QH 369

THE HONEY BEE.

ITS

Natural History, Physiology

AND [illegible]EMENT.

BY

Edward Bevan M.D.



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TO HER GRACIOUS MAJESTY

THE QUEEN.

MAY IT PLEASE YOUR MAJESTY,

HAVING received the high honour of being permitted to dedicate my Treatise on the Honey-Bee to Your Majesty, while presumptive heiress to the British Throne, I trust that, under the altered circumstances of Your Majesty's distinguished character, I may still be allowed to avail myself of the gratifying privilege.

Though my offering is humble, yet the usefulness of its object and the beautiful analogies afforded by the

œconomy of the insect whose history it records, will, I venture to hope, sanction it in Your Majesty's estimation, and I am strengthened in this hope, by Your Majesty's having become the Patroness of the Linnæan Society.

The queen of every bee-community has been destined to fill her high station, from a very early age, (not always from her birth); she has the most diligent attention bestowed upon her, to qualify her for the important functions which she has to perform: and she is, at all times, sedulously guarded from those hazards, to which it is the lot of bees more humbly born and educated, to be exposed. In all these particulars, I presume that a perfect analogy with Your Majesty may be drawn.

Again, the queen of the hive-bees is ever to be found in the enjoyment of the devoted attachment of her people,

ever most pleased, when they have the fullest portion of remunerating occupation, ever capable of rousing their most active energies for the promotion of the general weal, and of inducing them to flock around her person, whenever that weal is endangered. In each of these respects I trust that Your Majesty will ever bear an equality perfect comparison.

Finally, on occasion of the death of a sovereign bee, she is mourned over by her people, with so fervent and sincere a regret, that it would seem as if a calamity had befallen them, of so dire a nature, as to threaten the dissolution of the whole community; and, for a time, no successor that can be presented to them, however well fitted to perform the functions of royalty, can be rendered acceptable. Whenever it shall please the Almighty Disposer of events to call Your Majesty from this present state of

existence, may the beneficence of your reign, while living, render the comparison after death, no less complete in this than in the two former cases.

And now, with most cordial wishes, as well for your own sake as for the sake of our common country, that Your Majesty's reign may be long and prosperous, I beg leave to subscribe myself

With grateful regard,

Your Majesty's obedient and faithful subject,

EDWARD BEVAN.

Llanferry near Carmarthen,
June 7, 1838.

XIII Q.39

ADVERTISEMENT.

In the advertisement prefixed to the former edition of this work, I called for ingenuous criticism upon my lucubrations, and most ably as well as agreeably has that call been responded to. It introduced me to an acquaintance and correspondence with some of the first scientific and practical Apiarians and Naturalists of the day, and elicited a variety of contributions in the way of correction and suggestion, and also a considerable accession of fresh matter.

Some one, speaking on the subject of Huber's defective vision, said he regarded it as an advantage, on account of the necessity which it imposed upon him to avail himself of the assistance of others, whereby it so happened that he had the benefit of two pair of eyes instead of one! Whatever may be thought of this remark, the advantage which I have possessed, in extent of observation, will I am sure be admitted. Huber had the benefit of two pair of eyes in *one* Apiary; I have had the advantage of at least six or seven pair in as many different Apiaries; and over one of them has presided a scientific observer, who, together with a genius but little, if at all inferior to Huber's, combines a courage

and perseverance which place him quite upon a level with Burnens; I allude to Mr. R. Golding*, of Hunton, near Maidstone. To the Rev. W. Dunbar also, of Applegarth Manse, Dumfriesshire, this edition of my work is indebted for many valuable suggestions, both on points of physiology and practice. Various hints and the results of sundry experiments have likewise been received from other intelligent Naturalists and Apiarians, particularly from T. A. Knight, Esq., of Downton; Edward Newman, Esq., of Deptford; Sir J. G. Dalyell, of Edinburgh; Mr. Harman, of Cranbrook; Mr. Humphrey, of Staplehurst; and Mr. Dewey, of Melton Mowbray.

Although situated at considerable distances from each other, our operations may be said to have been combined; the object of my fellow-labourers and myself has been to elicit facts. Like the alchemists of old, we have thrown our materials into each other's crucibles, and submitted them to the test of experiment; but, unlike the alchemists, we have produced the results we sought for, and by comparing our several products, have proved by their similarity, the accuracy with which the different processes were conducted, and have thereby verified the facts which they were instituted to ascertain.

Under these advantages the work once more seeks the notice of the public; and once more calls upon it for ingenuous criticism.

* To this gentleman I desire to express my especial acknowledgment for the assistance which I received from him, as regards the rationale of piping and the philosophy of swarming.

INTRODUCTION.

Although the great addition which has of late been made to our knowledge of the honey-bee, may seem to render a reference to ancient writers comparatively unimportant; yet a few prefatory observations, upon the rise and progress of apiarian science, may not be out of season.

The natural history and management of bees would probably occupy the attention of man at an early period. Surrounded by a boundless variety of living creatures, he would naturally be led to notice their habits and œconomy; and no part of the animal world, or at any rate no part of the world of insects, would be more likely to engage his consideration than the honey-bee. Honey would, in all probability, constitute one of his earliest luxuries; and, as he advanced in civilization, he would, as a matter of course, avail himself of the industry of its collectors, by bringing them

as much as possible within his reach.* ; and by this means he would take an important step towards an acquaintance with entomology. But the progress made by our earliest progenitors, in this or any other science, is involved in the obscurity and uncertainty necessarily appertaining to the infancy of society.

The first indications of attention to natural history are contained in the Old Testament. The interest which it excited in the mind of SOLOMON, evinces how highly it was esteemed in his time. The records of its first progression are however entirely lost, and no regular history of this science exists prior to the days of ARISTOTLE, who under the auspices and through the munificence of his pupil Alexander the Great, was enabled to prosecute with the greatest advantage, for the time in which he lived, his experiments and inquiries into every department of natural history. Alexander felt so strong a desire to promote this object, that he placed at the disposal of Aristotle a very large sum of money, and in his Asiatic expedition employed above a thousand persons in collecting and transmitting to him specimens from

* Columella states that the idea of deriving emolument from the labours of the bee was first entertained in Greece, after the introduction of the colony which accompanied Cecrops from Egypt to Attica, by whom bees were established upon Mount Hymettus.

every part of the animal kingdom. Aristotle is therefore to be regarded as having laid the first foundation of our knowledge of that kingdom. He must likewise have derived great advantages from the discoveries and observations of preceding writers, to whose works he would probably have easy access. No individual naturalist could, without such assistance, have produced so valuable and extensive a work on natural science as that which Aristotle has bequeathed to posterity. And though the opinions of himself and his contemporaries have been transmitted to us in an imperfect manner, and abound in errors; still he and his illustrious pupil THEOPHRASTUS, who succeeded him in the Lyceum, may be regarded as the only philosophical naturalists of antiquity, whose labours and discoveries present us with any portion of satisfactory knowledge.

Prior to their time we read of ARISTOMACHUS of Soli in Cilicia, and of PHILISCUS the Thasian having devoted many years of their lives to an investigation of the manners and habits of bees. The contemplations of the former are said to have been almost solely occupied by these insects for nearly sixty years; and the latter spent so great a portion of his time in the woods, in pursuit of the same object, as to have acquired the name of AGRIUS. Both these great bee-masters left behind

them, in writing, the results of their experiments and observations; but the original works have been long buried in oblivion. However small the contribution of knowledge which we have derived from these ancient worthies, they must have greatly aided the progress of their favourite science, and are at all events evidences of the zeal with which it was prosecuted in their day.

About three hundred years after the time at which Aristotle wrote, his observations on the honey-bee were "embellished, and invested with a species of divinity, by the matchless pen of VIRGIL," in his fourth Georgic; and it excites feelings of regret, that poetry, which for its beauty and elegance is so universally admired, should be the vehicle of opinions that are founded in error.

About the commencement of the Christian æra, COLUMELLA, who was a very accurate observer, and exhibited considerable genius as a naturalist, made some curious and useful remarks upon bees in his treatise *De Re Rustica*; but Columella, like Virgil, appears to have acquiesced in and copied the errors of his predecessors.

After him the elder PLINY gave a sanction to the opinions which he found prevalent, and added to them others of his own. But Pliny, though a laborious compiler, occupied himself with too great a variety of pursuits to attain excellence in any

As a naturalist, however, he is happy in some of his descriptions. To him we are indebted for the transmission to us of all that was actually known, or supposed to be known, of natural history in his day. I say—supposed to be known; for many of the opinions and conjectures which he has put forth, have been shown by modern investigators to be ill-founded.

The notions of the ancients respecting natural philosophy rested on no rational foundation; ideas of charms and of planetary influence directed their most important pursuits, and led to the formation of very absurd theories. When the writer last-named recommends that the dust in which a mule has rolled should be sprinkled on persons who are violently in love, as a sovereign remedy for amatory ardour, and gravely tells us that snakes are sometimes produced from the human medulla,—with many frivolous conceits of the like kind, we may safely pronounce that he or his contemporaries, or both, were very credulous, and that the science of experimental philosophy was scarcely cultivated among them.

After the compilation of Pliny's vast Compendium, nearly fourteen hundred years rolled away without anything being done for entomology or for natural history in general. The Arabians, who alone preserved a glimmer of science during

those dark ages that succeeded the fall of the Roman empire, cultivated natural history only as a branch of medicine, and from their writings little can be gleaned in furtherance of our present object.

On the revival of learning, in the fifteenth century, and after the discovery of the art of printing, various editions were published of the works on natural history, written by the fathers of that science. Sir Edward Wotton, Conrade Gesner, and others, produced conjointly a work on insects, the manuscripts of which came into the possession of Dr. Thomas Penry, an eminent physician and botanist in the reign of Queen Elizabeth. After devoting fifteen years to the improvement of the work, the Doctor died, and the unfinished manuscripts were purchased at a considerable price by Mouffet, a contemporary English physician of singular learning, who with great labour and at great expense arranged, enlarged, and completed the work. When nearly ready for the press, he also died; and the papers, after lying buried in dust and obscurity for several years, at last fell into the hands of Sir Theodore Mayerne (*Baron d'Aubone*), a court physician in the time of Charles the First, who gave them to the world in 1634. The arrangement of this work is defective; but, for the period in which

it was written, it is a very complete and respectable Treatise on Entomology. It was highly recommended by Haller; and as a storehouse of ancient entomological lore it has not yet lost its utility. Its pages are embellished with nearly 500 wood-cuts. An English translation of it was published in 1658.

According to Fabius Columna, PRINCE FREDERIC CESI, president of the Roman Academy of Sciences, wrote a treatise upon bees; but the work has not been preserved, and we are unacquainted with its merits.

These authors were succeeded by Goedart, Swammerdam, Maraldi, Ray, Willughby, and Lister, who, by their indefatigable exertions, towards the close of the 17th century threw very considerable light upon every branch of natural knowledge. GOEDART spent forty years of his life in attending to the proceedings of insects, "daily conversing with insects," as he expresses it, and published in 1662 a work on their natural history; but the plates with which it is embellished form the best part of it. SWAMMERDAM published his celebrated work, "A General History of Insects," in 4to, in 1669: a more enlarged edition, in two volumes folio, containing the history of bees, was afterwards published in 1737, under the auspices of Boerhaave, from the manuscript of Swammer-

dam. Those readers who have patience to wade through these tedious volumes, will find it rewarded by the attainment of much curious information. MARALDI published in the Memoirs of the Royal Academy of Sciences for 1712, his account of the manners, genius, and labours of the bee. He is said to have been the inventor of glass hives, and to that invention may be attributed the success of his inquiries. Swammerdam founded his system upon what has been called the metamorphotic basis; and RAY, in conjunction with his friend WILLUGHBY, whom he calls the profoundest of naturalists and the most amiable and virtuous of men, erected his superstructure on the same basis. In the *Historia Insectorum* of Ray, evidently the joint production of himself and Willughby, especial attention is paid to the Hymenoptera: it contains various interesting observations on their manners and characters; and the descriptions, in which he was assisted by the use of very powerful microscopes, are concise and well drawn. Dr. MARTIN LISTER, in an appendix to Ray's work, and in various other writings also, contributed materially to elucidate the science of entomology. MADAME MERIAN likewise deserves well, for her industrious pursuit of this subject, particularly for her beautiful illustration of the metamorphoses of insects in Surinam.

The French natural historian, REAUMUR, stands prominent among the students of entomology, for the unsurpassed enthusiasm, and accuracy with which he has investigated some of its most intricate parts. To him the genus Apis is under greater obligations perhaps than to any entomologist either of ancient or modern times. See his immortal work, "Mémoires pour servir à l'Histoire des Insectes," in 6 vols. 4to. 1732—1744.

About this period also flourished the great, the illustrious LINNÆUS, whose labours diffused light over every department of natural science, and have justly caused him to be regarded as one of its brightest ornaments. He has generally been considered as the founder of the artificial system of arrangement; but a very near approach to it was made by that brilliant constellation of naturalists whom I have enumerated as having flourished at the close of the 17th century, and who may probably be regarded as having paved the way, and prepared materials, for the formation of his more perfect system.

Afterwards appeared the works of the celebrated BONNET of Geneva, the admiring correspondent of Reaumur, and the patron and friend of Huber. This great physiologist became addicted to the study of entomology before he was seventeen years of age, from reading *Spectacle de*

in *Nature*; and his decisive experiments upon Aphides do him the highest credit. His works are universally admired for their candour and ingenuity, as well as for their manifest tendency to promote the happiness of man, by exciting in him the love of knowledge and virtue.

We now come to the physiological discoveries of SCHIRACH, HUNTER and HUBER, men who have wonderfully advanced the science of entomology by a series of experiments most ably conducted, by the most patient investigation, and the most accurate and enlightened observation, and placed it upon the solid foundation of rational induction.

Several other writers also, both in systematic works and in periodical publications, have contributed to throw much light upon the œconomy and habits of the bee. Of the latter description in our own country may be enumerated ARTHUR DOBBS, Esq., THOMAS ANDREW KNIGHT, Esq., Sir C. S. MACKENZIE, GEORGE NEWPORT, Esq., and the Rev. W. DUNBAR.

Hitherto I have referred to the writers on natural history in general, or to the natural historians of bees in particular: many writers, however, have paid great attention to the domestic management of these insects. Their culture is indeed an object highly deserving the attention of the agriculturist, as well as of the natural philosopher.

In the hands of a judicious and moderately attentive apiarian, they may become a profitable branch of rural œconomy: even the most humble cottager may be made to participate in the benefit of an improved mode of managing them; and as there is so much to admire in their general œconomy and peculiar habits, the man of leisure may secure to himself a source of pleasing and rational amusement in the possession of an Apiary; for the pursuit of apiarian science, in common with the study of other branches of natural history, leads to a salutary exercise of the mental faculties, induces a habit of observation and reflection, and may sometimes prove a valuable resource for keeping off that *tædium vitæ*, but too frequently attendant upon a relinquishment of active life. No pleasure is more easily attainable, nor less alloyed by any debasing mixture; it tends to enlarge and harmonize the mind, and to elevate it to worthy conceptions of Nature and its Author:

"..... The men
Whom Nature's works can charm, with God himself
Hold converse; grow familiar, day by day,
With his conceptions; act upon his plan,
And form to his the relish of their souls."—AKENSIDE.

In the following Treatise it has been my endeavour to combine, as much as possible, the profitable with the instructive and amusing; in

seeking which object I have endeavoured to clear the ground before me of the wild-flowers of conjecture and hypothesis, with which the fecundity of the human imagination has strewed it, and to substitute in their place the less showy, but more useful, products of experiment and rational deduction, the growth of which it should be the object of every labourer in the field of science to promote. Always bearing in mind that false theories often lead to erroneous practices, I have carefully abstained from an indulgence in theory of a merely speculative kind, and confined myself simply to offering such opinions to the attention of my readers as have been confirmed by repeated experiment and observation, and to the recommendation of such practices as have been found useful by myself, or by others on whose reports I can place the fullest reliance.

Among the writers who have improved the domestic management of bees, may be enumerated Butler, Purchas, Warder, White, Thorley, Wildman, Keys, Bonner and Huish, all of whom have thrown considerable light upon this important object.

Persevering, however, as were the efforts of the writers I have named, to obtain an accurate knowledge of the physiology of bees, and to discover the best plan for their management, much

was left by them undiscovered, in both these departments. I trust that, on a perusal of the experiments and observations detailed in the following pages, my readers will perceive that several of the difficulties and obscurities with which the subject has been beset, have been cleared away, and that much has been recently done to elucidate the physiology, as well as to simplify the management, of the bee.

Many of the tracts on bees are professedly written for the perusal of the cottager. To him I do not so particularly address myself, as to the more intelligent members of the community; and so far as I am able to succeed in making an impression upon them, I shall consider myself as virtually benefiting the cottager. The latter is generally too much of a machine to be the first to adopt any improvement, however important; he is more likely therefore to obtain bee-knowledge from the example or *viva voce* instruction of his enlightened neighbours, than through the direct medium of the press.

ADDENDUM.

At page 200, I have recommended the Apiarian to afford his bees a liberal supply of food, in an ungenial autumn. Besides the reasons there assigned for it, my attention has lately been called to another, by Mr. Newport, to whom I have several times had occasion to refer, in the following sheets. After stating that all creatures which enter into a state of hybernation, previously become fat, and acquire a plethoric condition, Mr. N. observes, "It is well known to the cottager, that when the flowers have not yielded an abundance of honey in the latter part of the summer, the bees in his hives will have less chance of existing through the winter, than when the production of honey has been plentiful. This latter circumstance may, perhaps, be said to arise from a deficiency in the quantity of honey stored up by the bees, but I have strong reason for believing that it arises chiefly from the bees being in a worse bodily condition, and having but a small quantity of nutriment stored up within their own systems, which alone enables them to pass some portion of the winter in a state of repose. If the female of the common humble bee, *Bombus terrestris*, Steph., which sleeps through the winter, and appears early in the following spring, be examined about the end of September, its abdomen is found to be supplied with large bags of fat. At that period the insect is less active, and evolves a smaller quantity of heat than in the spring, when there is a much lower temperature of the atmosphere. And if, at that period, the insect be deprived of food, it will continue to live very much longer than it would have lived, under similar circumstances, and exactly at the same temperature of the atmosphere, in the month of April."

ERRATA.

Page 12, note, last line but one.—*For* been, *read* seen.

Page 200. l. 19.—*For* unusually, *read* unnecessarily.

Page 139, last two lines, and page 140. line 1.—*For* where a summer heat is preserved during the coldest months of winter, *read* which is capable of producing a summer heat in the coldest weather.

Page 140. l. 1.—*For* has ranged, *read* has been known to range (vide p. 316.).

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A GENERAL VIEW

OF THE

HISTORY AND PHYSIOLOGY

OF

THE BEE.

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BEE



PART I.

CHAPTER I.

HISTORY AND PHYSIOLOGY.

THE BEE is considered by Naturalists as belonging to what are called perfect societies of insects, and in entomological arrangements is placed in the order Hymenoptera, genus Apis. Of this genus there are many species; Linnæus has enumerated 55; in the Dictionnaire des Sciences Naturelles 70 species are characterized; and Mr. Kirby, in his Monographia Apum Angliæ, has described above 220, natives of England. The species to which I shall principally call the attention of my readers is the *domestic* HONEY BEE.

Every association of bees comprises three descriptions of individuals; and each description is distinguished by an appearance and cast of character peculiar to itself.

> "First of the throng and foremost of the whole,
> One 'stands confest the sovereign and the soul.'"

This couplet may, to a limited extent, be applied to other kinds of bees; but it is more peculiarly applicable

to hive-bees, as amongst them there has never been found, in any single family, more than one acknowledged regnant chief, usually designated by the name of Queen; of whom, as having the highest claim to our attention, I shall first proceed to speak.

The QUEEN, who is at once the mother and the mistress of the hive, differs, as Mr. Hunter has observed, from the royal chiefs of other insects, such as hornets, wasps, and humble-bees; for the chiefs of these latter societies seem to *work themselves into royalty*, whereas the queen of the hive-bees *reigns from her very birth*. She is distinguishable from the rest of the society by a more measured movement, by the great length of her body, the proportional shortness of her wings, and her curved sting. Her body tapers gradually to a point, her under jaws are shorter, her head is rounder, her trunk more slender, and not half so long as that of the working bee. Her wings extend only half the length of her body, but are strong and sinewy. Her legs, though longer, have neither brushes nor baskets. Her colours also distinguish her from the rest of the community as much as her shape; the upper surface of her body is of a much brighter black; the under surface and the legs are of a dark orange or copper colour, that of the hinder legs being somewhat deeper than the rest.

Next in order come the WORKING BEES: these are, by some, called *neuters* or *mules*; by others, *female non-breeders*. From what will be said hereafter, I think that my readers will consider the latter as the more appropriate title, the workers being sterile females with undeveloped ovaries. In a single hive the number of these varies from 12,000 to 20,000. (Where, by affording room, swarming is prevented, a single family in summer

may contain 50 or 60,000.) They are the smallest members of the community, are furnished with a long flexible apparatus known by the name of proboscis, have a peculiar structure of the legs and thighs, on the latter of which are small hollows or baskets, to receive the propolis and farina which they collect, and they are armed with a straight sting. Upon them devolves the whole labour of the colony; they rear the young, guard the entrances, elaborate the wax, collect and store the provision, and build the cells in which it is warehoused, as well as those that contain the brood.

Thirdly, there are the DRONES, or MALES, to the number of perhaps 1500 or 2000, according to the strength of the family. These make their appearance about the end of April, and are never to be seen after the middle of August, excepting under very peculiar circumstances, which will be stated hereafter. They are one-third larger than the workers, somewhat thicker, and of a darker colour; they have shorter jaws as well as a shorter proboscis, and are more blunt at the tail than either the queen or the workers; the last ring of the body is fringed with hairs, extending over the tail and visible to the naked eye. They make a greater noise in flying, are destitute of baskets on their thighs, and have no sting; are rather shorter than the queen, but generally much larger. Underneath the tail two small protuberances of a yellowish colour may be seen, which are regarded as the distinctive marks of their sex. In some swarms no drones are observable: probably these are first swarms, which being always led off by old queens, have no occasion for drones, if there be any truth in the theory to be hereafter stated.

Contrary to what occurs in the human species and in

other parts of the animal creation, among bees, the females alone exhibit activity, skill, diligence, and courage, whilst the males take no part whatever in the labours of the community, but are idle, cowardly and inactive, and possess not the usual offensive weapon of their species. The only way in which the drones are generally believed to promote the welfare of the society is a sexual one; and I shall endeavour to show in the course of this chapter, that they serve no other purpose than that of impregnating such of the young queens as may lead forth swarms in the season, or be raised to the sovereignty of the parent hive. As the drones are "never seen settling on any kind of flowers, nor laying up honey in the cells, they most probably feed at home, and fully answer the description given of them by the poet:"

"Immunisque sedens aliena ad pabula fucus." VIRGIL.

