1880, I was engaged in an ascent of Chimborazo, and was encamped on its western side, at 15,800 feet above the sea. The morning was fine, and all the surrounding country was free from mist. Before sunrise, we saw to our north the great peak of Illiniza, and twenty miles to its east the greater cone of Cotopaxi, both without a cloud around them, and the latter without any smoke issuing from its crater—a most unusual circumstance; indeed, this was the only occasion on which we noticed the crater free from smoke during the whole of our stay in Ecuador. Cotopaxi, it should be said, lies about forty-five miles south of the equator, and was distant from us sixty-five miles.

We had left our camp, and had proceeded several hundred feet upwards, being then more than 16,000 feet above the sea, when we observed the commencement of an eruption of Cotopaxi. At 5.45 a.m. a column of smoke of inky blackness began to rise from the crater. It went up straight in the air, rapidly curling, with prodigious velocity, and in less than a minute had risen 20,000 feet above the rim of the crater. I had ascended Cotopaxi some months earlier, and had found that its height was 19,600 feet. We knew that we saw from our station the upper 10,000 feet of the volcano, and I estimated the height of the column of smoke at double the height of the portion seen of the mountain. The top of the column was therefore nearly 40,000 feet above the sea. At that elevation it encountered a powerful wind blowing from the east, and was rapidly borne for twenty miles towards the Pacific, seeming to spread very slightly and remaining of inky blackness, presenting the appearance of a gigantic inverted ⌐, drawn upon an otherwise perfectly clear sky. It was then caught by a wind blowing from the north, and was borne towards us, and appeared to spread rapidly in all directions. As this cloud came nearer and nearer so of course it seemed to rise higher and higher in the sky, although it was actually descending. Several hours passed before the ash commenced to intervene between the sun and ourselves, and when it did so we witnessed effects which simply amazed us. We saw a green sun, and such a green as we have never, either before or since, seen in the heavens. We saw patches or smears of something like verdigris-green in the sky, and they changed to equally extreme blood-reds, or to coarse brick-dust reds, and they in an instant passed to the colour of tarnished copper or shining brass. Had we not known that these effects were due to the passage of the ash, we might well have been filled with dread instead of amazement; for no words can convey the faintest idea of the impressive appearance of these strange colours in the sky, seen one minute and gone the next, resembling nothing to which they can be properly compared, and surpassing in vivid intensity the wildest effects of the most gorgeous sunsets.

The ash commenced to pass overhead at about midday. It had travelled (including its detour to the west) eighty-five miles in a little more than six hours. At 1.30 it commenced to fall on the summit of Chimborazo, and before we began to descend it caused the snowy summit to look like a ploughed field. The ash was extraordinarily fine, as you will perceive by the sample I send you. It filled our eyes and nostrils; rendered eating and drinking impossible; and reduced us to breathing through handkerchiefs. It penetrated everywhere, got into the working parts of instruments, and into locked boxes. The barometer employed on the summit was coated with it, and so remains until this day.

That which passed beyond us must have been finer still. It travelled far to our south, and also fell heavily upon ships on the Pacific. I find that the finer particles do not weigh the 1/25,000 part of a grain, and the finest atoms are lighter still. By the time we returned to our encampment the grosser particles had fallen below our level, and were settling down into the valley of the Chimbo, the bottom of which was 7,000 feet beneath us, causing it to appear as if filled with thick smoke. The finer ones were still floating in the air, like a light fog, and so continued until night closed in.

In conclusion, I would say that the terms which I have employed to designate the colours which were seen are both inadequate and inexact. The most striking features of the colours which were displayed were their extraordinary strength, their extreme coarseness, and their dissimilarity from any tints or tones ever seen in the sky, even during sunrises and sunsets of exceptional brilliancy. They were unlike colours for which there are recognised terms. They commenced to be seen when the ash began to pass between the sun and ourselves, and were not seen previously. The changes from one hue to another, to which I have alluded, had obvious connection with the varying densities of the clouds of ash that passed; which, when they approached us, spread irregularly, and were sometimes thick and sometimes light. No colours were seen after the clouds of ash passed overhead and surrounded us on all sides.

I photographed my party on the summit of Chimborazo whilst the ash was commencing to fall, blackening the snow furrows; and, although the negative is as bad as might be expected, it forms an interesting souvenir of a remarkable occasion. EDWARD WHYMPER

December 21

NOTES

THE announcement that Prof. Flower has accepted the appointment of superintendent at the Natural History Museum, vacated by the resignation of Prof. Owen, is premature, though we believe that steps are being taken to secure Prof. Flower's services for that important appointment.

WE regret to have to record the death of M. Yvon Villarceau, one of the astronomers of the Paris Observatory and a member of the Academy of Sciences for more than twenty years. M. Yvon Villarceau had been a pupil of the École Central des Arts et Manufactures, and was regarded as one of the most eminent of French mathematicians.

IT has been arranged by H.M. Trawling Commissioners that Prof. McIntosh, of the University of St. Andrews, will proceed systematically at intervals (probably once a fortnight) to the trawling grounds on the east coast of Scotland for the next six months, and undertake certain investigations concerning the grounds and their inhabitants. Each trip will probably occupy about two days. The Granton General Steam-Fishing Company's steam-trawler *Wallace*, which is fitted with all the recent appliances for such work, and is a swift and powerful steamer, will be used for the investigations, which will be at once commenced. An experienced long-line fisherman and trawler from St. Andrews (Alex. W. Brown) will accompany the professor as assistant.

THE friends of the late Mr. W. A. Forbes, the Prosector of the Zoological Society of London, have decided to collect his most important papers in a memorial volume, and the following gentlemen have been appointed to act as a committee for this purpose:—Prof. Flower, Prof. Bell, Mr. H. H. Johnston, Mr. Mivart, and Mr. Sclater. The committee find that Mr. Forbes's papers can be most suitably republished in a form similar to that adopted in the memorial volume of the memoirs and papers of Mr. Forbes's predecessor in the Prosectorial office (the late Prof. Garrod). Following the precedent of the "Garrod Memorial Committee," they propose to ask for subscriptions of one or more guineas, and to give to subscribers a copy of the work for every guinea subscribed. Mr. Sclater will edit the Forbes Memorial Volume, Mr. Johnston will prepare a biographical notice and portrait, and Mr. F. Jeffrey Bell, 5, Radnor Place, Gloucester Square, W., will act as Secretary and Treasurer.

THE appointment of a Japanese student as assistant to the Professor of Anatomy at Berlin has been approved by the Minister of Public Worship.

MR. FRANCIS ELGAR, Consulting Naval Architect and Engineer in London, has been unanimously elected by the Glasgow University Court to the John Elder Chair of Naval Architecture.

AN expedition is at last being organised under the auspices of the British Association to proceed to Mount Kilimanjaro, the snow-clad peak of Eastern Equatorial Africa. The party will be under the charge of Mr. H. H. Johnston, who has recently returned from the Congo. The party will leave England at the beginning of March.

HEAVY indeed is the burden of educating laid upon the Southern States! With only one half at school of a population the illiterate proportion of which, among both whites and negroes, is increasing, and in some States this increase of illiteracy greater among the whites than among the negroes; with the negro, the non-taxpaying element, increasing fastest, notwithstanding white immigration; with trades destroyed, and property in consequence reduced in value 40 per cent., and in some States still falling in value; with the franchise, nevertheless, given to this increasing body of ignorance; evil indeed may be the result to a republic if the whole Union does not assist to correct it. Emancipation was a national act, and the nation ought to meet the inevitable consequence. So urges Dr. Haygood, in the United States educational circulars referred to last week, with the warning that no white men will agree for long to be voted down by a majority of illiterate blacks and whites.