"Their short proboscis sips
No luscious nectar from the wild thyme's lips,
From the lime's leaf no amber drops they steal,
Nor bear their grooveless thighs the foodful meal:
On others' toils, in pamper'd leisure thrive
The lazy fathers of th' industrious hive.
Yet oft, we're told, these seeming idlers share
The pleasing duties of parental care,
With fond attention guard each genial cell,
And watch the embryo bursting from its shell." EVANS.*

Mr. Morris of Isleworth, in the Transactions of the

* The elegant writer from whose unfinished poem, "The Bees," I have made this quotation, was for many years an eminent physician in Shrewsbury, but has now retired into Wales, where I hope he will find sufficient leisure and encouragement to resume the truly classical theme which he has so nearly completed. Of the three parts which have been already published, I shall frequently avail myself in the course of this treatise, as well as of the highly interesting notes which are appended to them.

Society for the Encouragement of Arts, &c. for 1791, gives it as his opinion that the drones "*sit upon the eggs*," as the mother lays them;" and says, that he has "often seen them sit in a formal manner on the combs, when the brood is hatching, while the other bees were very busy at work." I suspect that Mr. Morris mistook *sleeping* for *brooding*, and that the drones were only taking a nap. Fabricius says that insects never sit on their eggs. Swammerdam was of this opinion as respects the bee community. Messrs. Kirby and Spence, however, have observed that the female ear-wig does sit upon her eggs: they also make one other exception in favour of the field bug (*Cimex griseus*), but add that these are the only ones. De Geer has given a very interesting account of both these insects, particularly of the strength of parental affection exhibited by the females. The female of the former assiduously sits upon her eggs, as if to hatch them; and after they are hatched, broods over the young as a hen over young chickens. And when the eggs of the latter are hatched, she also, after the manner of a hen, goes about with the brood, consisting of thirty or forty in number, and never leaves them: they cluster round her when she is still, and follow her closely wherever she moves.

In justice to the opinion of some of my brother apiarians, Feburier among the rest, I ought to state, that they consider the drones as useful in preserving such a degree of warmth in the hive as is requisite for maturating the brood in due season, and that their assistance in this way is more especially useful after the issue of one or more swarms has very much depopulated a hive of its working community. In refutation of this opinion I would observe, that apprehending I possessed a family

which had lost its queen, and in which, besides having a very scanty population, there was no brood, I had recourse, with the assistance of my friend Mr. Golding, (then on a visit with me,) to the excision of a piece of comb, from one of my Huber-hives, containing brood and eggs of all ages: with this the weak family was superhived by means of a perforation in the lid of the box, which was surmounted by an inverted half-pint tumbler. The bees very quickly clustered round the piece of comb, but not numerously, and no pains were taken to keep up artificial warmth; still the brood underwent all its regular changes within the accustomed time, the weather being but moderately warm. From this experiment it would appear that no very *extraordinary* heat was required for bringing the *eggs* and *larvæ* of *working bees* to maturity. It is to be remarked, however, that no queen was raised, consequently it may still be a question how far such additional heat as a body of drones may be capable of supplying is necessary to the perfect evolution of *royal* brood. But even for that purpose I doubt their importance, when I consider the facility with which artificial queens are produced in single leaf hives, in which there are frequently no drones at all, or none worthy of notice, and in which the narrowness of the hive does not admit even the workers to cluster in such a body as the theory I am combating presupposes.

Besides the three essential members of the bee-community, just described, about the commencement of the swarming season a few bees may occasionally be seen, which present a somewhat singular appearance. They have small light-coloured top-knots on the centre of their frontlets, which very much resemble a pair of short antennæ rising from a single root. This append-

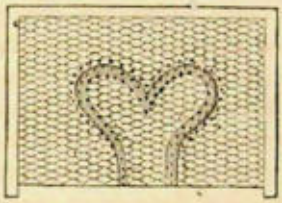
age is of a very tenacious texture, by means of which (for it is an apparently extraneous substance,) it forms a close adhesion to the head of the insect. The bees that are thus ornamented are probably what Butler designated by the name of *Captains*. In all other respects they perfectly resemble the working inmates of the hive, and appear, like them, to be actively engaged in the business of the family.

Huber has also called the attention of the Apiarian to another kind of bees, which like these appear to be only casual inmates of the hive, from which they are soon expelled by the workers. He has called them *black bees*, and says he first noticed them in two of his hives in the year 1809, and on several other occasions from that time to the year 1813. They present a perfect resemblance to the working bees, excepting in their colour, which, in consequence of their being less downy, appears darker. On dissection, their internal structure also appears to be the same. Huber regards them as imperfect bees, but leaves to future naturalists an inquiry into their nature and origin. Messrs. Kirby and Spence have thrown out a conjecture that these black bees may be *superannuated bees*, that being no longer capable of contributing towards the labours of the community, are banished or destroyed by its younger members. They found their conjecture upon the usual effect of superannuation in rubbing off the hair of insects, and thereby giving them a darker hue. From the uniformity of their aspect, however, their appearing only in certain seasons, and being then found in considerable numbers, it seems more likely that they owe their peculiarities to some such congenital accident as varies the colour of other domesticated animals. It being the

effect of superannuation will appear still more improbable from what will be said hereafter on the brevity of the bee's life.

It is the office of the queen bee to multiply the species by laying eggs, which she deposits in cells constructed for their reception by the working bees. These cells vary from one another in size, (and in the instance of the royal cells they also vary in form and direction,) according as they are intended to be the depositories of eggs that are to become drones, or of those that are to become workers. But for a more particular account of these cells, *vide* Part 2. "Architecture of Bees." The experiments of the Rev. W. Dunbar, Minister of Applegarth, afford an important addition to our general stock of knowledge respecting bees; and they are quite in accordance with similar experiments made by Mr. Golding and myself. Mr. D. gave his observations to the public in the Edinburgh Philosophical Magazine, in which he states that when the queen is about to lay, she puts her head into a cell, and remains in that position for a second or two, probably to ascertain its fitness for the deposit which she is about to make. She then withdraws her head, and curving her body downwards, inserts her tail into the cell: in a few seconds she turns half round upon herself and withdraws, leaving an egg behind her. When she lays a considerable number, she does it equally on each side of the comb, those on the one side being as exactly opposite to those on the other as the relative position of the cells will admit. The effect of this is to produce a concentration and œconomy of heat for developing the various changes of the brood. The following sketch is taken from a plate given by Mr. Dunbar, to represent the comb upon which his ob-

servations were made, and to show that part of it which was occupied by brood, the surrounding part of the square having been full of sealed honey.



The dotted stripe of unequal breadth which separates the brood portion of the comb from that which contained honey, is designed to represent a series of cells which were the depositories of a compound of farina and honey for the larva food. The widest part of the brood-cells was bordered by three rows of these store-cells: as the dimensions of the one were contracted, the breadth of the other diminished, so that the neck or narrowest part was bounded by only a single line of store-cells; so admirably was the supply of food adjusted to the probable demand for it, in its immediate vicinity.

The *eggs* of bees are of a lengthened oval shape, with a slight curvature, and of a bluish white colour: they are about the size of those which are laid by the butterfly upon cabbage leaves, are composed of a thin membrane, filled with a whitish liquor, and being besmeared, at the time of laying, with a glutinous substance, they adhere to the bases of the cells, and remain unchanged in figure or situation for four days; they are then hatched, the bottom of each cell presenting to view a small white worm or maggot, with several ventral rings. On its growing so as to touch the opposite angle of the cell, it

coils itself up in the shape of a semicircle; to use the language of Swammerdam, it coils itself up like a dog when going to sleep; and floats in a whitish transparent fluid, which is deposited in the cells by the nursing-bees*, and by which it is probably nourished; it becomes gradually enlarged in its dimensions, till the two extremities touch one another and form a ring. In this state it obtains indifferently the name of *worm*, *larva*, *maggot*, or *grub*, and is fed with farina or bee-bread. The slightest movement on the part of the nursing-bees suffices to attract it to its food, to receive the welcome morsels of which it eagerly opens its two lateral pincers†, and a most liberal supply is afforded to it, though by no means trenching on the bounds of prodigality. So nicely do the bees calculate the quantity which will be required, that none remains in the cell when the larva is transformed to a nymph. It was the opinion of Reaumur, and is still that of many eminent naturalists, that farina does not constitute the sole food of the bee-larvæ, but that it consists of a mixture of farina with a certain proportion of honey and water, partly digested in the stomachs of the *nursing-bees*, the relative proportions of honey and farina varying according to the age of the young. The compound at first is nearly insipid, but gradually receives an accession of sweetness and acescency, which increase as the insects approach maturity.

Schirach imagined that the semen of the male was the food of the larvæ: Bonnet entertained the same opinion, founded upon his observation that the drones, in going across the combs, pass by those cells that contain no maggots, but stop at those which do, giving a knock

* For an account of these, see Part II. Chap. xxxiii.

† "Suâ ipse facultate se erigit, cibumque capit."—Aristotle.

with the tail at them three times. Upon this Mr. Hunter observes that *three* is a famous number! and we know very well that the development is complete in hives that do not contain a single drone.

The larva having derived support in the manner above described for four, five, or six days, according to the season*, continues to increase during that period, till it occupies the whole breadth and nearly the length of the cell. The nursing-bees now seal up the cell, with a light *brown* cover, externally more or less *convex*, (the cap of a drone-cell is more convex than that of a worker,) and thus differing from that of a honey-cell, which is *paler* and somewhat *concave*. The larva is no sooner perfectly inclosed than it begins to labour, alternately extending and shortening its body, whilst it lines the cell by spinning round itself, after the manner of the silk-worm, a whitish silky film or *cocoon*, by which it is encased, as it were, in a pod or pellicle. "The silken thread employed in forming this covering proceeds from the middle part of the under lip, and is in fact composed of two threads gummed together as they issue from the two adjoining orifices of the spinner†." When it has undergone this change, it has usually borne the name of *nymph* or *pupa*.

It may appear somewhat extraordinary that a creature which takes its food so voraciously prior to its assuming the pupa state, should live so long without food after that assumption: but a little consideration will perhaps abate our wonder; for when the insect has attained the state of pupa, it has arrived at its full growth, and pro-

* Schirach asserts, that in cool weather the development takes place two days later than in warm.

† Kirby and Spence

bably the nutriment, taken so greedily, is to serve as a store for developing the perfect insect.

The bee when in its pupa state has been denominated, but improperly, *chrysalis* and *aurelia*; for these, as the words import, are of a golden yellow colour, and they are crustaceous, whilst the bee-nymphs appear of a pale, dull colour, and readily yield to the touch. The golden splendour, to which the above names owe their origin, is peculiar to a certain species only of the papilio or butterfly tribe. The term *pupa*, which is employed by the higher class of entomologists, after the example of Linnæus, signifies that the insect is enveloped in swaddling clothes like an infant, a very apt comparison. Kirby and Spence have remarked that it exhibits no unapt representation of an Egyptian mummy*. When in this state it presents no appearance of external members, and retains no very marked indications of life: but within this outward case its organs are gradually and fully developed, its integuments hardened and consolidated; and as soon as it is qualified, it bursts its fetters, and is introduced to a new career of existence; from having been a mere worm, becomes a sportive inhabitant of the air, and enters upon new scenes and new enjoyments.

The *working bee-nymph* spins its cocoon in thirty-six hours. After passing about three days in this state of preparation for a new existence, it gradually undergoes so great a change as not to wear a vestige of its previous form, but becomes armed with a firmer mail, and

* Huber's translator says that naturalists of the present day incline to use the name of larva in all cases where the worm is not been under its final aspect; a term which signifies that the insect wears a disguise, *larva* being Latin for a mask.

with scales of a dark brown hue, fringed with light hairs. On its belly six rings become distinguishable, which by slipping one over another enable the bee to shorten its body whenever it has occasion to do so; its breast becomes entirely covered with gray feather-like hairs, which as the insect advances in age assume a reddish hue.

When it has reached the twenty-first day of its existence, counting from the moment the egg is laid, it quits the exuviæ of the pupa state, comes forth a perfect winged insect, and is termed an *imago*. The cocoon or pellicle is left behind, and forms a closely-attached and exact lining to the cell in which it was spun: by this means the breeding cells become smaller, and their partitions stronger, the oftener they change their tenants; and when they have become so much diminished in size, by this succession of pellicles or linings, as not to admit of the perfect development of full-sized bees, they are converted into receptacles for honey. When the combs of a hive become brittle, the bees destroy and replace them by new ones; but whether they ever do so on account of the diminished size of the cells, I am uncertain.

Such are the respective stages of the working bee; those of the royal bee are as follow. She passes three days in the egg and is five a worm; the workers then close her cell *, and she immediately begins spinning the cocoon, which occupies her twenty-four hours. On the tenth and eleventh days, as if exhausted by her labour, she remains in complete repose, and even sixteen hours

* Instead of being nearly horizontal like the other brood cells, those of the queens are perpendicular and considerably larger; in form they are oblong spheroids, tapering gradually downwards; their mouths being always at the bottom. *Vide* Part II. Chap. xxii.

of the twelfth. Then she passes four days and one third as a nymph. It is on the sixteenth day therefore that the perfect state of queen is attained.

The male passes three days in the egg, six and a half as a worm, and metamorphoses into a fly on the twenty-fourth or twenty-fifth day after the egg is laid. The great epoch of laying the eggs of males may be accelerated or retarded by the state of the atmosphere promoting or impeding the collections of the bees. The *development* of *each* species likewise proceeds more slowly when the colonies are weak or the air cool, and when the weather is very cold it is entirely suspended. Mr. Hunter has observed that the eggs, maggots and nymphs all require a heat above 70° of Fahrenheit for their evolution. The influence of temperature in developing embryo insects is very strongly illustrated in the case of the *Papilio Machaon*. According to Messrs. Kirby and Spence, "if the caterpillar of the *Papilio Machaon* becomes a pupa in July, the butterfly will appear in thirteen days; if it do not become a pupa till September, the butterfly will not make its appearance until the following June." And this is the case, say they, with a vast number of other insects. Reaumur proved the influence of temperature, by effecting the regular changes in a hot-house, during the month of January. He also proved it conversely, by having recourse to an ice-house in summer, which enabled him to retard the development for a whole year.

"The larvæ of bees, though without feet, are not always without motion *.

"They advance from their first station at the bottom

* "Nonne vides quos cera tegit sexangula fœtus?
Melliferarum apium sine membris corpora nasci?
Et serosque pedes serasque assumere pennas?"—Ovid.

of the cell in a spiral direction: this movement for the first three days is so slow as to be scarcely perceptible; but after that it is more easily discerned. The animal now makes two entire revolutions, in about an hour and three quarters; and when the period of its metamorphosis arrives, it is scarcely more than two lines from the mouth of the cell. Its attitude, which is always the same, is a strong curve. This occasions the inhabitant of a horizontal cell to be always perpendicular to the horizon, and that of a vertical one to be parallel with it *."

The young bees break their envelope with their teeth, and assisted, as soon as they come forth, by the older ones, proceed to cleanse themselves from the moisture and exuviæ with which they were surrounded: this operation being completed, it has been said that they begin to exercise their intended functions, and in a few minutes are gathering provision in the fields, loading "in life's first hour the hollow'd thigh." M. Maraldi assures us that he has "seen bees loaded with two large balls of wax returning to the hive the same day they became bees." "We have seen her," says Wildman, "the same day issue from the cell, and return from the fields loaded with wax, like the rest." But Feburier says that both drones and workers, after emerging from their cells, remain two days in the hive; and, considering that when first presented to our view they are little, grey, soft, comparatively helpless insects, it seems probable that several hours at any rate elapse ere they take wing.

Some naturalists speak in strong terms of the particular attention which the older bees pay to those that have recently emerged from their cradles, and even go so far as to insinuate that they give them a course of instruction prior to their entering upon the duties they have to

* Kirby and Spence.

perform. This, however, is no doubt all fanciful. It has led Mr. Dunbar to make the following observations. "In hundreds of instances," says he, "have I pitied the infant insect, when, after long struggling to get out of its cradle, it has at last succeeded so far as to extrude the head; and, when labouring with the most eager impatience, and on the very point of extricating the shoulders also, which would have at once secured its exit, a dozen or two of workers, in following their avocations, have trampled without ceremony over the struggling creature, which was then forced, for the safety of its head, quickly to pop down again into its cell, and wait till the unfeeling crowd had passed before it could renew its efforts. Again and again will the same impatient exertions be repeated by the same individual, and with similar mortifying interruptions, before it succeeds in obtaining its freedom. Not the slightest attention or sympathy did I ever observe on the part of the workers in these circumstances; nor did I ever witness the kind parental cares and sage instruction which M. Feburier speaks of. In fact, from the moment they have sealed the cell of the nymph, the bees seem to give up entirely anything like individual attention; and though when a brood comb is meddled with their utmost ire is kindled against the invader, yet as far as concerns the reception of the newly-hatched insect, and its introduction to the duties and avocations of the bee-community, they appear selfish and indifferent." These observations accord entirely with my own as far as respects the conduct of the bees towards the *infant workers*, but I have repeatedly seen assistance rendered to the emerging *drones*. As soon as the young insect has been cleaned from its exuviæ, and regaled with a little honey by its companions, the latter clean out the cell, preparatory to

its being re-occupied by a new tenant or with honey.

With respect to the cocoons spun by the different larvæ, both workers and drones spin *complete cocoons*, or inclose themselves on every side: royal larvæ construct only *imperfect cocoons*, open behind, and enveloping only the head, thorax, and first ring of the abdomen; and Huber concludes, without any hesitation, that the final cause of their forming only incomplete cocoons is, that they may thus be exposed to the mortal sting of the first hatched queen, whose instinct leads her instantly to seek the destruction of those who would soon become her rivals. If the royal larvæ spun complete cocoons, the stings of the queens regnant might be so entangled in their silken meshes as to be with difficulty disengaged, they might even be unable to retract them, and thus become the victims of their own fury. "Such," says Huber, "is the *instinctive enmity of young queens to each other*, that I have seen one of them, immediately on its emergence from the cell, rush to those of its sisters, and tear to pieces even the imperfect larvæ. Hitherto," he adds, "philosophers have claimed our admiration of Nature for her care in preserving and multiplying the species. But from these facts we must now admire her precautions in exposing certain individuals to a mortal hazard."

A curious circumstance occurs with respect to the hatching of the queen-bee. When the pupa or nymph is about to change into the perfect insect, the bees render the cover of the cell thinner, by gnawing away part of the wax, scooping it out in waved circles at its edges; and with so much nicety do they perform this operation, that the cover at last becomes pellucid, owing to its ex-

treme thinness, thus facilitating the exit of the fly. After the transformation is complete, the young queens would, in common course, immediately emerge from their cells, as workers and drones do; but the former generally keep the royal infants prisoners for some days, supplying them in the mean time with honey for food, a small hole being made in the cover of each cell, through which the confined bee extends its proboscis to receive it. The *royal insects* continually utter, while thus imprisoned, and whether imprisoned or not, a kind of song called PIPING, the modulations of which are sufficiently marked to make them readily distinguishable from each other. They consist of several monotonous notes in rapid succession, and Huber supposed the working bees to ascertain, by the loudness of these tones, the ripeness of their queens. This subject will be entered upon fully in Chap. XIV.

Probably the young queens are thus temporarily imprisoned the more completely to insure success to them in their first efforts to fly, which would seem to be an object of considerable importance: in furtherance of this, they are provided with capacious cells, which, by enabling them to expand their wings before they emerge, fit them for immediate flight; whereas the workers and drones issue from their cells with folded wings.

It has been said that the queen is a good deal harassed by the other bees upon her liberation, which has been attributed to their endeavour to compel her departure with a swarm as soon as possible. It has also been said that her majesty has the power of instantly putting a stop to this occasional worrying by uttering a peculiar noise, which has been called the "voice of sovereignty." But these notions are probably erroneous. With respect

to the first, it will, I think, be made apparent hereafter that the queen is never harassed by the bees on her liberation, except when she attempts to tear open the cells of her rivals: and as to the voice of sovereignty, I am not aware that any apiarian of the present day has ever witnessed an instance of its overawing effect. Mr. Dunbar, though he has seen her majesty raising her voice in the angry attitude described by Huber, never had any evidence of its impressing the bees with fear. Bonner has also declared that he never could observe in the queen anything like an exercise of sovereignty. Notwithstanding this want of evidence, however, among the generality of modern apiarians, we have the positive statement of Huber in favour of this vox regalis. He declares that he has heard it on various occasions, and witnessed the striking effect which it always produced. On one occasion, he observes, that a queen, having escaped the vigilance of her guards and sprung from the cell, was, on her approach to the royal embryos, pulled, bitten, and chased by the other bees. But standing with her thorax against a comb and crossing her wings upon her back, keeping them in motion, but not unfolding them, she emitted a particular sound, when the bees became, as it were, paralysed, and remained motionless. Taking advantage of this dread, she rushed to the royal cells; but the sound having ceased as she prepared to ascend, the guardians of the cells instantly took courage and fairly drove her away. This voice of sovereignty is described as a very distinct kind of clicking, composed of many notes in the same key, which follow each other rapidly. Butler speaks of the voice of the queen, and says that he has sometimes heard her raise it to a high pitch, (sounding like the

sharp note of a flute,) but not as producing a paralysing effect upon the bees; on the contrary, he refers to it as being uttered when she wishes the workers to face an enemy, "to fight for their prince, their lives, and their goods." When piping, prior to the issue of an after-swarm, the bees that are near her remain still, with a slight inclination of their heads, but whether impressed by fear or not seems doubtful.

Whether the queen possess the influential power ascribed to her of overawing the workers or not, it is universally allowed that there is a considerable degree of stateliness and dignity in all her movements—a stateliness which till very lately was regarded as being upheld by the appointment of a regular court of attendants to pay her royal honours. This appears to have been Dr. Evans's notion, as expressed in the following lines:

> "But mark, of royal port and awful mien,
> Where moves with measur'd pace the INSECT QUEEN!
> Twelve chosen guards, with slow and solemn gait,
> Bend at her nod, and round her person wait."