ON Thursday, at 9.21 p.m., a shock of earthquake was felt in Fünfkirchen, a town in the south of Hungary, not far from the confluence of the Danube and Drave. The shock lasted two seconds, and was accompanied by a loud underground rolling noise. At the same time a similar earthquake and noise occurred at Barcs, a place to the south-east of the former, on the banks of the River Drave. Both shocks moved northwards. An earthquake shock was also felt at Lisbon at 1.30 a.m. on the 22nd inst., but did not excite much notice. A second shock, which lasted twelve seconds, occurred two hours later; being accompanied by subterranean rumblings, it awoke the entire population, and caused a panic among the inhabitants in the narrow streets. The seismic wave passed from north-west to south-east.

THE fourteenth Annual Report of the Botanic Garden Board of New Zealand (1883) contains valuable information as to the ravages of certain scale insects (*Coccidæ*) in the colony. They appear to be principally of two kinds: one is an *Icerya*, nearly related to the sugar-cane pest of Mauritius, &c., the other a *Mytilaspis* allied to the common "apple scale" (*M. pomorum*). The *Icerya* is called the "wattle blight," but appears by no means to confine its ravages to the wattle trees. According to Mr. Maskell, it is the *Mytilaspis* that is the more serious, for it overruns in countless millions all kinds of fruit and other trees (fortunately it appears to be enormously infested and destroyed by a parasite). With regard to remedies, there is a little vagueness in the Report, owing apparently to the confusion of the two insects. The first portion speaks only of the *Icerya*, and states that Mr. Engle of Nelson had completely destroyed it by the

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"To the solid ground
Of Nature trusts the mind which builds for aye."—WORDSWORTH

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application of kerosene and fish oil. Subsequently Mr. Maskell, dealing with the *two* species, says that a mixture of kerosene and linseed oil (one-third or one-fourth of the former) as recommended by Mr. Comstock in America, had been perfectly successful so far as regards the *Mytilaspis*, which he does not regard as serious in its probable effect upon wattles (*Acacia*), but very serious with respect to fruit and other trees. On the other hand, he considers all remedies useless against the *Icerya* of the wattle other than the radical one of cutting down and destroying the affected trees. No indication is given, however, of the use of a force-pump in distributing the kerosene; if this were used, the remedial agent might be distributed to a greater height than would be possible by mere hand application, and moreover it might be made to penetrate dense hedges, &c., the interior of which it would be impossible to drench by hand labour. The improved form of application, as a "kerosene emulsion," recommended by Prof. Riley and Mr. Hubbard, did not appear to be known in New Zealand at the time the Report was drawn up. Any way it is satisfactory to hear that the *judicious* application of kerosene will certainly destroy scale insects without necessarily damaging the plants.

THE same Report speaks very hopefully of the ultimate success of attempts to cultivate hops in the province of Wellington; in Nelson success has been already secured. The great drawback is the expense of providing the necessary *poles*, and much stress is laid upon the necessity for cultivating oak, ash, birch, and species of *Eucalyptus* for that purpose. Of the indigenous poles, those of *Myrsine urvillei* are said to be the most durable.

THE additions to the Zoological Society's Gardens during the past week include a Toque Monkey (*Macacus pileatus* ♀) from Ceylon, presented by Mr. J. H. Barker; a Macaque Monkey (*Macacus cynomolgus* ♂) from India, presented by Mr. Douglas; a Common Marmoset (*Hapale jacchus*) from Brazil, presented by Mrs. Archer; a Moorhen (*Gallinula chloropus*), British, presented by Mr. T. E. Gunn; a Gannet (*Sula bassana*), British, presented by Mr. J. C. Baxter; two St. Thomas's Conures (*Conurus xantholæmas*) from St. Thomas, West Indies, presented by Mr. C. Wallis Enslie; two Fringed-lipped Lampreys (*Petromyzon branchialis*), British, presented by the Rev. F. T. Wethered; a Pied Wagtail (*Motacilla lugubris*), British; a Slaty Egret (*Ardea gularis*), European, purchased.