Mr. DunBar's observations, however, as well as those of Mr. Golding and myself, disprove this opinion. The queen has no regular guard, either when she traverses the combs or when she is stationary. In either case, as we have frequently observed, the working bees that happen to be near her, for the most part, turn their heads towards her, after the manner of courtiers in the presence of royalty, and wherever she moves, clear the way to allow her to pass, or rather get hastily out of her way, forming a circle round but never accompanying her. They occasionally, during her progress, fawn upon and caress her, touching her softly with their antennæ. As

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she moves onward, all the bees, through which she successively passes, pay her the same homage; those which in her track she leaves behind, close together, and resume their accustomed labours. This sort of *homage* is only *paid to fertile queens*; whilst they continue virgins, they receive no distinctive marks of respect. This fact was noticed by Huber, and it has several times fallen under my own observation. A very striking instance of it was remarked by Mr. Dunbar at the close of one of his experiments. "So long," says he, "as the queen which survived the rencontre with her rival remained a virgin, not the slightest degree of respect or attention was paid her by the bees; not one gave her food; she was obliged, as often as she required it, to help herself; and in crossing to the honey-cells for that purpose, she had to scramble, often with difficulty, over the crowd, not an individual of which got out of her way, or seemed to care whether she fed or starved; but no sooner did she become a mother than the scene was changed," and all testified towards her those affectionate attentions which are uniformly exhibited to fertile queens.

Bees, when deprived of their queen, have the power of selecting one or more worker-eggs, or grubs, and converting them into queens, thus showing that there is no inherent difference in female ova. To effect this, each of the promoted grubs has a royal cell or cradle formed for it, by having three contiguous common cells thrown into one; two of the three grubs that occupy those cells are sacrificed, and the remaining one is liberally fed with royal jelly. This *royal jelly* is a pungent food prepared by the working bees exclusively for the purpose of feeding such of the larvæ as are destined to be

come candidates for the honours of royalty, whether it be their lot to assume them or not. It is more stimulating than the food of ordinary bees, has not the same mawkish taste, and is evidently acescent from the first. The royal larvæ are supplied with it rather profusely, and there is always some of it left in the cell after their transformation. Schirach, who was secretary to the Apiarian Society in Upper Lusatia, and vicar of Little Bautzen, may be regarded as the discoverer, or rather as the promulgator of this fact; and his experiments, which were also frequently repeated by other members of the Lusatian society, have been amply confirmed by those of Huber, Bonner, Dunbar, Golding, and myself. Keys was a violent sceptic upon this subject (see his communications to the Bath Society); so likewise was John Hunter (vide Philosophical Transactions). But notwithstanding the criticisms and ridicule of the former, and the sarcastic strictures of the latter, the sex of workers is now established beyond all doubt. The fact is said to have been known long before Schirach wrote: M. Vogel, and Signor Monticelli a Neapolitan professor, have both asserted this; the former states it to have been known upwards of fifty years, the latter a much longer period; he says that the Greeks and Turks in the Ionian Islands are well acquainted with it, and that in the little Sicilian island of Favignana the art of *producing queens* has been known from very remote antiquity; he even thinks that it was no secret to the Greeks and Romans, though, as Messrs Kirby and Spence observe, had the practice been common, it would surely have been noticed by Aristotle or Pliny. Swammerdam was acquainted with the power of raising artificial swarms, but was aware of it only in those cases

where the hives contained royal cells: this knowledge was communicated to him by a breeder of bees. The result of Schirach's experiments was, that all workers were originally females, but that their organs of generation were obliterated merely because the germs of them were not developed; their being fed and treated in a particular manner in their infancy, or worm state, being necessary, in his opinion, to effect that development. Subsequent experiments have shown, however, that the organs are not entirely obliterated. They seem to be merely restrained from unfolding themselves by the size of their cradle and the quality of their food. The most incomprehensible part of the process is, that increasing the size, and changing the direction of the cell, and feeding the larvæ with a more pungent food, should not only allow the sexual organs of the insect to be fully developed, but should alter the shape of her tongue, her jaws, and her sting, deprive her of the power of secreting wax, and obliterate the baskets which, but for the changes just referred to, would have been formed upon her thighs.

Huber has been regarded as a man of a very vivid imagination; and as his eyesight was defective, he was obliged to rely very much upon the reports of Francis Burnens, his assistant; on both which accounts other apiarian writers have thrown some distrust upon his statements. Huish may be reckoned among the number; he has also made some observations upon Schirach's theory, and treated it with much petulance and ridicule. In answer to him and all other cavillers, I shall detail an experiment made by Mr. Dufour in his mirror-hive. In July, when the hive had become filled with comb and bees, and well stored with honey, and when

the queen was very fertile, laying a hundred eggs a day, Mr. D. opened the hive and took her majesty away. For eighteen hours the usual labours of the hive proceeded as earnestly and regularly as if the queen were still present; but no sooner was her loss discovered than all was agitation and tumult, the bees hurried backward and forward over the combs with a loud noise, rushed in crowds to the door and out of the hive as if going to swarm, and in short exhibited all the symptoms of bereavement and despair*. On the following morning he observed that they had founded five royal cells, in the usual way under such circumstances; and in the course of the same afternoon, four more were founded in parts of the comb where there were only eggs a day or two old. "Two of the royal cells advanced more rapidly than the rest, probably from the larvæ being of an age the fittest for the purpose: four came on more slowly, and three made no progress after the third day. On the seventh the two first were sealed, two more were nearly so; but neither they nor any of the rest advanced further: as if the bees, satisfied that they had secured at least *one* queen, judged it unnecessary to carry forward the others to maturity." On the morning of the fourteenth day from the old queen's removal, a young queen, differing in no respect from one produced in the natural way, emerged from her cell and proceeded towards the other royal cell evidently with a murderous intent. She was

* In one of my own experiments the bees were five days before they were aware of their situation: Mr. Golding finds that the period may be shortened by exciting an agitation in the family, by gently fumigating them for instance, which causes such a degree of alarm as to prompt them to an exercise of the most prominent of their instincts, that of assuring themselves of the presence and safety of their queen.

immediately pulled back by the workers with violence; and this conduct on their part was repeated as often as the queen renewed her destructive purpose. At every repulse she appeared sulky, and cried *peep, peep,* the unhatched queen responding, but in a somewhat hoarser tone, owing to her confined situation. This parley, as Butler calls it, continued for several hours together, with intervals of about a minute, and it affords an explanation of the two different sounds which are heard prior to the issuing of second swarms. On the afternoon of the same day a second queen was hatched; "I saw her," says Mr. D., "come forth in majesty, finely and delicately formed, but smaller than the other;" she immediately buried herself in a cluster of bees. Next morning there was a hot pursuit of the younger queen by the elder; but Mr. D. being called away, on his return half an hour afterwards, the former was dying on the alighting board, no doubt the victim of the other.

Though this is the *general* mode of proceeding when a hive contains more than one royal member, yet it is not the *uniform* mode: there are instances in which the queen regnant is not so blood-thirsty, and in which she does not suffer her attention to be withdrawn from her regular occupations, but leaves the destruction of her rival to the working bees, by whom she is so closely hemmed in as to have her existence terminated either by famine or suffocation.

Huber has stated that these artificial queens are mute; but the circumstance noticed by Mr. Dunbar of the two queens just referred to having answered each other, disproves that statement. Contrary also to the experience of Huber, Mr. D. found that the cells of artificial queens were surrounded by a guard. I have just ad-

verted to the protection which they afforded to the royal cells when assailed by the first hatched queen.

That *the working-bees are females* is clear from the circumstance of their being known occasionally to lay eggs. This fact was first noticed by Riem, and was afterwards confirmed by the experiments of Huber, whose assistant on one occasion seized a fertile worker in the very act of laying. It is a remarkable fact that these *fertile workers* never lay any but *drone* eggs. This uninterrupted laying of drone eggs was noticed by the Lusatian observers, as well as by the naturalist of the Palatinate. Bonnet, on referring to this fact, supposes there must have been small queens mixed with the workers upon which the experiments were made, whose office it was to lay male eggs in *all* hives; for neither he nor the before-named observers imagined that the workers were ever fertile, though from the oft-repeated experiments, just alluded to, they must have regarded them as females. Probably the fertility of these workers is occasioned by some royal jelly being casually dropped into their cells, when grubs, as they uniformly issue from cells adjoining those inhabited by grubs, that have been raised from the plebeian to the royal rank; of course therefore they are never found in any hives but those which have had the misfortune to lose their queen. Fertile workers appear smaller in the belly and more slender in the body than sterile workers, and this is the only external difference between them.

If any further proof were required to establish the opinion that working bees are females, the question has been set at rest for ever by *the dissections of Miss Jurine*, daughter of the distinguished naturalist of Geneva: what had eluded the scalpel and the microscope of that

penetrating and indefatigable naturalist Swammerdam, was reserved for the still finer hand and more dexterous dissection of a lady. Miss Jurine, by adopting a particular method of preparing the object to be examined, brought into view the rudiments of the ovaria of the common working bee: her examinations were several times repeated, and always with success: in form, situation and structure, they were found to be perfectly analogous to those of the queen bee, excepting that no ova could be distinguished in them. M. Cuvier, however, thought that he observed minute chaplets in common bees, resembling those in the oviducts of queens; an additional confirmation, if any were wanted, of the opinion that workers are females whose organization is not developed. Miss Jurine undertook the delicate task to which I have just referred, at the request of M. Huber, who speaks of her as a young lady who had devoted her time and the liberal gifts of nature to similar studies, and says that she already rivalled Lyonnet and Merian; but adds, "we had soon to deplore her loss." The research was first made to ascertain whether black bees, which, when they appear in a hive, are much persecuted, were exposed to this persecution in consequence of their sex exciting the jealousy of the queen. The success of the investigation induced this accomplished young lady to extend her dissection to the common workers, which was crowned with a result equally gratifying. Parallel instances have been observed with regard to the humble-bee, the wasp and the ant, amongst which, those that have usually been called neuters are found to be females, and when fertile, they, like the fertile workers in a bee-hive, produce males universally.

Having now traced these insects through their regu-

lar stages of egg, larva, nymph, until they become perfect bees, and having noticed the facts which show the working bees to be females, I shall advert to the more intricate and mysterious business of *Impregnation*. This is a subject which was long involved in obscurity, and which indeed is still clouded by some uncertainty. Schirach and Bonner stoutly denied the necessity of sexual intercourse between the queen and the drones, considering the former as a mother and yet a virgin, and Swammerdam was of the same opinion; he ascribes impregnation to a vivifying seminal aura, which is exhaled from the drones and penetrates the body of the queen. This opinion arose from his observing a very strong odour to be exhaled, at certain times, from the drones; Hanc sententiam ratam habuit, quia organa apum propagini servientia, sexus utriusque, ritè dissecta, inter se ita disparia videbantur, ut congressus ne fieri quidem ullo pacto posset. His opinion with respect to the vivifying influence of the seminal aura also accounted satisfactorily, to his own mind, for there being such a prodigious number of drones, as, in proportion to their number, would of course be the intensity of their peculiar odour. Reaumur very successfully combated this fanciful doctrine, and Huber has confuted it by direct experiment. Reaumur inclined to the opinion that there was a sexual intercourse, though his experiments left that question undecided. Arthur Dobbs, esq. has given it as his opinion that the queen's eggs were impregnated by coition with the drones, and that a renewal of the intercourse was unnecessary. He however thought that she had intercourse with several, in order that there might be a sufficient deposition of sperm to impregnate all her eggs. About the beginning of the last century,

Maraldi broached another hypothesis; he imagined that the eggs were fecundated by the drones, after the queen had deposited them in the cells, similarly to what takes place in the fecundation of fish-spawn. In 1777 that ingenious naturalist Mr. Debraw, who was apothecary to Addenbroke's Hospital at Cambridge, also adopted this opinion; and even so late as the year 1817 Huish has supported the same doctrine, and I believe does so at the present time. Debraw thought he had discovered the prolific fluid of the drones, in the brood cells, which fertilizing the eggs caused them to produce larvæ. Huber repeated the experiments of Debraw, and at first gave him credit for the reality of the discovery; but further and more minute observation convinced him that it was illusory, and that what he, as well as Debraw, had taken for seminal fluid, was nothing more than light reflected from the bottoms of the cells, when illuminated by the sun's rays. Moreover, it did not escape the acute mind of Huber, that eggs were laid and larvæ hatched, when there were no drones in existence, viz. between the months of September and April. The two hypotheses just mentioned, accounted satisfactorily, to their supporters, for the prodigious disproportion in the number of the sexes. But Huber made the experiment of confining the queen and rigidly excluding every male from a hive; nay more, he carefully examined every comb, and satisfied himself that there was neither male nymph nor worm present; and lest it should be supposed that the fertilizing fluid might be imported from other hives, he totally confined the bees, on two occasions, and still the eggs were prolific; which proves clearly that their fertility must have depended upon the previous impregnation of the queen. The analogy of

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wasps is indeed admitted, by Huish, to discountenance the opinion which he entertains in common with Maraldi and Debraw. The queen wasp alone survives the winter, and deposits her first eggs in the ensuing spring in combs of her own construction. Here then impregnation must have taken place in the preceding autumn, whilst the eggs were in the ovaria. It was the opinion of Hattorf, Schirach, and probably also of Bonner, that the queen-bee impregnated herself; but this opinion is too extravagant to require serious refutation: it arose probably, from their making experiments upon queens taken indiscriminately from the hives, and which had previously been impregnated. This no doubt misled Debraw, who, without knowing it, had chosen for experiment some queens that had had commerce with the males. The experiments of Huber were made upon virgin-queens, with whose history he was acquainted from the moment of their leaving their cells. In the course of his experiments he found that the queens were never impregnated, so long as they remained in the interior of the hive; but that *impregnation always takes place in the open air*, at a time when the warmth and brightness of the day have induced the drones to issue from the hives; on which occasions the queen soars high in the air, love being the motive for the only distant journey she ever takes. "The rencontre and copulation of the queen with the drone take place exterior to the hive," says Lombard, "and whilst they are on the wing." They are similarly constituted with the whole family of flies. A corresponding circumstance may also be noted with respect to the queen-ant; and Bonnet, in his *Contemplations de la Nature*, has observed, that she is always impregnated whilst she is on the wing. The dragon-

flies copulate as they fly through the air, in which state they have the appearance of a double animal.

> ....." When noon-tide Sirius glares on high,
> .....Young Love ascends the glowing sky,
> From vein to vein swift shoots prolific fire,
> And thrills each insect fibre with desire.
> Thence, Nature, to fulfil thy prime decree,
> Wheels round, in wanton rings, the courtier bee;
> Now shyly distant, now with bolden'd air,
> He woos and wins the all-complying fair;
> Through fields of æther, veil'd in vap'ry gloom,
> They seek, with amorous haste, the nuptial room;
> As erst th' immortal pair, on Ida's height,
> Wreath'd round their noon of joy, ambrosial night."
>
> EVANS.

The males and the fertile females among ants are winged insects; the former, as in the case of drone-bees, perish a short time after their amours; and the females, having alighted upon a spot suitable for the formation of a colony, cut off their own wings, as being no longer of any use to them. (Linnæus had observed that the females lost their wings a certain period after impregnation.) A domino Hunter didici, se bombinatrices sub oculos in coitu junctos, ut apud muscas mos est, vidisse. "Aculeus," inquit, "articulo temporis ejicitur, et inter gemina insecta, dorso feminæ, imponitur. Hoc situ aliquandiù manent." In the hornet it is the same*.

On the 23rd of July, 1836, I was myself an eye-witness of the facts here recorded, in the humble-bee. A conjoined pair descended obliquely and rapidly through the air, making a loud buz, and alighted on a flower-bed in my garden. I placed a tumbler glass over them

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and observed their proceedings for about twenty minutes, when they became disunited, but with considerable difficulty and not without an angry scuffle, two or three drops of a limpid fluid falling from betwixt them. Having kept them together and fed them for two days, I could on no occasion perceive any further advances on either side, but rather symptoms of aversion. At the end of this time the drone died: the queen lived and appeared lively through many days, when I gave her her liberty and she flew gaily away.

If the queen-bee be confined, though amid a seraglio of males, she continues barren. Prior to her flight, (which is preceded by the flight of the drones,) after traversing the alighting board for a few moments, she flies off to a short distance, hovers round the hive, as if to survey the localities, for the purpose of recognition, and sometimes, after flying a few feet from it, returns to it again: finally she rises aloft in the air, describing in her flight horizontal circles of considerable and gradually increasing diameter, and soars at last to such a height in the air as renders it impossible to follow her movements. She returns from her aerial excursion in about half an hour, with the most evident marks of fecundation. Excursions are sometimes made for a shorter period, but then she exhibits no sign of having been impregnated. It is curious that Bonner should have remarked those aerial excursions, without suspecting their object. "I have often," says he, "seen the young queens taking an airing upon the second or third day of their age." Yet Huish says, "It is an acknowledged fact that the queen-bee never leaves the hive, on any account whatsoever." Perhaps Huish's observations were made upon first swarms; and these are uniformly

conducted by old queens, a fact which was known to Swammerdam. Old queens have not the same occasion to quit the hives that young ones have,—viz. to have intercourse with the drones; for, according to Huber, one impregnation is sufficient to fertilize all the eggs that are laid for two years afterwards, at least. He *thinks* it is sufficient to fertilize all that she lays during her whole life. This may appear, to some, an incredible period; and Huish inquires, admitting that a single act of coition be sufficient to fecundate all the eggs existing in the ovaria at the time, how those are fecundated which did not exist there? But when we consider that in the common spider, according to Audebert, the fertilizing effect continues for *many years*; and that the fecundation of the eggs of the female aphides or green lice, by the males of one generation, will continue for a year, passing, during that period, through *nine* or *ten successive generations* of females, the causes for doubt will, I think, be greatly diminished: at any rate we are not at liberty to reject the evidence of facts, because we cannot understand their modus operandi. With respect to the aphis, Bonnet says the influence of the male continues through *five* generations, but Lyonnet carried his experiments to a more extended period; and according to Messrs. Kirby and Spence, who give it "upon the authority of Mr. Wolnough of Hollesley (late of Boyton) in Suffolk, an intelligent agriculturist, and a most acute and accurate observer of nature, there may be *twenty* generations in a year." Reaumur has proved that in *five* generations one aphis may be the progenitor of 5,904,900,000 descendants. It may be objected to me here, that the aphis is a viviparous insect, and that the experiments which prove what I have referred to, do not therefore

bear upon the question. It has been ascertained, however, that they are strictly oviparous at the close of the year (one species is at all times so), at other times ovoviviparous; and in either case the penetrating influence of the male sperm is surely still more remarkable where there has been no immediate commerce with the male, than in the direct case of the oviparous bee! It has been observed, however, that the further the female aphides are removed from the first mother, or that which had known the male, the less prolific do they become. In order to put my readers in possession of Dr. Fleming's opinion upon this subject, I will quote what he has said in his Philosophy of Zoology. "Impregnation, in insects, appears to take place while the eggs pass a reservoir containing the sperm, situated near the termination of the oviduct in the vulva. In dissecting the female parts, in the silk-moth, says Mr. Hunter, I discovered a bag, lying on what may be called the vagina or common oviduct, whose mouth or opening was external, but it had a canal of communication betwixt it and the common oviduct. In dissecting these parts, before copulation, I found this bag empty; and when I dissected them afterwards, I found it full. (Phil. Trans. 1792. p. 186.) By the most decisive experiments, such as covering the ova of the unimpregnated moth, after exclusion, with the liquor taken from this bag, in those which had had sexual intercourse, and rendering them fertile, he demonstrated that this bag was a reservoir for the spermatic fluid, to impregnate the eggs, as they were ready for exclusion, and that coition and impregnation were not simultaneous." Linnæus thought that there was a sexual intercourse between the queens and the drones, and he even suspected that it proved fatal to the

latter. His opinion, on both these points, seems to be confirmed by the experiments of Huber; who ascertained by repeated observations on newly impregnated queens, Fuci organum, post congressum, in corpore feminæ hæsisse, undè exitus fatalis expectandus esset; ita autem accidere re verâ non liquet. Mr. Golding has had sufficient evidence of this fact to remove from his mind all doubt respecting it, and Mr. Dunbar has actually had the most complete ocular demonstration of it. "Apum regina et mater," says Mr. Kirby, "in sublime fertur maritum infelicem petens, qui voluptatem brevem vitâ emat." Reaumur thought sexual union necessary to impregnation, and tried many experiments to ascertain the fact; such as confining a queen under a glass in company with drones: and these experiments were repeated by Huber. Both these naturalists witnessed the solicitations and advances of the queens towards the drones, nihilominùs, coeuntia tempore quovis conspicere non possent. Reaumur *fancied* he saw it; there is, however, very great reason to believe that he was mistaken: the queens so exposed all proved barren. Swammerdam asserted that clipping the wings of queens rendered them sterile, a fact which militates very much against his own theory of impregnation being produced by a seminal aura, but strongly confirms the theory of Huber; as in all probability the mutilating experiments of Swammerdam were made upon virgin queens, which thereby lost the power of quitting the hives. Huber found that clipping the wings of *impregnated* queens produced no effect upon them; it neither diminished the respectful attentions of the workers, nor interfered with their laying of eggs. Why impregnation can only take place in the

open air and when the insects are on the wing, at present remains a mystery.

The young virgin queens, generally, set out in quest of the males, the day after they are settled in their new abode, which is usually the fifth day of their existence as queens, two or three days being passed in captivity, one in the native hive after their liberation, and the fifth in the new dwelling. Butler witnessed the excursions of the queens, and speaks of the attentive manner in which a party of workers accompany them.

The ancients seem to have been very solicitous to establish for the bees a character of inviolable chastity: Pliny observes, "Apium enim coitus visus nunquam." And Virgil endeavours to support the same opinion:

> "But of all customs which the bees can boast,
> 'T is this that claims our admiration most;
> That none will Hymen's softer joys approve,
> Nor waste their spirits in luxurious love:
> But all a long virginity maintain,
> And bring forth young without a mother's pain."

It was the opinion of most ancient philosophers that bees derived their origin from the putrid carcases of animals. *Vide*, Chap. ii. Some also have supposed them to proceed from the parts of fructification in flowers. Virgil, borrowing as usual from Aristotle, among the rest:

> "Well might the Bard, on fancy's frolic wing,
> Bid, from fresh flowers, enascent myriads spring,
> Raise genial fermen in the slaughter'd steer,
> And people thence his insect-teeming year;
> A fabled race, whom no soft passions move,
> The smile of duty nor the glance of love." EVANS.

"To vindicate, in some measure, the character of the insect queen, Mr. Wildman boldly dared to stem the torrent, and revive the long-forgotten idea suggested by Mr. Butler in his *Feminine Monarchy*, that queens produce queens only, and that the common bees are the mothers of common bees." But all these fanciful notions must yield to the clear and decisive experiments of Huber, who has satisfactorily shown that *the queen is the general mother of all*; he has also resolved the causes of former mistaken opinions. Many apiarians have found a difficulty in admitting the theory of Huber, in consequence of the very great disproportion in the number of the sexes, there being only one female to several hundred males, and one impregnation being, in his opinion, all that is required to fertilize myriads of eggs. The number of drones may be considered as in accordance, in some degree, with the general profusion of nature: we find her abounding with supernumeraries in a great variety of instances, in the blossoms of trees and flowers, as well as in the relative number of one sex to the other among animals. Huber conceives that it was necessary there should be a great number of drones, that the queen might be sure of finding one, in her excursion through the expanse of the atmosphere, and run no risk of sterility.