INTERNATIONAL POLAR OBSERVATORIES

I BEG to inclose you an extract from a letter just received from Prof. Wild, President of the International Polar Committee, and which gives information as to the several expeditions which conducted observations in the circumpolar regions during the twelve months ending August 31, 1883.

ROBERT H. SCOTT

"I take this opportunity of stating concisely what I have hitherto learnt as to the present condition or the return of the various expeditions.

"1. The United States—Point Barrow.—The Expedition was to have returned in the summer of 1883. Definite information as to its return has not yet been received.[1]

"2. England and Canada—Fort Rae, on the Great Slave Lake.—According to a communication received from Mr. Scott, dated November 21 last, the Expedition has safely returned to England.

"3. United States—Lady Franklin Bay.—The attempts to relieve the Expedition this summer by ship have, like those of last year, failed owing to the unfavourable condition of the ice. (Extract from newspapers.)

"4. Denmark—Godhavn, in Greenland.—According to a communication from Captain Hoffmeyer, dated December 8, the Expedition has safely returned to Copenhagen with a rich store of observations.

"5. Germany—Cumberland Sound (Davis Strait).—According to a communication received from Dr. Neumayer, dated November 1, the Expedition has safely returned to Hamburg, having completed its task in a satisfactory manner.

"6. Count Wilczek's Station (Austria)—Jan Mayen, in Marymuss Bay.—The Expedition has safely returned to Vienna, having completely carried out its programme. A short report of its operations has been published by M. von Wohlgemuth, the Chief of the Expedition.

"7. Sweden—Spitzbergen (Cape Thordsen, in the Ice Fjord).—Dr. Rubenson states that the Expedition has safely returned to Stockholm.

"8. Norway—Bossekop, near Alten.—From a letter from Prof. Mohn, dated September 7, the Expedition stopped work on August 31, having completely carried out its programme, and on September 17, according to a report in *Naturen* (October, 1883) it safely returned to Christiania.

"9. Finland—Sodankyla.—The Expedition completed its task for the first year, but, according to a communication from Prof. Lemström, dated August 5, the observations will be continued another year, as the Government of Finland has provided the funds for the purpose.

"10. Russia—Nova Zembla (Möller Bay).—The Expedition returned to St. Petersburg in October with a rich store of observations.

"11. Holland—The Kara Sea.—The Expedition could not reach its original place of destination, Port Dickson, but was surrounded by ice in the Kara Sea, and has, according to a letter from Prof. Buys Ballot, dated October 1, safely returned to Utrecht, having under the circumstances only imperfectly carried out its programme.

"12. Russia—Mouth of the Lena (Sagastyr).—The Expedition, which suffered from storms during the passage down the Lena, was not properly established until October 20, 1882; from that date it has been able to carry out all the work laid down in the programme. It will continue its observations for another winter.

"13. France—Cape Horn (Orange Bay, Terra del Fuego).—According to a report from Prof. Mascart, dated November 17, the Expedition has returned safely to Paris, with a rich store of materials.

"14. Germany—The Island of South Georgia (Moltke Harbour).—This Expedition has also safely returned, according to a communication from Dr. Neumayer.

"Of the fourteen Expeditions, therefore, three will continue their observations for about another year (Lady Franklin Bay, Sodankyla, and Lena delta); the continuance of a fourth (Point Barrow) is at present unknown, the other ten have safely returned."

[1] We believe this party arrived at San Francisco some weeks ago.—ED.

MOVEMENTS OF THE EARTH[1]

III.—*Rotation of the Earth*

THE several ideas concerning the movements of the earth which were introduced in the last lecture will in the present one have to be dealt with in greater detail.