In page 28, I have stated the opinion of Mr. Dobbs, that a queen has intercourse with several drones; and what I have also stated upon the authority of Mr. Hunter, in page 34, with respect to the silk-moth and other insects, gives countenance to that opinion: nor do I see its inconsistency with the discovery made by Huber. Though there is reason to believe that the act proves

fatal to one devoted drone, yet those that are so fortunate as to obtain the first favours of her majesty, may escape uninjured. If the conjecture which I have thus hazarded be correct, it will appear less surprising that so many drones should be brought into existence.

As soon as a few portions of comb are completely formed the queen begins to lay eggs in the cells, and when making this first deposit is very numerously surrounded, her attendants clinging to one another, and forming a living curtain before her, so completely impenetrable to our eyes as to preclude all observation of her proceedings: unless the leaf-hive of Huber be employed or the mirror-hive of Mr. Dunbar, it is hardly possible to catch a glimpse of her excepting when she lays her eggs near the exterior parts of the combs. By the time that combs five or six inches square are constructed, eggs, honey, and bee-bread will be found in them.

Huber states that *the laying usually commences forty-six hours after the intercourse with the male; and that during the eleven succeeding months, worker-eggs only are laid; after which a considerable and uninterrupted laying of drone-eggs commences.* Subsequent observation and experience have shown this statement to be incorrect. Huber evidently conceived that there was a difference between the eggs originally destined to royalty and those that are intended on their first deposition to become workers; and seeing that royal cells were regularly constructed at intervals, from about the commencement till the end of the fourth week after drone-eggs began to be laid, he took it for granted that no female-eggs were laid during that week, but those called

royal; whereas had his attention been directed to the actual state of his hives at this period, he would have found them to contain a certain portion of worker-brood, of all ages, and have been convinced that during the whole period occupied in the laying of drone-eggs, constructing and tenanting the royal-cells, the usual deposits are also generally made in worker-cells. My attention was first directed to this erroneous notion of Huber by my intelligent friend Mr. Golding, whose penetrating mind suffers nothing to escape him, which intellectual energy and patient observation can elicit. Of his correctness in the present instance, any one who possesses one of the hives to be hereafter described may readily satisfy himself.

The period at which the queen begins to lay may be retarded by the temperature of the atmosphere. Huber relates an instance where, the weather having become suddenly cold, after an impregnation which took place on the 31st of October, that queen did not lay till the March following. The effects of retardation will be noticed presently.

After the queen has completed her chief deposit of worker-eggs, she increases very much in size and moves heavily: in this state she begins to lay drone-eggs, the workers having already prepared cells for their reception. She continues this laying for about twenty-eight or thirty days. *At about the twentieth day the workers construct the* ROYAL CELLS, *in which the queens (without discontinuing the laying of eggs in other cells, both drone and worker,) deposit, at the interval of one, two, or three days, those eggs from which the queens are successively to spring.* It has been said that there is never more than one of these deposits in a day, and where

their amount is small, this statement is probably correct; but it is also probable that there are occasional departures from it, for Butler tells us that he was informed by a friend, on whom he could rely, that a hive, in one season, had given birth to no less than *seventeen princesses**. After the emigration of a swarm and a cast, the supernumeraries were severally brought out dead.

The laying of drone-eggs, which is called the great laying, usually commences at the end of April or the beginning of May. There seems to be a secret relation between the production of these eggs, and the construction of royal cells; for regularly on the 20th or 21st day (if at all), as has been already observed, royal cells are founded. *About the time when the larvæ, hatched from the eggs laid by the queen in the royal cells, are ready to be transformed to nymphs, (sometimes sooner, sometimes later, depending on circumstances which will be hereafter detailed), this queen generally leaves the hive, conducting a swarm along with her.*

A first swarm is always led off by the old queen; and Huber remarks that this is a wise provision of nature, for, being the strongest, she would never fail to overthrow the younger competitors for the throne, near which "the jealous Semiramis of the hive will bear no rival." The queen, having finished her laying of male eggs, and her deposition of female eggs in the royal cells, prior to her quitting the old hive, is ready to commence in the new one with the laying of worker-eggs, workers being first needed in order to secure the continuance and prosperity of the newly-founded commonwealth. The bees that remain in the old hive have been sup-

* Vide Chap. xxxii.

posed to guard with particular care the royal cells, in order to prevent the young queens successively hatched from leaving them, except at an interval of several days from each departure of a swarm, or at the moment of swarming. But I have already adverted to their mode of proceeding on these occasions, vide page 18, and shall enter more fully into the subject in Chap. xiv. *The law of primogeniture* is always strictly observed towards these royal insects, the first-born or princess-royal being always selected to assume the sovereignty over the new colony, or, if vacant, to occupy the throne in its native home; and so on with respect to the third and fourth, or whatever number may issue. These after-swarms, however, particularly the later ones, are often accompanied by more than one princess, several of them frequently obtaining their liberty at the same time; owing, in all probability, to the guards no longer keeping a strict watch over them, in consequence of the bustle of swarming. In these cases, the victorious in combat assumes the sovereignty over the new colony *. Such a ferment occasionally rages in the hives, as soon as the young queens are hatched, that Huber has often observed the thermometer placed in the hive rise suddenly from about 92° to above 104° Fahrenheit. This suffocating heat he considers as one of the means employed by nature for urging the bees to go off in swarms. *In very warm weather one strong hive has been known to send off four swarms in eighteen days.*—Vide Chap. xiii.

According to Huber, *the queen ordinarily lays about* 12,000 *eggs in two months*, one impregnation serving,

* It is remarkable that a queen seldom, if ever, leads forth a first swarm, except there be sunshine and calm air, a circumstance which will be explained in Chap. xiv.

as has been before stated, for the whole complement of eggs, of every description, which she lays during two years at least. It is not to be supposed that she lays at the rate of 12,000 eggs every two months, but she does so at the principal laying in April and May. In July there is usually a relaxation in the deposition of eggs, in August it increases again considerably, but is far below the spring laying in point of numbers. With longer or shorter intervals this continues till early in November, when there is usually a cessation. In the interval between these two *important* layings (viz. in July) Swammerdam found the eggs in the appendages of the oviducts were not so large or perfect as those in the prolific queens of May and August. This state of the hive leads the cottagers to take their honey early in August, because they find the hives in general contain but little brood at that time. Reaumur states the number of eggs laid by a queen in two months at double the amount of Huber's calculation; viz. 200 a day, on an average. This variation may have arisen from variety of climate, season, or other circumstances. *A moderate swarm has been calculated to consist of from* 12,000 to 20,000 bees, about equal to a two months' laying. Schirach says, that *a single queen will lay from* 70,000 to 100,000 *eggs in a season*. This sounds like a great number, but it is much exceeded by some other insects. The female of the white ant extrudes not less than 60 eggs in a minute, which gives 3600 in an hour, 86,400 in a day, 2,419,200 in a lunar month, and the enormous number of 211,449,600 in a year. Though she does not lay all the year probably, yet, setting the period as low as possible, her eggs will exceed the number produced by any other known animal in creation.

If the *impregnation* of a queen be by any means *retarded* beyond the 20th or 21st day of her life, a very extraordinary consequence ensues. Instead of first laying worker-eggs, and drone-eggs at the usual period afterwards, she begins from the 45th hour to lay the latter, and lays no other during her whole life. It should seem as if the rudiments of the worker-eggs withered in the oviducts, but without obstructing the passage of the drone-eggs. The only known fact analogous to this is the state of certain vegetable seeds, which lose the faculty of germination from age, whatever care may have been taken to preserve them. This retardation seems to have a singular effect upon the whole animal œconomy of the queen. "The bodies of those queens," says Huber, "whose impregnation has been retarded, are shorter than common; the extremities remain slender, whilst the first two rings, next the thorax, are uncommonly swollen." In consequence of the shortening of their bodies, their eggs are frequently laid on the sides of the cells, owing probably to their not being able to reach the bottom; the difficulty is also increased by the two swollen rings. In these cases of retarded impregnation and exclusive laying of drone-eggs, the prosperity of the hive of course terminates with the lives of the workers.

These retarded queens seem to have their instincts impaired, for they deposit their eggs indiscriminately in the cells, whether originally intended for drones or for workers,—a circumstance which materially affects the size of the drones that are reared in them. There are not wanting instances of royal cells being occupied by them, and of the workers being thereby so completely deceived as to pay the tenants, in all respects, the ho-

nours of royalty. This circumstance appears the more extraordinary, since it has been ascertained that when eggs have been thus inappropriately deposited by *fertile workers*, they are uniformly destroyed a few days afterwards, though for a short time they receive due attention.

If the impregnation of a queen be retarded beyond the fifteenth day, and have not reached the twenty-first, a portion of female eggs will be laid, but a still larger portion of male eggs; a fact which may account for the disproportionate success of different stocks or swarms in the same apiary. Feburier relates a remarkable instance of this, but which he only adduces as evidence of first swarms being led off by old queens. It was a case in which the impregnation of the queen had been retarded the summer preceding by the unfavourable state of the weather, which is often wet and cold in the neighbourhood of Versailles (Feburier's residence). In this hive he found, as early as the middle of March, a considerable number of drones and a great deal of drone-brood. Contrary to his expectation, a swarm issued from it. The natural order of things was then restored. The old queen had of course accompanied the swarm, and her successor in the stock-hive commenced the usual laying of worker-eggs. On examining the *swarm* three weeks afterwards, it was found, as might have been expected, to contain drone-brood. But from some cause, which Feburier does not state, he was unable to keep up a regular chain of observation, for he says, "on examining the combs anew,"—but without telling us what time had intervened betwixt the two examinations,—"I found there none but worker-brood; the drones had been killed, and the drone-brood thrown out." But we are left in doubt as to whether this altered condition of the

hive was owing to the old queen having assumed a natural state, or to her having been supplanted by a successor, or whether any of the drone-combs had given place to worker-combs. In some parts of France the drones are called *hatchers*, and hence the swarms which are accompanied by retarded queens are called hatcher-swarms; and those French bee-masters from whose apiaries such swarms have issued, all assure M. Feburier that the result has, in the main, accorded with that which occurred to himself, and that unless the retarded queen goes off with a swarm, the stock always perishes.

The workers have been supposed by some apiarians to transport the eggs from place to place; if such were ever the case, this would seem to be an occasion calling for the practice: on the contrary, instead of removing the eggs from the sides to the bottoms of the cells, for the sake of better accommodation, this object is accomplished by their lengthening the cells, and advancing them two lines beyond the surface of the combs. This proceeding affords pretty good evidence that *the transportation of eggs* forms no part of the workers' occupation. It is still further proved by their eating any worker-eggs that a queen may, at any time, be forced to deposit in drone-cells, or drop at random in other parts of the hive; a circumstance which escaped the notice of former naturalists, and misled them in their opinion respecting transportation. A somewhat similar occurrence was noticed by Mr. Dunbar in his mirror-hive. (For an account of this hive, see Chap. ix.) Mr. D. observed, that whenever the queen dropped her eggs carelessly, they were eagerly devoured by the workers. Now, if transportation formed a part of their employment, they would, in these cases, instead of eating

the eggs, have deposited them in their appropriate cells. It seems very evident, therefore, that the proper disposition of the eggs is left entirely to the instinct of the queens. The workers having been seen to run away with the eggs in order to devour them, in all probability gave birth to the mistaken notion that they were removing them to their right cells. Among humble bees the workers have a disposition to eat the eggs, which extends even to those that are laid in proper cells where the queens often have to contend for their preservation.

After the swarming season is over, viz. towards the end of July (in dry summers sooner), a general *massacre of the drones* takes place: the business of fecundation being now completed, they are regarded as useless consumers of the fruits of others' labour, "fruges consumere nati;" love is at once converted into furious hate, and a general proscription takes place. The unfortunate victims evidently perceive their danger; for they are never, at this time, seen resting in one place, but darting in or out of the hive with the utmost precipitation, as if in fear of being seized. Their destruction has been generally supposed to be effected by the workers harassing them, till they quit the hive: this was the opinion of Mr. Hunter, who says the workers pinch them to and fro without stinging them, and he considers their death as a natural rather than an untimely one. Bonnet seems to agree with Mr. Hunter; but Huber, by placing his hives upon a glass-table, through which the proceedings of the bees could be observed, says, he ascertained that *the destruction of the drones was effected by the stings of the workers*; vide Chap. xxix, article Sting. Butler and Reaumur seem also to have been of this opinion; and the latter has remarked, that "notwith-

standing the superiority which the drones seem to have from their bulk, they cannot hold out against the workers, who are armed with a poniard which conveys poison into the wounds it makes." The moment this formidable weapon has entered their bodies, they expand their wings and expire. Pliny also has spoken decidedly to this point: "Certum est Apibus Fucos interfici." Though this mode of destroying the drones may be sometimes practised *within* the hives, yet many (probably the greater portion) appear to be merely expelled or disabled in their wings, at the roots of which the workers may frequently be seen worrying them, and great struggles in front of the hives take place at this season, from which, though many a drone escapes, it is apparently with but little desire to return.

This sacrifice of the drones is not the consequence of a blind indiscriminating instinct; for *if a hive possess fertile workers, and no proper queen, or one whose impregnation has been retarded, or have in any way been deprived of her, no massacre of the drones takes place*, though the hottest persecution rage in the surrounding hives. Bonner, who had witnessed such a condition of his hives, supposed the drones to be preserved for the sake of the additional heat which they would generate *during winter*! Huber conceived it was to impregnate a new queen. Both these naturalists seem to have thought, that where no massacre took place, the drones survived the winter. But from what will be stated in Chap. xxix, I think it will appear probable that, under all circumstances, those which are brought into existence at the usual period disappear before winter, and that the *natural* term of their lives does not exceed four months. So convinced are some apiarians of their non-importance

when the swarming season is over, that they take pains soon after to destroy them as mere useless consumers; for this purpose Reaumur tells us that M. de Moral, a lieutenant of artillery at Saumur, invented a valve which admitted both ingress and egress to the workers, but allowed only egress to the drones.

At the time of this general massacre, not only all the drones that have undergone their full transformations, but every embryo, in whatever period of its existence, shares the same fate, the maxim with bees being to attend to the general welfare of the community, and to allow none to eat that are not useful in some way. The workers, therefore, drag forth even the young drones from the cells, and, after sucking the fluid from their bodies, cast them out of the hive. In all these respects the hive-bees resemble wasps, but with this difference; among the latter, not only are the males and the male larvæ destroyed, but all the workers and their larvæ (and the very combs themselves,) are involved in one indiscriminate ruin, none remaining alive during the winter but the queens, which lie dormant in various holes and corners till the ensuing spring,—of course without food, for they store none. The importance of destroying these mother wasps in the spring, will be noticed in another place.

Morier, in his second journey through Persia (page 100), has recorded a fact, which, though it did not come under his own immediate observation, was related to him by a person on whose authority he could place full reliance, and which is directly the reverse of what I have stated respecting bees. It is, that among the locusts, when the female has done laying, she is surrounded and killed by the males.

CHAPTER II.

THE APIARY.

THE first object of consideration in the establishment of an apiary is situation.

The aspect has in general been regarded as of prime importance; but I think there are other points of still greater.

Excepting in peculiarly sheltered nooks, an apiary would not be well situated near a great river, nor in the neighbourhood of the sea, as in windy weather the bees would be in danger of drowning from being blown into the water. It was the opinion of the ancients that bees, in windy weather, carried weights, to prevent them from being whiffled about in their progress through the air. Virgil has observed that

> "They with light pebbles, like a balanc'd boat,
> Pois'd through the air, on even pinions float."
>
> SOTHEBY'S GEORGICS.

This assertion, which was probably borrowed by the poet from his predecessor Aristotle, and which was afterwards repeated by Pliny, is now ascertained to be erroneous. The error has been noticed by both Swammerdam and Reaumur, and ascribed by them to preceding observers having mistaken the mason-bee for a hive-bee. The former builds its nest against a wall, with a composition of gravel, sand, and its own saliva, and when freighted with the former article, may easily have led a

careless observer into the erroneous opinion above alluded to.

From a similar inaccuracy of observation, it is probable that flies were confounded with bees by ancient naturalists, and that from thence arose the absurd notion of the latter being generated in putrid carcases, as we know the former to be; and this error was most likely confirmed by their having found both honey and bees in the carcases of dead animals, as recorded in the case of Samson.

Though, for the reasons above stated, an apiary would not be well situated near a large river, yet it should not be far from a rivulet or spring: such streams as glide gently over pebbles are the most desirable, as these afford a variety of resting-places for the bees to alight upon. In default of these natural resources, an artificial supply of water should be substituted in a shallow pan, with layers of small stones at the bottom, to prevent the submersion of the bees. This accommodation in a hot dry season is of considerable importance, as it saves that time which must otherwise be spent in fetching water from a distance; for without water no wax can be formed.

It is of course of the greatest importance that the apiary be situated near to good pasturage, such as clover, saintfoin, buckwheat, &c., and the garden in which the hives are situated should be well stocked with suitable plants.

It should be near the residence of the proprietor, as well for the purpose of familiarizing the bees with his family as for affording a good view of their general proceedings; if so situated that its front may form a right angle with the window of the family sitting-room, an

easy opportunity will be afforded to watch the bustle of swarming.

An out-door apiary should admit of being approached at the back part, to give an opportunity of making observations on the proceedings of the bees, or to perform any requisite operation upon them.

The hives should be placed upon separate stands, supported by single posts or pedestals, three or four feet from each other. They should stand quite clear of any wall or fence, and be raised from eighteen inches to three feet above the ground. The cottagers, particularly in exposed situations, are in the habit of placing their hives much nearer the ground, to prevent their being overturned in windy weather; but it would seem more salubrious for the bees to be placed out of reach of the wintry exhalations which rise from the earth. Mr. Butner, speaking of the culture of bees in forests, says he considers that their situation in high trees is favourable to their health, from the superior purity and dryness of their atmosphere.

The stones or resting-boards on which the hives are placed project several inches in front of the hives, that the bees may have plenty of room to alight when they return home loaded from the fields; should have a *gentle* slope forwards to prevent any moisture from lodging upon them, and be screwed down firmly to the tops of the stands, that the hives may not be overturned by high winds or other accidents. For external protection, vide Chap. VIII. Hives.

The hives should be guarded as much as possible from the extremes of heat and cold, should not be exposed to the drippings of trees, nor be in the vicinity of noisome smells nor disagreeable noises, neither should

the bees be subjected to the interruptions occasioned by a public footpath.

Most apiarians are agreed that the aspect of the apiary should, in this country, be more or less southerly, varying to the east or west according to its situation as respects the protection it may receive from trees, buildings, or high grounds, or as it may be exposed to particular currents of air or prevailing winds. As a general rule, I recommend that on the eastern side of the British Isles its frontage should have an inclination to the west, and *vice versâ* on the western side.

Milton says, "It is not material in what aspect the stock stands, provided the sun shines upon the hive once in the course of the day, as well-peopled hives, kept dry, will thrive in most situations." And where due attention has been paid to other circumstances calculated to promote their prosperity, I have known them thrive in almost every aspect.

Some recommend a valley or hollow glen, for the convenience of the bees returning home with their loads. At any rate care should be taken that no walls, trees, houses, nor anything else, impede the issuing forth of the bees to their pasturage, nor obstruct their return in right lines to the hives. They should be able to fly off from the resting-boards at an angle of about forty degrees with the plane of the horizon.

Wherever an apiary be planted great attention should be paid to neatness in every part; it should be kept as free as possible from spiders and other insect intruders, and no weeds should be suffered to grow in its immediate vicinity, for these, when long, frequently entangle a weary bee, and render it a prey to various enemies to which the weeds afford shelter and concealment.

To those who, residing in towns, may consider it indispensable to the success of an apiary that it should be closely surrounded by good pasturage, and be thereby deterred from benefiting and amusing themselves by keeping bees, it may be satisfactory to learn that the apiary of the celebrated Bonner was situated in a garret in the centre of Glasgow, where it flourished for several years, and furnished him with the means of making many interesting and valuable observations, which he gave to the world about fifty years ago.

CHAPTER III.

THE BEE-HOUSE.

No one who could afford to purchase bee-boxes and construct a bee-house, or to convert to that use some building already erected, would hesitate, I should think, to give them the preference over common straw-hives and an out-door apiary, as well for comfort and convenience as for security. It is by no means an unfrequent occurrence for bees to take up their residence in human habitations, and in such cases to afford large quantities of honey. May not this be attributed to the superior shelter which such habitations afford them from the vicissitudes of the seasons? See an account of Vives's bees in Chap. XXXI.

The whole building, besides answering the purpose of an apiary, may be made subservient to other uses;—my own serves for storing potatoes. The potato cellar is built with bricks, and sunk two-thirds of its depth in the earth; and the bee-house, which is construeted with timber, lathed and plastered both within and without, is raised upon it, having several steps up to the door. The advantage of such elevation has been referred to in the last chapter. The dimensions of the house are seven feet square in the clear, which affords room for seven colonies; three in front, and two at each end. These dimensions may of course be varied to meet the views and means of each respective bee-master.

The piles or stories of bee-boxes are placed within the building at somewhat less than two feet apart, so as to

make the external entrance to each pile respectively about a yard asunder. See the plate which forms the frontispiece of this work, exhibiting three protected entrances.

The boxes should be ranged upon a shelf, from six to twelve inches above the floor of the house. The external entrances should be at least four feet from the ground, and nearly on a level at their lower parts with the shelf within; their height and width must not of course be less than that of the box-entrances; and, to afford accommodation to the bees when freighted with their various collected treasures, a wooden shelf or resting-board should be fixed against the front of the bee-house, two or three inches thick, to prevent warping and extending through its whole length; it should be a foot wide and rest on cross pieces nailed fast to the uprights with which the house is built: these cross pieces should extend also far enough into the interior of the building to serve as supporters to another shelf, fifteen inches wide, on which the bee-boxes are to be ranged. The resting-board should be divided into several compartments, by bricks on the edge, slated over, and should extend the whole width of the board. *Vide* Frontispiece. By this means the entrances will be well sheltered, and accommodation afforded for the bees when they are at any time driven home, by stress of weather, in greater numbers than can readily pass through the entrances into the boxes; for, on the approach of a storm, they will sometimes return home from the fields in such numbers, and with such precipitation, as almost to block up the entrances into the hives. This outward protection serves also to keep the alighting boards dry, which is of considerable im-

portance to the bees on their return home in cool weather.

The building is not only thatched thick on the top, but down the sides and ends, as low as the potato-cellar. On that side where the bees enter the boxes, the thatch of course terminates at the top of the compartments, over which it is spread out so as to conceal the slate coverings. The floor of the bee-house is boarded and the potato-cellar ceiled; the space between the ceiling and the floor above being filled with dry sawdust. The door should be situated at the back of the house, the windows one at each end, for the purpose of ventilation; a precaution sometimes necessary in very hot weather, which now and then occasions the wax to become so much softened as to endanger a separation of the loaded combs from their attachments; and it will be desirable to have the windows hung upon centre pins, as this will afford the greatest facility for giving an exit to any bees that may accidentally get into the bee-house.

Bee-houses might be so constructed in gentlemen's pleasure grounds as not only to be interesting and useful, but highly ornamental, and be advantageously substituted for those fancy erections which often serve merely as objects to adorn the parterres and shrubberies of the opulent.

CHAPTER IV.

PASTURAGE.

It is of the first importance to the success of an apiary, that it should be in a neighbourhood where the bees can be supplied with an abundance of good pasturage, as upon that will depend the fecundity of the queen and the harvest of wax and honey.

If *Dutch clover* (*Trifolium repens*) be neither grown abundantly by the neighbouring farmers, nor the spontaneous growth of the surrounding country, the apiarian should, if possible, crop some ground with it himself, as it is one of the grand sources from which bees collect their honey in the spring, and indeed during a considerable portion of the principal gathering season. From the value of clover in this respect, one species of it (*Trifolium pratense*) has acquired the name of Honeysuckle clover. *Yellow trefoil* also (*Medicago lupulina*), though not so great a favourite with the bees as Dutch clover, is nevertheless a valuable pasturage for them, in consequence of its blossoming earlier than the clover.

Though I have made Dutch clover take precedence of every other bee pasturage,—a precedence to which, at least in this country, it is fairly entitled,—yet it is by no means the first in the order of the seasons.

> "First the gray willow's glossy pearls they steal,
> Or rob the hazel of its golden meal,
> While the gay crocus and the violet blue
> Yield to the flexile trunk ambrosial dew." Evans.

The earliest resources of the bee are *the willow**, *the hazel*, *the osier*, *the poplar*, *the sycamore* and *the plane*, all of which are very important adjuncts to the neighbourhood of an apiary. The catkins of several of them afford an abundant supply of farina, and attract the bees very strongly in early spring when the weather is fine. Mr. Kirby, in his *Monographia Apum Angliæ*, considers the *female* catkins of the different species of Salix as affording honey, the *male* ones, pollen.

To these may be added *the snowdrop*, *the crocus*, *white alyssum*, *laurustinus*, &c.

Orange and *lemon trees* also, and other *greenhouse plants*, afford excellent honey, and might be advantageously presented to the bees at this season.

Gooseberry, *currant* and *raspberry trees*, with *sweet marjoram*, *winter savory* and *peppermint*, should not be far off them. From the early blossoming of the two first, and from their yielding an extraordinary quantity of honey, they form some of the first sources of spring food for bees, and in all probability furnish them with the pale green pellets then seen upon their thighs.

The peach, *nectarine*, &c. are also valuable, on account of their blossoming very early.

Apple and *pear trees*, which in Worcestershire and Herefordshire, during several weeks of spring, seem to form

> "One boundless blush, one white empurpled shower
> Of mingled blossoms,"

and give those counties the appearance of a perfect

* The extraordinary quantity of honey collected from the willow, in particular, will be noticed hereafter.

paradise, "may be said to constitute a second course for the bees, after their earlier spring feast on the willows and on the bloom of the currants, gooseberries, and all the varieties of wall fruit."

Alder buds and *flowers* are particularly grateful to bees; the former are said to afford honey for six months together. The maple and the lime also afford it for a considerable time.

Dickson, in his "Agriculture," states that the blossoms of *the bean*, which are highly fragrant, though affording but a scanty supply of honey, are nevertheless frequented by crowds of bees. "Is this," says Dr. Evans, "an instance of mistaken instinct?"

Mr. Golding has observed, that the blossom of the bean is not so attractive to bees as the black spots upon the footstalks of its leaves; to visit these he has seen a bean field crowded with bees, prior to the appearance of a single blossom.

The young spotted leaves of *the vetch* (*Anthyllis vulneraria*), they likewise ply continually for three months together, even though very distant from their homes, not one in ten settling upon its blossoms.

From the partiality of these natural chemists for the spotted leaves of the vetch and bean, I suspect that the spotting originates from disease, which causes those leaves to throw out a honeyed secretion. In this opinion I am strengthened by what Mr. Hubbard has stated, in a paper presented to the Society of Arts for 1799, respecting papilionaceous plants. "It is not," says he, "from the flower, but a small leaf, with a black spot on it, which, in warm weather, keeps constantly oozing, that the bees gather their honey." Mr. Hubbard also assures us in the same paper that *the tare*

(*Ervum hirsutum* et *tetraspermum*) is highly useful to bees, and that several acres sown near his apiary, otherwise badly situated, rendered it very productive.

The blossoms of *turnips*, *mustard*, and all *the cabbage tribe* are also important auxiliaries; their culture is strongly recommended by Wildman, as affording spring food to the bees. In the autumn a field of *buckwheat* becomes a very valuable resource for them, from its prolonged succession of bloom. Buckwheat flowers in bunches, which contain ripe seeds in one part, while blossoms are but just opening in another. Huber has given his testimony in favour of this black grain, and Worlidge says that he has known the bees of a very large apiary fill the combs with honey in a fortnight in consequence of being placed near a large field of buckwheat. Bees indeed like to have everything upon a large scale; whole fields of clover, beans, the brassica tribe, and buckwheat attracting them much more strongly than scattered plants, though affording finer honey, such as creeping lemon thyme, mignonette, &c.

Some flowers they pass by, though yielding a considerable quantity of honey: those of the honeysuckle for instance, though much frequented by the humble-bee, are never visited by the hive bee, the superior length of the proboscis of the former enabling it to collect what is quite out of the reach of the latter. Every flower of the trumpet honeysuckle (*Lonicera sempervirens*), if separated from the germen, after it is open, will yield two or three drops of pure nectar.

In the Transactions of the Society of Arts for 1789, Mr. John Lane speaks of the fondness of bees for *leek blossoms*, and says that he raised leeks extensively for their use. In some districts of South Wales, where leeks

and onions are cultivated extensively for seed, their blossoms, towards the end of summer, are crowded with bees, and the honey collected at this period in such districts receives a manifest alliaceous impregnation.

"Your bees will rejoice," says Mr. Isaac, "when they see the neighbourhood variegated by the blossoms of *sunflowers*, *hollyhocks* and *Spanish broom*, and even the *dandelion*, which embellishes the garden of the sluggard." Dr. Evans observed that bees not only collect farina from the numerous assemblage of anthers in the flower of the hollyhock, but a balsamic varnish also, (most likely propolis,) from the young blossom buds, and says he has seen a bee rest upon the same bud for ten minutes at least, moulding the balsam with its fore feet and transferring it to the hinder legs. An elegant modern writer, speaking of the fondness of bees in general for the flowers of the hollyhock, observes that "it has been held a gross libel upon animals to say, that a man has made a beast of himself, when he has drunk to such excess as to lose his reason; but we might without injustice say, that he has made a humble-bee of himself, for those little debauchees are particularly prone to intoxication. Round the nectaries of hollyhocks, you may generally observe a set of determined topers quaffing as pertinaciously as if they belonged to Wilkes's club; and round about the flower, (to follow up the simile,) several of the bon-vivants will be found lying on the ground inebriated and insensible." I have frequently seen the ground beneath one of my pear-trees strewed over with hive-bees and wasps, in a similar state, after they had banqueted upon the rich juices of the fallen fruit. Mr. Kirby, in his *Monographia Apum Angliæ*, observes that the male humble-bees, when the thistles are in bloom,

are often seen asleep or torpid upon the flowers, and sometimes acting as if intoxicated with the sweets they have been imbibing.

The holly, the privet, phillyrea, and *common bramble,* together with *sweet fennel, nasturtiums* and *asparagus,* are also much frequented by the bees. They are likewise very partial to the yellow flowers of *the crowfoot,* as well as to the flowers of *dead nettle,* especially the white.

The blossoms of *the cucumber, gourd* and *vegetable marrow* also, yield a considerable quantity both of honey and farina, as do likewise those of the *white lily.*

"Apes æstate serenâ
Floribus insidunt variis, et candida circum
Lilia funduntur." VIRGIL.

Dr. Evans speaks of the *Cacalia* or *Alpine coltsfoot* as affording a great quantity of honey, the scent of which is often diffused to a considerable distance; and Dr. Darwin, in a note to his "Botanic Garden," mentions having counted on one of those plants, besides bees of various kinds, upwards of two hundred painted butterflies, which gave it the appearance of being loaded with additional flowers.

"When o'er her nectar'd couch papilios crowd,
And bees in clusters hum their plaudits loud." EVANS.

"What is it," says the anonymous writer whom I lately quoted, "that brings the bees buzzing round us so busily? See, it is this tuft of coltsfoot, which they approach with a harmonious chorus, somewhat like the *Non nobis, Domine,* of our singers; and after partaking silently of the luxurious banquet, again set up their tuneful Pæans."

Ornamental flowers, such as roses, ranunculuses, anemones, pinks, and carnations afford little or no pabulum for bees, and tulips are probably pernicious to them, dead bees being frequently found in their flowers.

It would be a great acquisition to the bees to have near the large plantation of *borage*, which affords peculia- icate honey, as does also *viper's bugloss*. The form- ntinues blooming for many months, and, bearing a pendent flower, "hanging the pensive head," it is not liable to be washed by rain; *mignonette* (*Reseda adorata*) too if sown abundantly is a plant of considerable importance to the apiary, and for a somewhat similar reason, its continuing in bloom till the autumnal frosts set in, and yielding honey of peculiar whiteness and delicacy. Instances are recorded of an abundant crop of these two flowers affording a large supply of honey to the apiary near which they were sown, when, at the same time, there was a general failure of all the neighbouring stocks.

Lemon thyme should be planted in every bee-garden, wherever room can be afforded: it blossoms late, the beginning of August, and yields very fine-flavoured honey. It might be advantageously used as an edging for garden walks and flower beds, instead of box, thrift, or daisies. Box has the character of giving honey a bitter flavour, and Pliny has observed that the Romans, in laying tribute upon Corsica, exacted from the inhabitants two hundred pounds of wax, but wholly excepted honey, on account of its being flavoured by the box-tree.

The *common teasel* (*Dipsacus sylvestris*) not only supplies honey from its rich purple heads, but yields a seasonable supply of water in the cups formed by their

leaves at every joint of the stem, which contain from a spoonful to half a pint of water. This, as well as *the great hairy willow herb* (*Epilobium hirsutum*), a very ornamental, though a very common plant, growing by the sides of rivulets, is therefore a desirable adjunct to every apiary.

So likewise are *furze*, *broom*, *heath* and *saintfoin*. The blossoms of furze so abound with honey as to be pervaded strongly by the scent of it, and the broom has been extolled ever since the days of Pliny. Mr. Bradley speaks in the highest terms of its blossoms, as affording a great quantity of honey; but he greatly prefers the *Spanish broom* (*Spartium junceum*), and says that an acre of it would maintain ten stocks. A species of *broom* (*Spartium nubigenum*,) growing abundantly in the Canary Islands, renders the Peak of Teneriffe productive of a very pure and transparent honey, of a delicious aromatic taste, and superior to that of Hymettus. The culture of saintfoin as a bee-pasture is also well worthy of the apiarian's attention in some situations; for though it flourishes best in a calcareous soil, it will thrive in soils which are too poor either for grass or tillage. Furze and broom are particularly serviceable on account of their blossoming early and long, and abounding in farina.

On the other hand, the lateness of its bloom makes *ivy* a very valuable resource for the bees. On a fine day at the end of October, among the ivy-mantled towers of an old castle, I have heard their humming noise, so loud as scarcely to be exceeded by that which they make, among the trees affected with honey-dew, in summer. I should however conceive that the ivy blossom is principally serviceable as affording pollen,

which the bees probably warehouse, for feeding the young larvæ in the ensuing spring. What White says would lead to a somewhat different conclusion. "It is the last flower," says he, "that supports the hymenopterous and dipterous insects." Mr. Hunter recommends St. John's wort (*Hypericum perforatum*), which also comes in late, as a favourite plant for collecting pollen, for winter's store. This stored pollen is used for feeding the earliest hatched larvæ, though it is evident that the bees prefer fresh for the purpose, from their collecting it as early in the spring as possible, and from the quantity that is found in every old hive.

Commons surrounded by woods are well known to make an apiary productive, the commons abounding with wild thyme and various other flowers, which the scythe never touches; and the trees, in addition to their farina, affording in some seasons a profusion of honey-dew. The forwardness and activity of hives thus situated, may, in part, be attributed to the sheltering protection of the woods.

Keys says he never observed bees to be particularly fond of the wild thyme. In this he is opposed to almost all the authors who have written upon the subject. Aristotle, Theophrastus, Pliny, Varro, Columella, and various other writers speak of it in the highest terms *. The Abbé Barthelemy speaks thus of bees:—"These insects are extremely partial to Mount Hymettus, which they have filled with their colonies, and which is covered almost everywhere with wild thyme and other

* "Ego, apis Matinæ
More modoque
Grata carpentis thyma per laborem
Plurimum."—HORACE.

odoriferous plants; but it is chiefly from the excellent thyme the Mount produces, that they extract those precious sweets, with which they compose a honey in high estimation throughout Greece."—Vide Chap. XXVI.

"Here their delicious task the fervent Bees,
In swarming millions, tend: around, athwart,
Through the soft air the busy nations fly,
Cling to the bud, and, with inserted tube,
Suck its pure essence, its æthereal soul;
And oft with bolder wing, they soaring dare
The purple heath, or where the wild thyme grows,
And yellow load them with the luscious spoil."

THOMSON.

That flowers impart a portion of their flavour to honey, seems to be generally admitted, though probably not so much as some have imagined. It is not to be supposed that the bee confines itself, in this country at least, to a few particular flowers,—it ranges through a great variety; excellent honey has been produced where the bees had little access to any flowers but those of nettles and other weeds.

Still however the balm of Pontus, the thyme of Hymettus, and the rosemary of Narbonne, are generally supposed, from their aromatic flowers, to give its peculiar excellence to the celebrated honey of those places.

It should seem therefore that *rosemary* might prove of importance in the neighbourhood of an apiary, by improving the quality and increasing the quantity of honey in certain seasons, viz. if the weather were very hot and dry, when it blossomed; for it never affords much honey in this country, excepting in such a season. It blossoms the earliest of aromatic herbs, and should of course be planted in a southern aspect.

Having said thus much upon the power which flowers

possess of imparting a peculiar flavour to the honey which is extracted from them, I will now advert to what has been stated relative to their impregnating it with deleterious qualities. During the celebrated retreat of the ten thousand, as recorded by Xenophon in his *Anabasis*, the soldiers sucked some honey-combs in a place near Trebizonde, where was a great number of bee-hives, and in consequence became intoxicated, and were attacked with vomiting and purging. A great number of them were so completely overcome as to be incapable of standing, and the ground was so strewed with their bodies, that it resembled a field after a battle. He states that he did not lose a single soldier, but that those who were thus affected seemed like persons who had been suddenly debilitated by a violent diarrhœa. They did not recover their senses for twenty-four hours, nor their strength for three or four days. Tournefert, when travelling in Asia, bearing in mind this account of Xenophon, was very diligent in his endeavours to ascertain its truth, and had good reason to be satisfied respecting it. He concluded that the honey had been extracted from a shrub growing in the neighbourhood of Trebizonde, which is well known to produce the beforementioned effects, and even to disturb the head by its odour. From his description and that of others, the plant from which this honey was extracted, appears to be the *Rhododendron Ponticum* or *Azalea Pontica* of Linnæus, both nearly allied to each other, and growing abundantly in that part of the country. The smell resembles honey-suckle, but is much stronger. Father Lamberti confirms Xenophon's account, by stating similar effects to have been produced by the honey of Colchis or Mingrelia, where the shrub is also common.

Dr. Darwin, in his "Temple of Nature," states that some plants afford a honey which is intoxicating and poisonous to man; and that what is afforded by others is so injurious to the bees themselves, that sometimes they will not collect it. And Dr. Barton, in the American Philosophical Transactions, says that, in the autumn and winter of 1790, the honey collected near Philadelphia proved fatal to many, in consequence of which, a minute inquiry was instituted under the direction of the American Government, when it was ascertained satisfactorily, that the fatal honey had been chiefly extracted from the flowers of the *Kalmia latifolia*. Still more recently, two persons at New York are said to have lost their lives by eating wild honey, which was supposed to have been gathered from the flowers of the dwarf laurel, a thriving shrub in the American woods. I shall resume this subject in Chap. XX. on Bee-maladies.

It appears also that at the time of the inquiry set on foot by the American Government, similar fatal consequences were produced among those who had eaten the common American pheasant, which, on examination, was found to arise from the pheasants having fed upon the leaves of the same plant *Kalmia latifolia*.. This led to a public proclamation prohibiting the use of the pheasant for food during that season. "To the credit of the genus of plants last-named, it should be mentioned that one species (*Andromeda nitida* or *lucida* of Bartram) affords abundance of excellent honey; hence the name of honey-flower is given to it by the country people in Georgia and Carolina, not however merely from the circumstance just mentioned, but from the regular position of the flowers on the peduncle, which open like the cells of a honey-comb, and from the

odour of these flowers, which greatly resembles that of honey."—*Barton.*

As most of the plants here enumerated are now introduced into our gardens, they might be supposed to injure the British honey. Most probably, however, their proportion to the whole of the flowers in bloom is too small to produce any such inconvenience; whereas on their native continent they exclusively cover whole tracts of country.

I cannot close this chapter on Bee-Pasturage, without adverting to what Linnæus has said of the *Fritillaria imperialis* or *crown imperial*, and of the *Melianthus* or *honey-flower*. Of the former, he observes that "no plant, melianthus alone excepted, abounds so much with honey, yet the bees do not collect it." Of the latter he remarks, "that if it be shaken whilst in flower, it distils a shower of nectar." This observation applies more particularly to the *Melianthus major*. And with respect to the *Fritillaria*, Dr. Evans says, "that the bees do sometimes visit it; and he thinks that they would do so oftener, but for the disagreeable fox-like smell that emanates from it."

The *liquidambar* and *liriodendrum* or *tulip-tree*, both which are so ornamental, the former to our shrubberies and the latter to larger plantations, have been much extolled, as affording food for bees. The liquidambar bears bright saffron-coloured flowers, and highly perfumed and glossy leaves, and its whole rind exudes a fragrant gum. The liriodendrum is crowned with large bell-shaped blossoms, of every rainbow hue, which give it a very splendid appearance.

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CHAPTER V.

HONEY-DEW.

The term *honey-dew* is applied to those sweet clammy drops that glitter on the foliage of many trees in hot weather. The name of this substance would seem to import that it is a deposition from the atmosphere, and this has been the generally received opinion respecting it, particularly among the ancients; it is an opinion still prevalent with husbandmen, who suppose it to fall from the heavens. Virgil speaks of "Aërii mellis cœlestia dona:" and Pliny expresses his doubts, "sive ille est cœli sudor, sive quædam siderum saliva, sive purgantis se aëris succus." The Rev. Gilbert White, in his Naturalist's Calendar, regards honey-dew as the effluvia of flowers, evaporated and drawn up into the atmosphere by the heat of the weather, and falling down again in the night with the dews that entangle them. But if this were the case, the fall would be indiscriminate, and we should not have it confined to particular trees and shrubs, nor would it be found upon green-house and other covered plants. Some naturalists have regarded honey-dew as an exudation or secretion from the surface of those leaves upon which it is found, produced by some atmospheric stroke, which has injured their health. Dr. Darwin stands in this class. Others have viewed it as a kind of vegetable perspiration, which the trees emit for their relief in sultry weather; its appearance being never observed in a cold ungenial summer. Dr. Evans is of this opinion, and makes the following com-

parative remark: "As the glutinous sweat of the negro enables him to bear the fervours of his native clime far better than the lymph-perspiring European; so the saccharine dew of the orange, and the fragrant gum of the Cretan cistus, may preserve them amidst the heats even of the torrid zone." Mr. Curtis tells us that the honey-dew is an excrementitious matter, voided by the aphis or vine-fretter, an insect which he regards as the general cause of what are called blights. He assures us that he never, in a single instance, observed the honey-dew unattended with aphides.

His opinion is confirmed by the circumstances of its being generally found upon leaves which have others above them, the under sides of which are inhabited by those insects. They may "be seen distinctly with a strong magnifier, on the leaves of the cherry, lime, &c.; but invariably on the inferior surface, piercing the vessels, and expelling the honey-dew from their hinder parts. They might easily have escaped the observation of the earlier philosophers, from being frequently concealed within the curl of the leaves that are punctured."

I believe it will be found that *there are at least two sorts of honey-dew; the one a secretion from the surface of the leaf*, occasioned by one of the causes just alluded to, *the other a deposition from the body of the aphis*. Sir J. E. Smith observes of the sensible perspiration of plants, that "when watery, it can be considered only as a condensation of their insensible evaporation, perhaps from some sudden change in the atmosphere. Groves of poplar or willow exhibit this phenomenon, even in England, in hot calm weather, when drops of clear water trickle from their leaves, like a slight shower of rain. Sometimes this secretion is of a saccharine nature, as

De la Hire, observed in orange trees." "It is somewhat glutinous in the tilia or lime tree, rather resinous in poplars, as well as in *Cistus Creticus*." "Ovid has made an elegant use of the resinous exudations of Lombardy poplars, which he supposes to be the tears of Phaëton's sisters, who were transformed into those trees. Such exudations must be considered as effusions of the peculiar secretions; for it has been observed that manna may be scraped from the leaves of *Fraxinus ornus*, as well as be procured from its stem by incision. They are often perhaps a sign of unhealthiness in the plant; at least such appears to be the nature of one kind of honey-dew, found in particular upon the beech, which, in consequence of an unfavourable wind, has its leaves often covered with a sweet exudation, similar in flavour to the liquor obtained from its trunk."

The other kind of honey-dew which is derived from the aphis, appears to be the favourite food of ants, and is thus spoken of by Messrs. Kirby and Spence, in their valuable Introduction to Entomology:—"The loves of the ants and the aphides have long been celebrated; and that there is a connexion between them, you may, at any time in the proper season, convince yourself; for you will always find the former very busy on those trees and plants on which the latter abound; and if you examine more closely, you will discover that the object of the ants, in thus attending upon the aphides, is to obtain the saccharine fluid secreted by them, which may well be denominated their milk. This fluid, which is scarcely inferior to honey in sweetness, issues in limpid drops from the abdomen of these insects, not only by the ordinary passage, but also by two setiform tubes placed, one on each side, just above it. Their sucker being inserted

in the tender bark, is without intermission employed in absorbing the sap, which, after it has passed through the system, they keep continually discharging by these organs. When no ants attend them, by a certain jerk of the body, which takes place at regular intervals, they ejaculate it to a distance."