It was then agreed that if the whole expanse of the heavens were to travel with a perfectly equable motion in one direction, such a motion for instance as would result from all the stars being fixed to a solid transparent substance like those crystal spheres that the ancients really believed to exist; or if, on the other hand, the earth herself, instead of being free to turn as she listed with varying velocity in any direction, really went with perfect constancy in the direction opposite to the apparent motion of the stars, the visible effects would be the same in both cases, so that an appeal to our eyes would not suffice to enable us to say whether the earth moved or whether she remained at rest while the celestial sphere revolved around her.

Under these circumstances what is to be done? It has been seen how, both with regard to the measurement of space and the measurement of time for astronomical purposes, those interested in the physics and beauties of the various classes of celestial bodies outside our own earth have picked and chosen now one bit of physical science and now another to help them in their inquiries; and with regard to this very important question, "Does the earth move or is she at rest?" we shall see how very beautifully and perfectly the question has been answered by the application of certain mechanical principles.

The majority of people, I suppose, have some acquaintance, however slight, with machinery—with steam engines for in-

[1] Continued from p. 69.

stance; and it is a familiar fact how very important a part is played in the steam-engine by the flywheel. Why should that be? Why should this flywheel be so important that it is only quite recently that mechanicians have learned to do without it? For this reason: if a mass of matter such as a flywheel is once made to revolve, it will retain that motion for a long time, resisting any tendency to an increase or decrease of its velocity. It is in consequence of this property which the revolving flywheel possesses that an engineer is able to get over the dead points in his engine, whilst

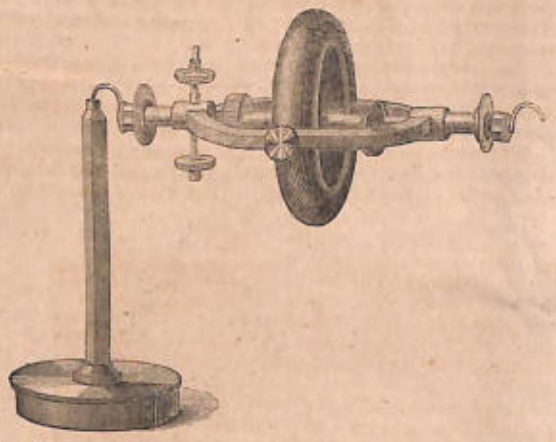

FIG. 27.—Rapidly rotating wheel supported at one end of its axis.

it also acts in preventing the engine making too sudden a start. In addition to this, when we have a mass of matter in the condition of the revolving flywheel it has some very peculiar qualities, only observed when such a mass of matter is in motion. If, then, we have a wheel so arranged that a very rapid rotation is being imparted to it, it does not behave as it would when at rest. These properties possessed by a rotating body can be well shown by an instrument known as the gyroscope, of which we shall speak more fully later on. It consists essentially of a

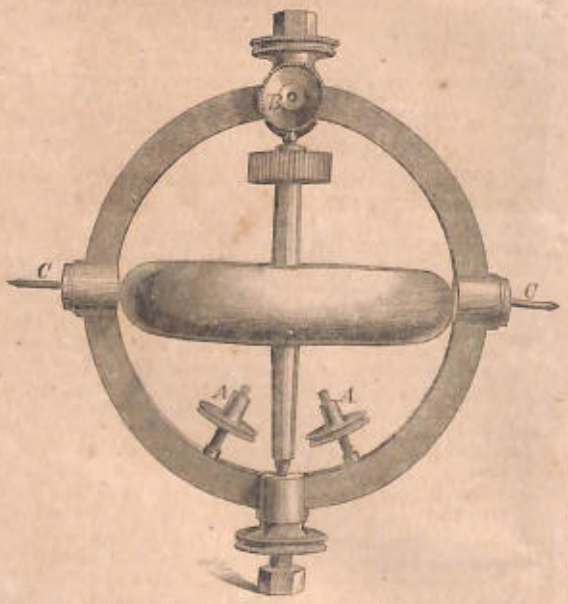

FIG. 28.—Rotating disk of gyroscope. CC, knife edges; AA, BB, adjusting weights.

disk to which a very rapid rotation can be imparted by a train of wheels or by other means. If the disk be set rotating, it is found to possess those curious qualities of which I have spoken. If whilst rotating at a high velocity it be placed in the position shown in Fig. 27, it will not fall, but will take on a movement of revolution round the stand.

From considerations suggested by this and other similar experiments, Foucault pointed out that it might be demonstrated whether the earth moved or whether she remained at rest. It struck him that the problem should be attacked somewhat in this manner:—

Suppose the earth to be at rest, and that either at the north or south pole a pendulum, suspended so that its point of support had as little connection with the earth as possible—so that it should, in fact, like the rotating flywheel, be independent of external influences, were set vibrating. Then an observer at the north or south pole would note that the swinging pendulum (the earth being considered as at rest) always had the same relation to the objects on his horizon. But, said Foucault, suppose that the earth does move. Then the swing of such a pendulum would not always be the same with regard to the places on the observer's horizon. Let the earth be represented by a globe. Suppose it to rotate from west to east. Place it with the north pole uppermost, and set the pendulum, whose point of support is disconnected from the rotating earth, vibrating. Then the pendulum will appear to travel from left to right as the earth rotates from right to left beneath it. Now suppose the pendulum to be suspended in the same way at the south pole, right and left now being changed. The earth of course rotates in the same direction as before, but the pendulum now appears to change the

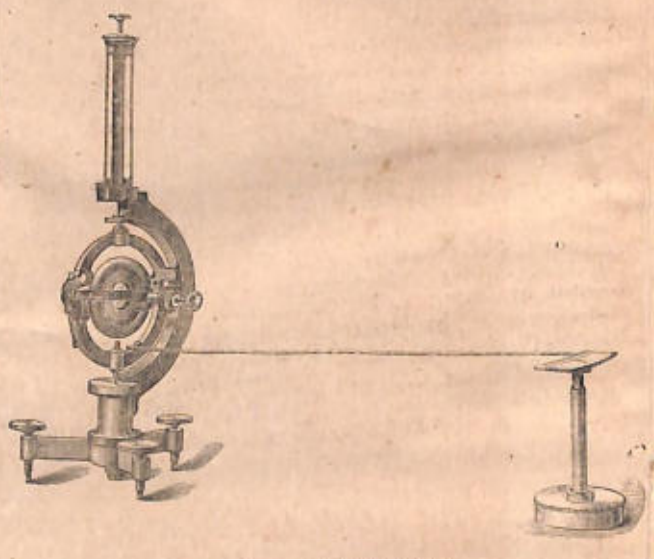

FIG. 29.—Gyroscope; general view.

plane of its swing from right to left. At the equator the earth simply rotates straight up and straight down beneath the swinging pendulum.

From these considerations it became evident to Foucault that, if there were any possibility of demonstrating the movement of the earth by means of the pendulum, the demonstration would take this form. Provided it were possible to swing a pendulum so that it should be as free as possible from any influence due to the rotation of the earth, and take that pendulum to the north pole, it would appear to make a complete swing round the earth in exactly the same time that it really takes the earth to make a complete rotation beneath it. At the south pole exactly the same thing would happen except that the surface of the earth would appear to move in the opposite direction to what it did at the north pole. Now it will be perfectly clear that if we thus get a pendulum appearing to swing one way on account of the true motion of the earth at the north pole and in the opposite direction on account of the true motion of the earth at the south pole; at the equator, as we found in dealing with our model earth and model pendulum, it will not change the plane of swing either way, that is to say, the time taken by a pendulum to make a complete swing will be the smallest possible at the poles, whilst at the equator it will be infinite.

At all places, therefore, between either pole and the equator