Mr. Knight once observed a shower of honey-dew descending in innumerable small globules, near one of his oak-trees, *on the 1st of September*; he cut off one of the branches, took it into the house, and holding it in a stream of light, which was purposely admitted through a small opening, distinctly saw the aphides ejecting the fluid from their bodies with considerable force, and this accounts for its being frequently found in situations where it could not have arrived by the mere influence of gravitation, and of course for the erroneous notions, adverted to at page 70. The drops that are thus spurted out, unless interrupted by the surrounding foliage, or some other interposing body, fall upon the ground; and the spots may often be observed, for some time, beneath and around the trees affected with honey-dew, till washed away by the rain. The power which these insects possess of ejecting the fluid from their bodies, seems to have been wisely instituted to preserve cleanliness in each individual fly, and indeed for the preservation of the whole family; for pressing as they do upon one another, they would otherwise soon be glued together, and rendered incapable of stirring. "When the ants are at hand, watching the moment at which the aphides emit their fluid, they seize and suck it down immediately: this however is the least of their talents; for they absolutely possess the art of making the aphides yield it at their pleasure; or in other words of milking them."

The ant ascends the tree, says Linnæus, *that it may milk its cows the aphides*, not kill them. Huber informs us that the liquor is voluntarily given out when solicited by the ant, the latter tapping the aphis gently, but repeatedly, with its antennæ, and using the same motions as when caressing its own young. He thinks, when the ants are not at hand to receive it, that the aphis retains the liquor for a longer time, and yields it freely and apparently without sustaining the least detriment: for even after acquiring wings, it shows no disposition to escape. A single aphis supplies many ants with a plentiful meal. The ants occasionally form an establishment for their aphides, constructing a building in a secure place at a distance from their own city, to which after fortifying it, they transport those insects, and confine them under a guard, like cows upon a dairy farm, to supply the wants of the metropolis. The aphides are provided with a hollow pointed proboscis, folded under the breast when the insects are not feeding, with which instrument they puncture the turgid vessels of the leaf, leaf-stalk, or bark, and suck with great avidity their contents, which are expelled nearly unchanged; so that however fabulous it may appear, they may literally be said to void a liquid sugar. On looking stedfastly at a group of these insects (*Aphides Salicis*) while feeding on the bark of the willow, their superior size enables us to perceive some of them elevating their bodies and emitting a transparent substance in the form of a small shower.

> "Nor scorn ye now, fond elves, the foliage sear,
> When the light aphids, arm'd with puny spear,
> Probe each emulgent vein, till bright below,
> Like falling stars, clear drops of nectar glow."—EVANS.

The *willow* accommodates the bees in a kind of three-

fold succession; from the flowers they obtain both honey and farina;—from the bark propolis;—and the leaves frequently afford them honey-dew at a time when other resources are beginning to fail.

Honey-dew usually appears upon the leaves as a viscid, transparent substance, as sweet as honey itself, sometimes in the form of globules, at others resembling a syrup; it is generally most abundant from the middle of June to the middle of July, sometimes as late as September.

It is found chiefly upon the *oak*, the *elm*, the *maple*, the *plane*, the *sycamore*, the *lime*, the *hazel*, and the *blackberry*; occasionally also on the *cherry*, *currant*, and other fruit trees. Sometimes only one species of trees is affected at a time. The oak generally affords the largest quantity. At the season of its greatest abundance, the happy humming noise of the bees may be heard at a considerable distance from the trees, sometimes nearly equalling in loudness the united hum of swarming. Of the *plane* there are two sorts; the *oriental* and the *occidental*, both highly ornamental trees, and much regarded in hot climates for the cooling shade they afford.

"Jamque ministrantem platanum potantibus umbram."
VIRGIL.

The ancients so much respected the former that they used to refresh its roots with wine instead of water, believing, as Sir William Temple has observed, that "this tree loved that liquor, as well as those who used to drink under its shade."

"Crevit et affuso latior umbra mero."—VIRGIL.

The *sycamore* has been discarded from the situation it used formerly to hold, near the mansions of the con-

vivial, owing to its liability to honey-dew, and the consequent early fall of its leaves. The *lime* or *linden* tree has been regarded as doubly acceptable to the bees, on account of its fragrant blossoms and honey-dewed leaves appearing both together, amidst the oppressive heats of the dog-days; but it seems doubtful whether the flowers have any attraction but their fragrance, as they are said to have no honey-cup.

This observation applies to the common lime-tree (*Tilia Europæa*) and one or two others. The flowers of some of the species have nectaries, and the Kowno honey, in high repute, is extracted almost exclusively from the blossoms of the lime-tree. So celebrated is this honey, that dealers are said to imitate it by bleaching common honey by steam.

Those who reside in the vicinity of such trees as are apt to be affected with honey-dew, will soon perceive the advantage of being able to afford their bees additional room as well as from having recourse to partial deprivation, upon the plan which will hereafter be explained; for during the time of a honey-dew, more honey will be collected in one week than will be afforded by flowers in several. So great is the ardour of the bees on these occasions, and so rapid are their movements, that it is often dangerous to be placed betwixt the hives and the dews.

That species of honey-dew which is secreted from the surface of the leaves, appears to have been first noticed by the Abbe Boissier de Sauvages. He observed it upon the old leaves of the holm-oak and upon those of the blackberry, but not upon the young leaves of either; and he remarked at the same time, that neighbouring trees of a different sort were exempt from it;

among these latter he noticed the mulberry-tree, "which," says he, "is a very particular circumstance, for this juice" (honey-dew) "is a deadly poison to silk worms."

Some years do not afford any honey-dew; it generally occurs pretty extensively once in four or five years.

CHAPTER VI.

PURCHASE OF BEES.

APIARIES are commonly founded in spring or autumn, and every one who meditates the establishment of an apiary, should be able to distinguish a good from a bad hive of bees, that he may guard against imposition when purchasing his first swarms or stocks.

Bees purchased in spring should not have issued later than the middle of the preceding June, and their removal may take place from the first to the middle of April, when the trying time, from mid February to the end of March, has passed away, for none but well-stored hives can bear up against the great inequality betwixt the internal demand and the external supply of that period.

The value of a hive of bees in spring, if it be a recent swarm, may be ascertained by its weight, which should not be less than three or four pounds on the day of swarming. A second swarm seldom exceeds two pounds in weight. But the weight *alone* of a *stock* hive is not a criterion of its worth; several other circumstances are to be considered, for the worst *stock* hives often weigh the heaviest. Still if a stock hive be a swarm of the current year, which is always desirable, weight may be regarded *in a great* degree as a *criterion of value*, its quantity of heterogeneous matters being probably inconsiderable. Such a hive, purchased in the autumn, should not weigh less than from twenty to

twenty-five pounds, and should contain about a peck of bees. There are surer grounds, however, upon which its value may be determined.

1st. The combs should be of a pale brown colour, as dark ones denote age; though even in this there may be deception, for old combs may be lengthened out and bordered with new wax.

2nd. They should be worked down to the floor of the hive.

3rd. Their interstices should be crowded with bees.

All these points may be safely ascertained by gently turning up the hive in an evening, when the bees are at rest. It may be well also to notice the proceedings of the bees in the day time. If when they quit the hive, to range the fields, they depart in quick succession and without lingering about; if they import pollen, and the entrance be well guarded by sentinels; these are pretty sure indications of a prosperous hive.

Those who are timid may ascertain the strength of a hive in the autumn by rapping its sides: if it contain a strong family there will be a loud humming noise within, somewhat protracted; if a weak one, the noise will be sharp and brief.

The hive, when purchased, should be raised gently from the stool, some hours prior to its removal, and be supported by wedges, that the bees may not cluster on the floor, as this would be productive of inconvenience at the time of their removal. After being wedged up, the hive should remain undisturbed till night, when, being placed upon a proper board, it should be carried away carefully, and placed at once where it is intended to remain, unless it be a recent swarm, which is to be

removed into a box. The mode of proceeding in this case will be noticed in Chapter XVI. But it would always be preferable to furnish the bee-merchant with a box or hive before-hand, and thus make one hiving suffice: in the latter case let the hive be a new one, that there may be no risk of its containing the eggs or larvæ of moths.

The bees of a hive recently removed from the garden of a near neighbour, if the weather be hot, may, early on the following morning, have a little tobacco smoke puffed into the hive, to induce them to note their new situation; if it be cold, they should be confined for a *few* hours, or else many of them, after flying about in quest of provision, will be lost, either by returning to their old station, or by being chilled to death in searching for their new one.

If the removal of a swarm be long deferred, there will also be danger of destructive contests with the vendor's bees, from the stragglers attempting to find an asylum in the other hives of his apiary, unless the new location be at the distance of from two and a half to three miles from the parent stock.

Should several days have elapsed prior to the removal of a swarm, it should be made with great caution, or there will be a risk of loosening the combs. In these cases, as well as in the removal of full hives, conveyance by water is the safest: next to that is slinging the hives upon a pole betwixt two men's shoulders. They may also be removed pretty securely in panniers on a horse or an ass, or even in a cart well bedded with straw, better still if it be accommodated with springs.

When a hive or box is well filled with honey, particu-

larly if stored in new combs, it should be placed in an inverted position, otherwise an accidental jolt may detach some of the combs from the roof. In all cases, the entrances throughout the journey should be kept securely closed with perforated tin or sheet-lead, to avoid the danger of suffocation, and prevent the escape of the bees, a caution particularly requisite if any quadruped be made use of on the occasion.

CHAPTER VII.

BEE-BOXES.

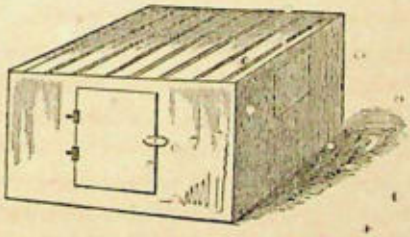
THERE has been some difference of opinion as to *the most suitable dimensions of bee-boxes*. In the former edition of this work, a preference was given to those of Keys, but subsequent information and experience induce me to recommend their diameter to be three-eighths of an inch less than his, viz. 11⅝ inches square by nine inches deep *in the clear*.

The *best wood* for them is *red cedar*, the fragrance of which is regarded by some as agreeable to the bees; but the chief grounds of preference are its effect in keeping moths out of the boxes, and its being a bad conductor of heat, from its lightness and sponginess. Whatever kind of wood be made use of, it should be *well-seasoned*; yellow deal answers the purpose very well.

The sides of the boxes should be an inch thick, and have the upper edges of the fronts and backs rabbeted out half their thickness and half an inch deep, to receive a set of loose bars upon their tops, which should be half an inch thick, 1⅛ inch wide, and seven in number. If the distances of the bars from each other be nicely adjusted, there will be interspaces between them of about half an inch. The precise width of the bars should be particularly attended to, and also their distances from each other; as any deviation in this respect would throw the combs wrong, particularly if that deviation gave an excess of room. It would be better, therefore, for them to be somewhat within the rule than to exceed it by ever so little, for whenever the bees

evince a disposition to depart from the prescribed dimensions, its tendency is generally to make the combs approximate. This has induced me to have my boxes surmounted by bars varying a little in their relative distances thus: the three centre bars are placed at the distance of only seven-sixteenths of an inch from each other, whilst the rest gradually recede from that distance, so that the two last interspaces on either side of the box, are nine-sixteenths of an inch in width. The same precision must be observed with respect to *the length* of the bars, as it is of great importance to have them indiscriminately applicable to every box*.

At the back of each box, a pane of glass should be fixed in a small rabbet, which may be covered with a half-inch door, hung with wire hinges and fastened by a button. This rabbet should be as shallow as possible, or the bees will be apt to occupy it with a thin comb.



The size of the door may be suited to the wishes of the apiarian: as this door will only give a view of the centre combs, it will be desirable to have a pane of glass in each side also, that the proprietor may be enabled to judge at any time of the stock of honey contained in the

* In case the joiner should exceed the specified dimensions of a box, the extra space must be thrown to its two sides.

box. These small glass windows will seldom do more than afford the proprietor an opportunity of ascertaining the strength of his stock of bees, and the quantity of honey they have in store; if he wish to see more particularly the operations of the labourers, or to witness the survey which the queen now and then takes of them, he may have a large bell-glass, surmounted by a straw-hive, which latter may be occasionally raised, for the purpose of inspection.

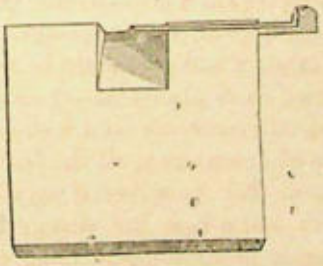
"By this blest art our ravish'd eyes behold,
The singing masons build their roofs of gold,
And mingling multitudes perplex the view,
Yet all in order apt their tasks pursue:
Still happier they, whose favour'd ken hath seen
Pace slow and silent round, the state's fair queen."

EVANS.

An opportunity of beholding the proceedings of the queen, in hives or boxes of the usual form, is so very rarely afforded, that many apiarians have passed their lives without enjoying it; and Reaumur himself, even with the assistance of a glass-hive, acknowledges that he was many years before he had that pleasure.

Each set of boxes must have one *close cover*, which should be an inch thick and well clamped at each end to prevent warping, as a considerable quantity of steam arises from the bees at certain seasons. The top being intended to take off and on, should be secured by means of four screws, each placed about an inch and a half from the respective corners; and it should also be fitted to, and screwed down upon, all the boxes before any of them are used, that whenever it may be necessary to remove, or to add a box, the change may be effected with the utmost promptitude. Long taper screws, as

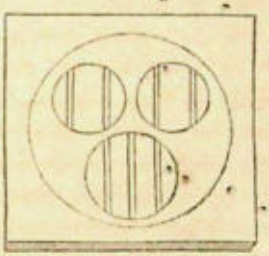
nearly of the same size as possible, should be selected before fastening on the tops, and to facilitate their removal, it would, before they are used, be dipped in some unctuous substance. Each set of boxes must also have a *loose* cover, an inch thick and extending about an inch and a half beyond the back and sides of the boxes. The outlet for the bees is usually cut in the lower edge of the boxes; but I have found sinking the floor half its thickness, at the centre of the front edge, much more convenient. The width of the part sunk should be about four inches, and should gradually diminish in depth till it reach the centre of the board. The sloping direction thus given will, in case of beating rain or condensed steam, prevent any wet from lodging within the hive. The floor must also be clamped at the ends, to prevent warping; for though the superincumbent weight renders it less liable to be warped, when in use, than the top, it will be very apt to do so when laid by. Either on the right or left hand side of the entrance, as may be most convenient, a *groove* must be cut half an inch deep and half an inch wide; to this groove a *slide* must be fitted (made to run easily,) for the purpose of closing the box, and preventing the egress or ingress of the bees, as occasion may require.



By having the entrances cut, as above shown, out of the thickness of the floor-boards, the boxes can be placed upon them in any direction that may be convenient, and are themselves rendered more simple in their construction. Féburier makes his floor-boards of sufficient depth (full an inch and half,) to admit of having the entrance, ploughed out within the thickness of the board, thus forming a covered passage or culvert to protect the bees from driving rains. This passage should be about three inches wide and half an inch deep, and should take a sloping direction for the reasons before stated.

A centre-board between each tier of boxes will likewise be convenient; to those who use dividers, it will admit of their more easy introduction, and prevent that disturbance of the combs in a super which is otherwise apt to be produced when they are worked down to the bottom. The centre-boards also allow of storifying with different sized as well as different shaped boxes; and in all cases they give a more finished appearance to the pile: they should be of the same size and thickness as the floor-boards, and comprise a range of bars corresponding in width and position with the loose bars of the box beneath, to afford a ready passage for the bees from box to box. If the bars of the centre-boards be made the eighth of an inch narrower than the loose bars, so that the interspaces of the former may exceed the required width between the latter, it will allow for a little inaccuracy in their adjustment; and if they are to be used with circular hives or octagon boxes, the exterior bars and openings must of course be accommodated to those shapes: indeed, boards that have been thus fashioned are applicable to hives or boxes either of a square, circular, or octagon form, as the bees rarely

travel along the corners of a box. If the centre-boards be not framed, but formed out of single boards, their two ends should either be clamped, or ploughed and tongued, to prevent warping. Mr. Golding has the centre-boards so fashioned, that they are adapted not only to be surmounted by a box, but also to admit of being supered with three small glasses or one large one. I consider this as a great improvement, and give a sketch of it accordingly.



The above directions for the construction of bee-boxes, &c., are given upon the supposition that they are to be made use of in an inclosed bee-house; but if they are to be used in an open shed, I recommend the tops and sides of the boxes to be made considerably thicker, and that poplar be substituted for deal, as being calculated to keep the bees warmer in winter and cooler in summer; and in all kinds of boxes it would be advantageous to let the fronts and backs be half an inch thicker at the bottom than at the top, to obviate the descent of the loaded combs in hot weather; the additional thickness being of course thrown to the inside only.

If boxes be made of slight materials, they may be very effectually protected from the vicissitudes of heat and cold by having a rough case placed over them, fashioned

out of such cheap materials as the Chinese tea-chests, and an inch or two larger in every direction than the boxes themselves. The top should be loose, to allow some chaff, saw-dust, or other light articles to fill closely the interstices between the sides and tops of the boxes. The loose lid must be kept down with a weight, and of course a sufficient exit must be made for the bees, to correspond with that in the bee-box. This mode of protection has been successfully practised by Mr. Dunbar for many years.

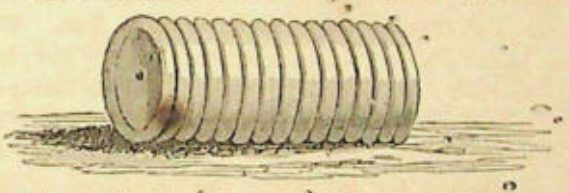
As the boxes and boards require to be made with great accuracy, that they may be nicely adapted to each other, a good joiner should be employed to construct them; for if there be any crevices, the bees will, according to their invariable custom, fill them with propolis, and thereby waste their valuable time. The square boxes which I have described are the simplest of any in their form: some persons prefer the octagon or hexagon form; in some situations, if windows be placed in the three posterior sides, those forms may be more convenient for exhibiting the operations of the bees, or the store of honey in the combs; but they are more expensive and more cumbrous if made as capacious as the square ones; and these latter answer the intended purposes so well, as to satisfy completely those who have used them.

Although I have endeavoured to give a clear description of the form and mode of constructing a bee-box and its appendages, probably it may be more satisfactory to young beginners to obtain a sight or a model of them: I refer them, therefore, to Mr. Ebenezer Jones, Ferry Side, near Caermarthen; or to Mr. John Milton, 70, Great Mary-le-bone Street, London.

CHAPTER VIII.

HIVES.

BEE-HIVES have been formed with various materials, the selection of which has depended partly upon the country or district in which they have been used, and partly upon the fancy of the apiarian. *Osiers*, *rushes*, *segs*, and *straw* have all been in requisition for forming hives; and Bonner, a late eminent bee-master in Scotland, proposed to have them made of *earthenware*: in France they were formerly made of this material, and are to this day in some of the Grecian islands: the following is a representation of one of them as given by Feburier.

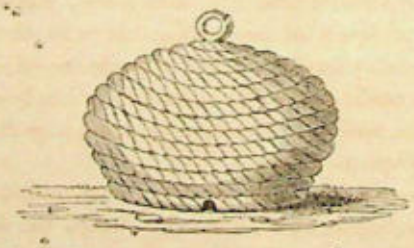


In North America, according to Brookes, they are formed out of the *hollow trunks of the liquid amber* tree, cut to a proper length and covered with a board to keep out the rain: for the same purpose the people in Apalia use *the trunk of the giant fennel*, after clearing away its fungous pith; and in other parts of the south of Europe the bark of the cork-tree is rendered subservient to hive-making, which, being easily separated from its trunk by one perpendicular and two circular sections, forms a hive at once, requiring the closing of only one seam, and the addition of a solid top to keep it steady upon its pedestal. Hives of this simple construction or the hol-

lowed trunks of trees, afforded probably the earliest domicile of domesticated bees. Hasselquist, in his "Voyages and Travels in the Levant," states, that the hives in Egypt are made of *coal dust and clay*, which, being well blended together, are formed into hollow cylinders of a span diameter, and from six to twelve feet long; these being dried in the sun, become so hard as to be handled at will. "I saw," says he, "some thousands of these hives at a village between Damietta and Mansora; they composed a wall round a house, after having become unserviceable in the use they were first made for."

In the chapter on storifying, I propose to give a history of the discovery and progressive improvement of boxes and storifying hives, and shall here chiefly confine myself to their form and dimensions.

The common bell-shaped straw-hives used by the cottagers, are too well known to need remark. For single hiving, the nearer they approach in shape to the large section of a circle, the earlier and the more frequently may the bees be expected to swarm. For the sake of giving security to the loaded combs, a slight departure from this shape might be made without sacrificing the above advantages; as thus:—



From a hive of this form three swarms issued for three successive years in the apiary of Mr. Dunbar.

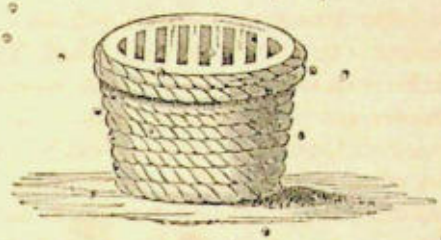
The *Chelmsford* and *Hertford hives* are considered as the handsomest shaped and best formed. Straw hives have also been contrived for storifying; these in France are said to have been invented by Bourdonnaye; Wildman has the credit of having introduced them into this country, where they have been called *Moreton-hives*, on account of the form *only*, the material of which they were made being reeds, and not straw. The *best straw* for constructing hives is that of *unblighted rye*, and *unthrashed* is preferable to thrashed straw, for, being smooth and entire, the bees will be spared a good deal of trouble, as they invariably nibble away the rough, sharp spiculæ which they find on the inner surface of a new hive. The ears of corn may be dissevered from the straw by a chaff-cutter, and thrashed with other corn.

The most approved size for a storifying straw hive is 9 inches high by 11½ wide at the top, gradually tapering downwards to 10½ inches diameter *in the clear*. For single-hiving on the Grecian plan, the hives should be 13½ inches in diameter at the top, and taper gradually downwards to 12½. This size will admit of eight bars, which, on the removal of side combs, will leave a better supply for the consumption of the family than if the hives were smaller and the bars fewer, and afford the owner a prospect of preserving his bees through the winter without feeding. The importance of having all bee-boxes made of the same dimensions has been already dwelt upon, and it is of course of equal importance with respect to straw-hives.

In fashioning these hives, the lower round of straw should be begun upon a wooden hoop, the bottom of which has been planed smooth, that it may sit closely to the middle or floor boards, which, besides rendering

morter or other luting unnecessary, will allow a more easy movement of the slide in the floor-board. Those who place their hives on stones or plain boards, must of course have entrances cut in the wooden hoop, 3 inches long and ⅜ of an inch high. The hoop should be perforated through its whole course, and the perforations made in an oblique direction, so distant from each other as to cause all the stitches of the hive to range in a uniform manner. The hoop may be first pierced with a small gimlet, and the holes completed with a very small rod of hot iron, (introduced from the inner side of the hoop,) so flattened as to make the perforation correspond as nearly as possible in shape and size with the bramble splits that are to be drawn through them. The stitch holes in the hoop should be filled with putty after the hive has been finished. The bars made use of should be of the same width, and placed at the same distances from each other, as recommended for the boxes; and the top of the hive should be so constructed as to form a rabbet for the ends of the bars to rest upon. Mr. Golding accomplishes this by having a band of straw worked round the top exterior to and upon a level with the usual finishing band, and surmounts this additional band with another round corresponding in diameter with the thickness of the bars, namely, half an inch. This contrivance obviates the necessity of stopping with cow-dung or other cement, as completely as the rabbet of a wooden box, and gives a finished appearance to the hive, the two projecting bands of straw forming a cornice round it.

The following is a sketch of this hive.



The direction of the bars should always be from front to back.

Centre boards and floors with sunk entrances will be equally advantageous for storifying hives as for boxes; but the outside covers should be made of straw, like round mats, and be wide enough to extend a little beyond the edges of the hives. Those who are desirous of having glass windows in their straw hives, may accomplish this object by cutting with a sharp knife through several of the bands of straw, in two places, three or four inches asunder. Mr. Golding effects this object by thrusting two strong wooden skewers through the bands of the hive, a little further asunder than the desired width of his windows; these give such firmness to the parts as to admit of the openings being cut with tolerable precision. The entrance of the wooden skewers may be facilitated by first tracing their course with a strong iron one. The windows are generally cut opposite the entrance, and about the centre, but may be made at any part of the hive. The ends of the cut straw-bands may be secured by stitches of packthread, or what is better, with softened mole snap-wire; the panes of glass may be fastened with putty, and the light be excluded by a wooden shutter, or a dark curtain, or in any other way that the ingenuity of the apiator may suggest.

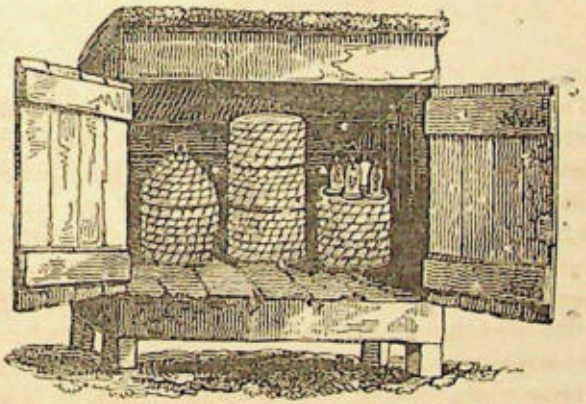
There is another form of straw-hive which, if the body were surmounted with bars instead of the circular notched board recommended by its patrons Chabouille, Brancherie, and Lombard, might I think be used with advantage by the cottager. It has been called the VILLAGE HIVE, and the following is a representation of it in its improved state.



The body of this hive is designed to be used permanently; the upper portion, or cap, (as Lombard calls it,) which will generally contain nothing but pure honey, should be removed annually, or oftener if the season permit. This hive is a great favourite in some parts of France, particularly in the neighbourhood of Narbonne, where quality is more attended to than quantity. To obviate the inroads of the wax-moth, and the disadvantages arising from an annual diminution in the size of the brood-cells, some of the old combs in this, as in all other hives surmounted with loose bars, may with little difficulty be removed as occasion may require; after which the bars armed with guide combs, as will be hereafter described, being replaced, (or substitutes for them,) will soon be re-furnished. This operation should

only be performed partially in any one year, and February is the most eligible time.

Out-door hives should have a protection either of straw caps or a shed. In case of a shed being had recourse to, it should be provided with a pair of folding doors at the back, and be inclosed on every side excepting where it is necessary to have openings for the egress and ingress of the bees. The roofs of these sheds are generally inclined to the back, to protect the bees from their drippings in wet weather; but a roof sloping in the opposite direction and overhanging considerably, would if spouted afford them a much better protection, with the additional advantage of allowing the proprietor more convenient access to his hives. The annexed plate presents a view of such a shed, and shows the various ways in which it may be furnished.



In every bee-house or bee-shed it will be found convenient to have a block of wood, about six inches long and three wide, between the front-wall and the hives, with a sufficient opening to admit the passage of the bees.

In the former edition of this work, I took some notice of the Grecian hive, mentioned by Wheeler as in use about the neighbourhood of Mount Hymettus. This hive was designed to permit the removal of side-combs, by the use of loose bars placed on the top of it. I expressed my approbation of its principle, but stated my doubts of its applicability to general use. Since that period, however, my doubts have been completely dispelled by the success which has attended a series of experiments performed by Mr. Golding, and by a satisfactory repetition of similar ones by myself. This patient and assiduous investigator of the laws of the apiarian republic commenced with that particular modification of the Grecian hive recommended by Huish, and the success of his first experiment afforded him much delight, but future trials convinced him that his success was merely casual; he thence suspected that there was some inaccuracy in the arrangement of the hive-bars; this he sought to rectify by attending closely to the proceedings of the bees when left to themselves. The result was what reason and philosophy would have suggested long since, had they been duly directed to the subject.

The disposition of the bee, as has been known for ages, is to construct its *brood* combs of one uniform thickness, and at nearly one uniform distance from each other, whilst the thickness and relative distances of the *store* combs are subject to variation, the cells for the reception of honey being frequently so elongated as for a single comb to measure from two to three inches in thickness. Hence arises a difficulty in adjusting the bars of a hive or box to such distances as shall be uniformly applicable to practical purposes; for if the breed-

ing distances were closely adhered to with respect to *all* the bars, (and it is impossible to determine how many will be required for brood,) some of the exterior ones would be found to approximate too much for the attachment of store-combs, and in all such cases the bees would be found to depart from the arrangement which is required for brood-combs. If, again, a full allowance were made through the whole range for the construction of honey-combs, these would deviate so widely from the breeding distances as to lead to equal disappointment from an opposite cause; the bars would some of them be too far asunder. Hence arises the difficulty, perhaps I might say the impracticability, of surmounting a hive or box with bars capable of easy removal under *all* circumstances. By compromising the two principles, (if I may use that expression,) as applicable respectively to brood and to honey-combs, Mr. Golding has made a very near approach to this practical desideratum in the culture of bees, so near as to render the system completely available in a very great majority of instances. In *his* arrangement, he exceeded the breeding distances by the eighth of an inch, placing his bars so as for them to measure one inch and ⅛ from the centre of each bar to that of its immediate neighbour, a departure so small from the natural distances as not to be objected to by the bees for brood-combs, whilst it enabled him to meet the elongation of the honey-cells and the consequently increased thickness of the exterior combs. With only a trifling alteration, these are the dimensions observed in the instructions given at page 83, in which I think as near an approach is made to the natural proceedings of the bees, as is consistent with the satisfactory performance of the requisite operations of the bee-

master. Mr. Golding's ingenuity did not stop here, for however accurately a hive or box, surmounted with bars, might correspond with the ascertained laws of the insects for whose use they were intended, it was still found that their proceedings were liable to some uncertainty, and that they did not always take the hint of their proprietor, but occasionally constructed combs diagonally or transversely *across* the bars. To obviate this inconvenience, he had recourse to an expedient, first suggested to his mind by the practice of Huber in his leaf-hive: he attached to the centre bar a piece of worker comb, an inch or two in depth, which the bees readily followed out, and always employed as the foundation of their first comb. This regulated the position of all those which were successively constructed on each side of it, and the hive having been furnished with bars of a proper width and correctly placed, the bees were thus induced, in a manner at once simple and beautiful, to construct a uniform range of combs, every one of which had a distinct attachment to a separate bar *.

Though this simple mode of proceeding will for the most part prove successful, *occasional* deviations having occurred, induce me to recommend placing a guide-comb on every alternate bar. Thus furnished, as soon as a box becomes filled with stores, one, two, or more of the exterior bars may at any time be removed, and exchanged for unoccupied bars, without disturbing the brood-combs, and with very little disturbance of the bees, all annoyance from them being easily prevented by

* The use of guide-combs was recommended by Della Rocca in what he called his improved Candiote Hive, but his bars were much too near each other, and his guide-combs very awkwardly applied.

having an assistant at hand to whiff a little tobacco smoke into the hive at the moment of removal.

The guide-comb must be fixed, in line with and upon the centre of the bar. Mr. Golding makes it secure in its position in the following manner. Having heated a flat iron, and inverted it on a table between two bricks, or blocks of wood quite level, he melts a bit of bees-wax upon it, and then draws the centre of his bar (which I recommend to be previously warmed) across the liquid wax, to acquire a thin layer of that substance upon its surface, and instantly taking the piece of comb and dipping the edge of it in the same liquified wax, presses it gently upon the waxed surface of the bar, when, if the business be adroitly managed, a firm adhesion will be effected. Some pieces of clean worker-comb should be annually preserved for this purpose, which should be stored in a dry box or drawer, inclosed in paper to protect them from moths, dust, &c. When applied, they must be nicely cut, and their original dependence preserved, that the dip or inclination of the cells may be in the right direction. These pieces of guide-comb need not be more than two inches in diameter. Bars that have already been used should not be cleared of propolis nor of *sound* wax, provided it have been the foundation of a comb correctly attached; the presence of propolis in particular is highly agreeable and attractive to bees.

The easy removal of loaded side-combs for obtaining occasionally whatever honey the bees can spare, is one advantage of hives or boxes surmounted with loose bars: they have also another, and an important one, particularly to the storifier or collateral hiver. Mr. Harman, an intelligent apiarian at Cranbrook, near Maidstone, called

the attention of Mr. Golding, some years ago, to the occasional superabundance of large celled-combs, in those hives or boxes which have been storified rather *late in the season*. I have several times observed this superabundance under such circumstances: it will on some occasions occur early in the season, *as early as the month of April*, now and then also even in *single* hiving. This state of the bee-hive (unnoticed by any preceding writer) is probably owing, in the case of doubled stocks, to the doubling having taken place when the queen is about to lay drone eggs, and when there is an instinctive disposition in the bees to provide against such laying. It may also arise, and where it occurs to the practicers of single-hiving, probably does arise, from the combs being built when there is a plentiful harvest of honey, such cells being then constructed as will hold the greatest quantity in a given space, and cause the least expenditure of labour and materials. In such a season, where ample room is afforded, the proportion of drone-combs will amount to one half or more. Indeed these honey-cells, whatever be their diameter, have sometimes a very great depth; I have frequently had combs that were 2½ inches thick, and sometimes find the cells on one side 1¾ deep, whilst those on the converse side are of the usual depth. It is remarkable that whatever be the *depth* of the honey-cells, their diameter, except in particular cases, such as the construction of transition cells, is uniformly either that of worker or that of drone-cells. However advantageous the large celled combs may be for storing honey, they would if left in stock-hives, prove highly prejudicial to the success of the apiary. The reason of this, independently of the occasional depth of the cells, will appear obvious

from what has been said in Chap. I. page 45. For want of attention to this subject, bee-masters must sometimes have found the products of their apiaries perplexingly uncertain, and will at once perceive the importance of the remedy now proposed, namely, the removal of as many bars as may be required, and the substitution of others furnished with worker-comb or pieces of guide-comb.

The ingenious application by Mr. Golding of a system of management, which, prior to his time, rested upon no definite principle, opens an entirely new field to the operations of the practical apiarian, wherein he will be able to work upon sure ground: to cottagers, when once inducted to its details, it must prove of incalculable value; and I avail myself of this opportunity, on their behalf and on my own, to express my acknowledgement to the indefatigable apiarian, who has thus enabled me to give publicity to this interesting and profitable mode of managing the bee-hive, which he has acquired almost entirely through the deductions of his own reasoning faculties, his sole reward, the consciousness of becoming a public benefactor.

Those whose convenience it might suit to visit Hunton, near Maidstone, would be amply compensated for their trip, by the advantage of seeing the system here recommended, in full operation, under the judicious management of Mr. Golding, and would there learn the best and cheapest mode of furnishing themselves with hives and boxes.

Comparative advantages of Wooden Boxes and Straw Hives.

Some apiarians confine themselves entirely to the use of wooden boxes, others make use exclusively of straw-hives; a third party employ both; and each kind have had their respective advocates amongst apiarian writers, the majority of whom have decided in favour of straw-hives; but it is to be recollected that when forming this decision, these writers have always had in their minds an out-door apiary, for which situation, on account of their exposure to the variations of temperature and the alternations of drought and moisture, straw-hives certainly possess advantages over wooden boxes; they are not so soon affected by a hot and dry or by a moist atmosphere; they do not part with so much heat in winter nor admit so much in summer, straw being, in the language of the chemists, a bad conductor of heat. Being much cheaper than any others, straw-hives are of course chosen by the cottager. But upon the storifying system, and with the advantage of a bee-house, I think *wooden boxes have a great superiority over straw-hives*; they are more firm and steady, better suited for observing the operations of the bees through the glass windows in the backs and sides, and less liable to harbour moths, spiders, and other insects; they permit the combs, at the period of deprivation, to be more easily separated from their attachments, and if well made, have a much neater appearance than straw-hives. Mr. Golding has, however, entirely discarded boxes from his apiary as winter domiciles for bees, having been less successful with them than with straw-hives; he now uses them merely for storifying in summer: from my own experience in the use of boxes,

I am induced still to retain them; and in a well-constructed and thickly covered bee-house, such as is recommended in Chap. 3, which will guard the bees well from the vicissitudes of heat and cold, I think them suitable for every purpose to which the apiarian can wish to apply them.

CHAPTER IX.

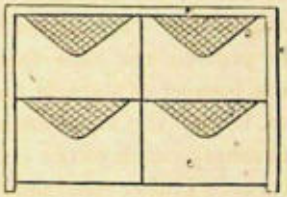
UNICOMB AND LEAF HIVES.

NARROW hives for experimental purposes, with large glazed doors on each side, have been used by amateur apiarians for many years. That of REAUMUR was too wide: it allowed the construction of two combs parallel to each other. This form is unfavourable, as it precludes an observation of the proceedings of the bees in the interspace between the combs. Bonnet recommended a hive, the doors of which should be only so far asunder as to allow the building of one comb between them. This suggestion was successfully adopted by Huber; and to prevent the bees from building short transverse combs, instead of a single one, parallel to the sides of the hive, he laid the foundation himself, by fastening a piece of empty comb to the ceiling of the box.

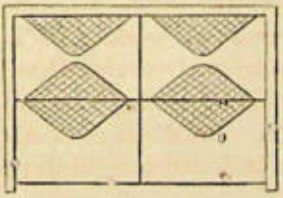
The hive, in which Huber conducted his first experiments, had only an interspace of an inch and a half between the glass doors, so that the bees could not cluster upon the surfaces of the comb, and yet had room to pass freely over it. Mr. JOHN HUNTER recommended the diameter of these narrow hives to be three inches, and the superficies of the sides of sufficient size to afford stowage for a summer's work. Mr. DUNBAR, with his *mirror-hive*, constructed somewhat like Huber's, has been able to make some interesting observations on the œconomy of the bee. The distance of his glass doors from each other is an inch and two-thirds; the height of the

hive about eighteen inches, the width about two feet. Across the centre of the mirror-hive, he introduced a light frame, which, though apparently dividing the hive into four compartments, allowed the bees a free passage; the light was excluded by a pair of folding shutters on each side.

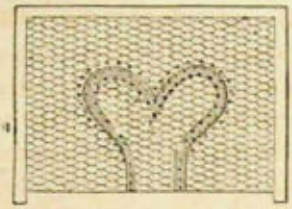
Mr. Dunbar hived a small swarm in one of these narrow boxes, in June 1819: the bees began to build immediately, and he witnessed the whole of their proceedings, every bee being exposed to view. The narrowness of their limits constrained them, from the very commencement, to work in divisions, so that four separate portions of comb were begun and continued nearly at the same time.



But this arrangement did not sufficiently employ these industrious creatures; for, contrary to their usual mode of building, which is from above, downwards, they laid two other foundations of comb upon the upper parts of the cross sticks.



The bees now wrought upwards and downwards at the same time till the originally-separate portions were united and become one comb.



For want of proper precautions, the family perished during the intense cold of January 1820.

On the 25th March following, Mr. D. introduced another family into the same unicomb hive; and so early as the 27th, he saw the queen laying the eggs of workers. This second family found plenty of honey and farina in the hive left by its former tenants. Other particulars, upon the same unquestionable authority, will be found in the chapters to which they belong.

Huber carried the principle of these experimental hives still further; he joined several of them together with hinges, which were so contrived as to admit of easy removal, and as the frames or leaves, as Huber called them, were not glazed, they afforded a free communication with each other.

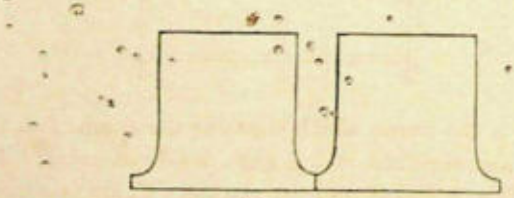
It has been said that Huber borrowed from the Candiotes the first idea of his leaf-hive. These descendants of a highly intelligent people, without being aware of the principle of their proceeding, continue the practice of their ingenious predecessors, in so far as simply surmounting their hives with loose bars can be considered as a continuation of it; and are thereby enabled *occa-*

sionally to raise artificial swarms, and *sometimes* to practise *partial deprivation*, in a very easy and simple manner; but there is much of casualty in their proceedings, little of science, for in answer to inquiries, which I have repeatedly instituted through the medium of persons residing in the islands of the Archipelago, I have learned that the attainment, of either of the advantages referred to, is liable to great uncertainty; the mere removal of loaded combs among the Greek apiarians, so far from being *at all times* a simple and easy process, to use the language of one of my informants, often involves "a very delicate and difficult operation."

Huber extended and rendered the system more complete, probably approximated it more nearly to that of its ancient Greek inventors. The experiments, however, of Mr. Golding, myself, and others, already detailed, have shown that this hive admitted of still further improvement: the leaves were too narrow to be applicable to all purposes, and the hive altogether has been so much simplified by Mr. G., that I shall confine myself to a description of the particular form and dimensions which he has adopted. As to the quality and thickness of the wood, the same instructions may be attended to as have already been given at page 82. The general width of the leaves should be an inch and five-eighths, but slightly varying in the same proportion as recommended for the bars in page 83. The *exterior* dimensions of this hive are one foot 2½ inches high, by one foot one inch deep: the width will depend on the number of leaves; the number usually employed is eight. The perpendicular bars at the front and back converge at the bottom towards each other, so that at the top the interior of the hive, from front to back, measures eleven inches, at the bottom only ten inches. The upright

pieces are of course kept in their positions by having the top pieces tenanted into them, and are further held together by a small cross bar, also tenanted into them, about half an inch or an inch from their lower ends, so as to allow a free passage for the bees beneath. A series of these leaves being placed in juxta-position, secured at the front by shifting butt hinges and at the back by hooks and eyes, and having a glazed door covered by a shutter at each end, constitute what, I think, will be found to be an improved modification of the hive of Huber.

A still-further improvement was made in this hive by Mr. Dunbar. When closing the leaves, (after inspecting the interior,) as those leaves were originally constructed, a few straggling bees were every now and then crushed betwixt their edges. To obviate this, Mr. D. had those edges ploughed out, through their whole extent, to within the eighth of an inch of their outsides, by which contrivance the bees are very effectually protected from injury. To render this description more intelligible, I give a transverse section of two of the leaves when closed.



The conjoined leaves should be placed on a floor-board of sufficient width to prevent the bees from escaping beneath them, when the hive is opened for inspection. By attaching a piece of guide comb to the top bar of each division, in the manner already described, the bees will be induced to construct their combs with such uniform regularity as to admit, at any time, of the opening

of the hive to inspect the interior, or to remove an entire division when loaded with honey-comb, or (if required for the purpose of observation or experiment,) to take out an entire brood-comb, or any portion thereof, without at all interfering with the other combs of the hive, or materially disturbing its general œconomy. The leaves, from betwixt which a remove has been made, should be either brought immediately, but carefully, into apposition, or have a spare supernumerary leaf interposed between them.

The preceding sketches may serve to show my readers the progressive proceedings of the bees in the unicomb hive: and the following outlines will give them a notion as well of the simple as of the compound hive.

Fig. 1.

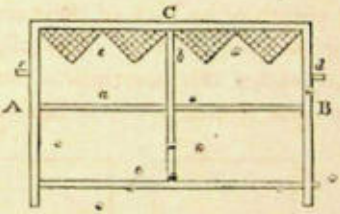


Fig. 1. is the frame which contains the comb, two feet long and eighteen inches high, inside measure. The uprights A and B, and the top piece C, are two inches broad, and one inch in thickness: *a* and *b* are the cross sticks of the frame, about three eighths of an inch square, for supporting the comb; *c* is a piece of comb fixed in the frame for direction to the bees; *d* and *e* are two iron eyes or staples, by which the frame is secured upon the rods of the floor-board.

Fig. 2.

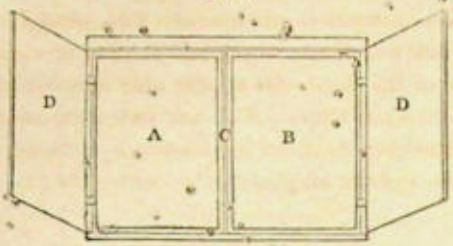


Fig. 2. represents one of the outer frames, containing two panes of glass, A and B, each eighteen inches long and twelve broad, fixed in slender frames, which are hinged to the outer frame, and shut flush with it, resting against a vertical bar, C, which is half an inch square. When the two outer frames are applied and fastened by means of hooks and eyes, one on each side, to the inner frame, containing the comb, the distance between the two glasses must be exactly an inch and two thirds. The frames being made to open is indispensable for experimental operations, such as seizing the queen, cutting out brood-comb, &c. DD are shutters, $1\frac{1}{2}$ inch in thickness, and of such size as to close with a check within the frame, till they nearly touch the glass. Their great thickness is to guard the bees from extremes of heat and cold.

Fig. 3.

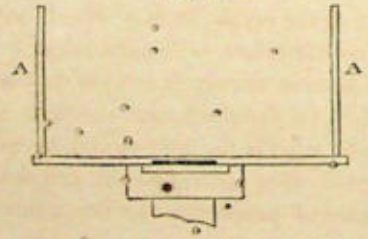


Fig. 3. is the floor-board, showing the entrance. There are two entrances, one on each side, ploughed out of the thickness of the wood, and sloping upwards to the centre of the floor. Of course only one entrance is to be open at a time. A A are two iron rods, which hold the hive firm on its board, by passing through the two eyes or staples in the centre frame.

Fig. 4.

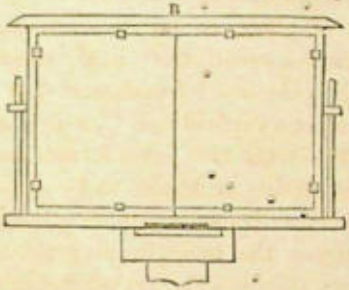


Fig. 4. is the hive mounted on its floor-board, with its shutters closed. B is the roof, formed of solid wood, sloping on each side and at the ends, and fastened on the top of the frame by a hook and eye at each corner. The whole turns on a pivot, C, formed out of the upper end of a post, which is fixed firmly in the ground. When the observer is satisfied with inspecting one side of the comb, he may wheel the hive round, and examine the other, without changing his station. He will of course survey that side first which is opposite to the one from whence the bees are issuing; and before he wheels the hive round, he will take care to open the entrance nearest to him and shut the other. By this mode of proceeding he can contemplate the

bees at his leisure, without disturbing them or incurring the smallest danger of being annoyed by them, for they become so much accustomed to the opening of the shutter, that the admission of light ceases entirely to disturb them.

Fig. 5.

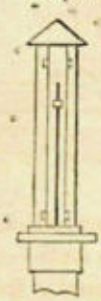


Fig. 5. is the hive seen in profile.

Fig. 6.

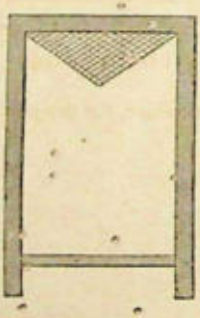


Fig. 6. represents one of the frames of the Huber hive.

Fig. 7.

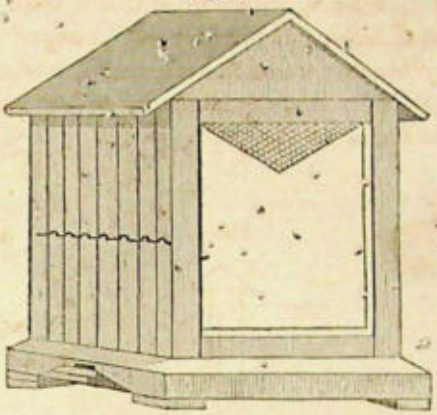


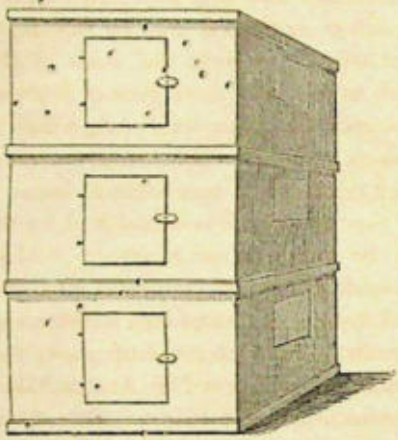
Fig. 7. is the Huber hive itself, composed of eight frames, and showing the hooks and eyes which secure it behind, each frame being secured in front by moveable hinges. Each external frame must have a glazed door, covered by a shutter. These are not shown in the figure.

It will be evident that both the Huber and Mirror hives here delineated are designed for an out-door apiary. For a bee-house or shed their construction may be simplified, particularly as respects the cappings, which are merely intended as protections from the weather.

* The floor-board is reversed, for the purpose of showing the entrance.

CHAPTER X.

STORIFYING AND COLLATERAL HIVING.



STORIFYING means the piling of hives or boxes upon each other, as shown in the above plate, and preserving a free communication between them, a method which enables the apiarian to take wax and honey without destroying the lives of the bees.

Attempts have been made to accomplish this object in different ways. THORLEY junior placed empty hives or boxes over full ones, WILDMAN and KEYS did the reverse, WHITE and MADAME VICAT placed them collaterally.

I have already observed that hives and boxes for storifying, and for observing the operations of the bees, have

been made of various forms and dimensions, and of different materials. ARISTOTLE, PLINY, and other ancient writers speak of contrivances for taking honey, and inspecting the operations of the bees. Modern writers, particularly MOUFFET, ridiculed the ineffectual schemes of their brethren of antiquity, and indeed they were very soon abandoned. The way in which *they* endeavoured to accomplish their objects was by the introduction of transparent substances into the sides of the hives or boxes, such as *isinglass*, *horn* (*cornu laterna*), *pellucid stone* (*lapis specularis*), probably *talc*, which is still used in the Russian navy for cabin windows, on account of its elasticity rendering it less liable to break by the percussion of the air, which is occasioned by the firing of cannon or by tempestuous weather. "Multi alvearia speculari lapide fecêre, ut operantes intus spectarent*." The use of these semitransparent substances most probably arose from the high price of glass; for glass, according to the researches of Mr. Arthur Aikin, *was* used by the Phœnicians. He traces its use from Sidon to Alexandria, thence to Rome, from whence it was introduced into France and England in the seventh and eighth centuries. Such imperfect transmitters of light, as the ancients employed, must have precluded minute observation, and even with the aid of GLASS, the scale upon which they prosecuted their object would have afforded them little insight into the proceedings of the bees, unless the insects had themselves been as transparent as the hives they worked in.

Mr. HARTLIB'S *Commonwealth of Bees*, published in 1665, contains the first account, I have seen, of glazed bee-boxes being employed in this country. He speaks of

* Pliny.

"an experiment of glassen hives invented by Mr. W. Mew, Minister of Easlington, in Gloucestershire:" his boxes were of an octagon shape, and had a glass window in the back. Mr. Mew had evidently a glimpse of the advantages which might be derived from storifying; but from his not possessing a knowledge of the principle which should have governed his proceedings, the practice in his hands was by no means successful, though in the experiment which he relates of the use of a triple story, two boxes were filled, a few combs built in the super, and fourteen quarts of honey taken from the bees. But it appears to have been the opinion of the early storifiers, that the box first filled was the one which should be taken away at the period of deprivation, and *this will account in some measure* for their ill success. (The erroneousness of this mode of proceeding will be particularly adverted to hereafter.) Besides, in the practice of Mew, the boxes were disproportionately large for the system to which they were applied, or indeed for any system of bee culture; they were fifteen inches in depth by two feet in diameter. He peopled these unwieldy hives by introducing two swarms into them at once; a practice on which I shall give my opinion when speaking of Mr. Nutt's boxes.

In the year 1675, JOHN GEDDE, Esq. published "*A New Discovery of an excellent Method of Bee-houses and Colonies,*" which was intended to preserve the lives of the bees; he obtained a patent for his boxes from King Charles II. According to Rusden, a London apothecary who published in 1769, Gedde's information was derived from Dr. Wilkins, bishop of Chester, and a fellow of the Royal Society, and in the advertisement annexed to his pamphlet containing the approbation of the

Royal Society, his system is spoken of *as an improvement upon others!* Still Gedde claims the invention of storifying, and says the Royal Society got the start of him in publishing in 1673 a written description which he had sent with his boxes to Sir W. Thomson. Gedde's boxes were used like Mew's, and like his were much too large; they were twelve inches high, sixteen wide, of a round or octagon shape, had each a hole in the top four inches square closed by a slide, and two rhomb-shaped windows at front and back. To the top of each box a frame was screwed for the attachment of combs, and removable at pleasure.

Gedde's boxes were considerably improved; first by RUSDEN, (who was empowered by him to grant licenses under his patent, for his peculiar management of bees and construction of boxes), and afterwards by JOSEPH WARDER, a physician at Croydon, author of "*The true Amazons, or the Monarchy of Bees.*" Dr. Warder enriched his account of these boxes with several curious circumstances respecting bees, some of which will be detailed in a future chapter. The method of these gentlemen seems not to have been generally known: even Swammerdam, who published in 1680, seems not to have been aware of it; if he had, he would have become acquainted with many circumstances respecting which he was evidently uninformed; and the want of this information, on the part of that eminent naturalist, is much to be lamented, as he was a very accurate observer, and a faithful reporter of what he did observe.

Gedde and Warder were succeeded by the Rev. JOHN THORLEY of Oxford, and the Rev. STEPHEN WHITE of Halton in Suffolk, the former of whom published "*An*

Enquiry into the Nature, Order, and Government of Bees;" the latter on "*Collateral Bee-boxes, or an easy and advantageous method of Managing Bees.*"

Mr. Thorley practised the plan of super-hiving, surmounting his *octagon boxes* and flat-topped hives with a *large bell-glass*, from which the light was excluded by a common straw-hive. It was by the aid of similar glasses that Maraldi was enabled to give to the world so accurate an account of the natural history and labours of bees.

> "Long from the eye of man and face of day,
> Involved in darkness all their customs lay,
> Until a Sage, well vers'd in Nature's lore,
> A genius form'd all science to explore,
> Hives well contriv'd in crystal frames dispos'd
> And there the busy citizens inclos'd."
>
> MURPHY'S VANIERE.

White's boxes have been objected to, because when placed on a level with each other the bees are apt to lay their eggs promiscuously in both; moreover, side-boxes have been regarded as inconvenient from the space they occupy.

The indefatigable Mr. WILDMAN devoted much of his time to the improvement of bee-boxes, he reduced them from the unwieldy size of his predecessors; and in addition to his usual mode of storifying, he also, like Thorley, occasionally surmounted his hives and boxes by a large bell-glass; and at the close of his treatise, we are informed that he introduced the method of obtaining fresh honey throughout the season, by means of small glasses ranged upon a flat-topped hive*; a prac-

* The mode of removing the glasses and taking the honey will be described in a future chapter.

hive still adopted by many apiarians of the present day.

"But faintly Rome thy waxen cities shone
Through the dim lantern or refractive stone,
And faintly Albion saw her film-wing'd train
Glance evanescent through the latticed pane,
Ere Wildman's art unveil'd the straw-girt round,
Its broad expanse with crystal vases crown'd,
And each full vase, like Amalthea's horn,
For Man successive graced the festal morn."—EVANS.

Madame VICAT, a very ingenious lady in Switzerland, published in the Memoirs of the Berne Society, some very judicious *Observations on Bees and Hives.* She recommended that, upon the storifying plan, the additional boxes should always be placed under the full ones, because she had observed, that the bees in constructing fresh works preferred descending to ascending. From what will be said hereafter, I think it will appear that this method is only applicable to the first year of a stock's being planted.

Lastly, we have Mr. KEYS's very useful book, "*The ancient Bee-master's Farewell,*" which was long a standard work to the apiarian.

Keys states, that upon the storifying plan, three pecks of bees will collect more honey in a season, than four divided into two families, upon the common plan, and that the proportion of *pure* honey and wax will likewise be greater. He observes, that a good storified colony has, under favourable circumstances, received an accession of thirty pounds of honey in seven days; whereas if a swarm had been sent off, the increase, in the same period, would not probably have been more than five pounds.

In single hiving, if rainy weather occur at the time,

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> MURPHY'S VANIERE.

White's boxes have been objected to, because when placed on a level with each other the bees are apt to lay their eggs promiscuously in both; moreover, side-boxes have been regarded as inconvenient from the space they occupy.

The indefatigable Mr. WILDMAN devoted much of his time to the improvement of bee-boxes, he reduced them from the unwieldy size of his predecessors; and in addition to his usual mode of storifying, he also, like Thorley, occasionally surmounted his hives and boxes by a large bell-glass; and at the close of his treatise, we are informed that he introduced the method of obtaining fresh honey throughout the season, by means of small glasses ranged upon a flat-topped hive*; a prac-

* The mode of removing the glasses and taking the honey will be described in a future chapter.

tice still adopted by many apiarians of the present day.

"But faintly Rome thy waxen cities shone
Through the dim lantern or refractive stone,
And faintly Albion saw her film-wing'd train
Glance evanescent through the latticed pane,
Ere Wildmen's art unveil'd the straw-girt round,
Its broad expanse with crystal vases crown'd,
And each full vase, like Amalthea's horn,
For Man successive graced the festal morn."—EVANS.

Madame VICAT, a very ingenious lady in Switzerland, published in the Memoirs of the Berne Society, some very judicious *Observations on Bees and Hives.* She recommended that, upon the storifying plan, the additional boxes should always be placed under the full ones, because she had observed, that the bees in constructing fresh works preferred descending to ascending. From what will be said hereafter, I think it will appear that this method is only applicable to the first year of a stock's being planted.

Lastly, we have Mr. KEYS's very useful book, "*The ancient Bee-master's Farewell,*" which was long a standard work to the apiarian.

Keys states, that upon the storifying plan, three pecks of bees will collect more honey in a season, than four divided into two families, upon the common plan, and that the proportion of *pure* honey and wax will likewise be greater. He observes, that a good storified colony has, under favourable circumstances, received an accession of thirty pounds of honey in seven days; whereas if a swarm had been sent off, the increase, in the same period, would not probably have been more than five pounds.

In single hiving, if rainy weather occur at the time,

the bees are prepared to throw off a swarm, and the hive be filled with comb to its utmost limit, all the bees must remain idle till the return of fine weather; whereas if additional room be given them, this check to their activity will to a certain extent be removed, as they will not only be enabled thereby to take every advantage of occasional gleams of sunshine, but even in its absence, to construct cells from the stores already collected. Though rainy weather has this effect upon bees, yet are they much less susceptible to moisture than to cold: they may frequently be seen in full activity upon a warm showery day, whereas on a cold dry one, they cluster closely together within the hives; the colder the weather the more closely they cluster. "When the lime tree and black grain blossom," says Huber, "they brave the rain, depart before run-rise, and return later than ordinary."

"Tantus amor florum et generandi gloria mellis."
VIRGIL.

Independently of the benefit derived from storifying, as keeping a numerous body of bees together, it will always be found advantageous to have hives of whatever sort well filled, as the bees uniformly work best when in a numerous body: this induced Mr. Espinasse and others strongly to recommend the union of stocks that do not well fill the hives.

Considering how much the attention of the public was lately called to Mr. Nutt's boxes and system of management, by the insertion of paragraphs in the newspapers, by the delivery of lectures, &c., I shall hardly be excused if I omit to make a few remarks respecting them.

Mr. Nutt's general plan of management is a modification of the collateral system, which, as I have already observed, has long been practised, chiefly upon White's plan, namely, with two boxes; others have preferred Ravenil's with three boxes, and that is the number recommended by Mr. Nutt. What he calls the Observatory Hive, is also a much older invention than his book would lead us to suppose. The principal novelty in Mr. Nutt's boxes is his contrivance for ventilating them by means of perforated tin tubes, resembling circular nutmeg-graters, which are passed down into the boxes through perforations in their lids. By the aid of these ventilators, he assures us he can *prevent swarming*, and keep the brood-combs quite distinct from the honey-combs, governing his proceedings in both cases by the use of a thermometer.

Most modifications in advance are those on the score of simplicity, but these are encumbered with much complexity, and the statements made by their advocate, respecting the quantity of honey afforded in a season, by each of his stocks, is certainly calculated to stagger credibility.

I am informed that in his lecture delivered at Maidstone in 1834, he asserted that from ten families, during the current year, he obtained 918 lbs. of honey; nay more, that the stocks still weighed 900 lbs.!!! Similar statements are made in his book, and so general are they that he appears to keep out of sight any allowance for situation, for season, or for any of those mischances to which even the best managed apiaries are occasionally liable.

In the British Isles, in France, Switzerland, and many other countries, there are not only great vicissitudes of

temperature, attended on the one hand by parching droughts, and on the other by a long continuance of wet weather; but there are also very marked differences in honey sources, not only throughout extensive districts but even in the same vicinity; and each of these causes, wherever it operates, must evidently produce a considerable effect upon the harvest of honey. To say, therefore, that a particular system of management will, in *any situation*, uniformly cause a great product of wax and honey, betokens a want of due attention to the sources whence honey is procured; and attributes to a *system* what is chiefly due to the *locality* in which it has been adopted. There are not wanting instances, in which it has been necessary to feed bees in one district, at the very time that those in its neighbourhood were actively engaged in storing their warehouses with honey. "At the time of the revolution," says M. Lombard, "M. Huber lived at Cour, near Lausanne; he had the lake on one side of his domicile and vineyards on the other. He soon perceived the disadvantage of his position (as regarded his bees). When the orchards of Cour had shed their blossoms, and the few meadows in the neighbourhood had been mown, he saw the stores of his stock hives diminish daily; the labours of the bees ceased so entirely that, even in summer, they would have died of hunger, had he not succoured them. In the meantime, though matters were going on so badly at Cour, the bees at Renan, Chablière, at the woods of Vaux, of Cery, and places at the distance of only half a German league, were living in the greatest abundance, threw numerous swarms, and filled their hives with wax and honey." Again, Huber himself says, "They succeeded no better at Vevay, although it is not more than half a league

from that place to Hautville, where they throve remarkably well." Similar disparities, in the productiveness of neighbouring localities, are by no means uncommon in this country; and who can be so deficient in discernment as not to perceive that the adoption of any system, however judicious, would be attended with different results in these different localities?

We are informed by White, that whilst in the bleak county of Cambridge, seventy or eighty hives may be seen in a single farm yard, supported no doubt by the neighbouring heaths, Suffolk, with its beautiful inclosures and its fine gardens, yields so scanty a supply of honey that he thought Halton could not maintain a dozen colonies.

From my own personal observation and inquiry in the year 1836, I can state that, in six different localities, the disciples of Mr. Nutt had been grievously disappointed in their expectations. At Maidstone, two sets of boxes had been in operation four years, during which time one of the proprietors had harvested only *twelve pounds of honey*!! The sole produce of the other was *one swarm*, but *no honey*. Near Dumfries also the system was equally unsuccessful: instead of the bees taking to the collateral boxes, they preferred swarming. At Melton Mowbray the same result was experienced. In the neighbourhood of Monmouth, a gentleman informed me that he intended writing to Mr. Nutt, for, says he, "I have attended strictly to his instructions, but they have failed me in every point. He led me to expect a great treasure of honey, I have not obtained a particle; he said his system of ventilation would prevent swarming, on the contrary, I have had a swarm this summer; and it was to present me with *pure honey*-combs in the colla-

term boxes, whereas they have been completely intermixed with brood-combs." Respecting the stock that was planted in the Zoological Gardens, Regent's Park, it was represented to me by a friend that in the month of August "the bees were looking deplorably unhappy"! And on visiting the gardens myself, in the early part of September, all observation was excluded by the boxes being carefully padlocked, the door-keeper assigning as the reason that there had been a failure. I have been alike unsuccessful in a family planted three years by myself on Mr. Nutt's system; they yielded me a swarm the second year, and twenty pounds of honey the third. The above facts must, I should conceive, convince any one that Mr. Nutt's *unparalleled* success, which has been stated to be produced by his boxes, is not the effect of his peculiar system, but of some unusually favourable local circumstances. In answer to those who have been disappointed in the use of his boxes, Mr. Nutt tells them they should have tenanted the hive, which he calls "the Pavilion of Nature," with two swarms, of course for the sake of having a large population, and this I have already stated to be an important desideratum; but from what will be said hereafter as to the brevity of the bee's life, it will appear that Mr. Nutt's mode of proceeding, whatever advantage it might give to the family during the first year of its establishment, can present none beyond that period: the swarms that were introduced will all have paid the debt of nature before its expiration; the hive will therefore not contain a greater number of bees afterwards, than can be bred by a single queen. Now it is not during the first year that Mr. Nutt leads those who adopt his plan, to expect a great harvest of honey; and as during every subsequent year, the stocks

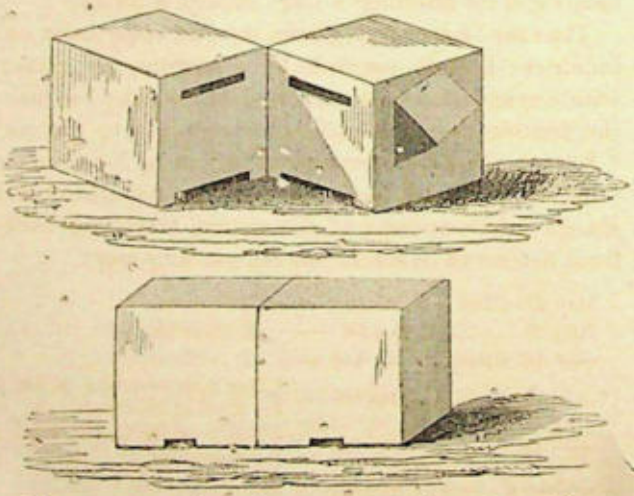
that had been doubled will be reduced to a level with single ones, that have been well supplied through the winter, this high-sounding theory dwindles into a vague hypothesis, and of course the practice raised upon it must fall to the ground.

Of the utility of his ventilating apparatus there seems much reason to doubt, for from various experiments that have been made by myself, and other scientific apiarians, it is evident that as high a temperature, *at least*, is required for comb building, (without which no honey can be stored,) as for maturating brood; therefore to reduce the temperature below the breeding heat, must not only *retard* the proceedings of the bees, but might also put an extinguisher upon comb-building altogether. Whatever success therefore may have been observed under the ventilating system must, I conceive, have been produced rather in defiance of it than as its result, that is, from the indefatigable little insects to which it has been applied being enabled, by unusual exertion, to render the ventilaters inoperative, or rather to counteract their operativeness.

The object of the bee-master should be to afford his bees convenient accommodation for breeding and storing honey, and to let the accommodation for each purpose be as distinct as possible; and whether he storify or use collateral boxes, if their dimensions and their facility of reciprocal communication be well contrived, he will, upon either system, be able to embrace all the advantages which can be afforded by it, to the bees or their owner.

Mr. Nutt and a few others think collateral hiving preferable to storifying, and for ladies or timid persons it may be a more easy method of conducting an apiary. The most suitable dimensions for collateral boxes are

10½ inches clear, in every direction, which will admit of their being surmounted with six bars each, at the relative distances recommended at page 83. The sides on which the boxes communicate need not be more than half an inch thick, all the rest should be as thick again. The intercommunication between the boxes is shown in the wood-cut, as are also the external entrances, each of which should be ⅜ of an inch deep. In lieu of the latter *the entrances* may be transferred to the floor board as described at page 85. The former may be opened or cut off by means of a sheet of tin or very thin board, and the entrance of the store box *from without* must be kept constantly closed, except at the time of deprivation. The following sketches give a back view of the boxes before they are joined together, and a front view when joined.



My own experience, however, and that of my friends, who have had each system in operation for a great many

years, are decidedly in favour of storifying, for in the first place, as has been elsewhere stated, indiscriminate breeding is far more apt to take place in collateral than in storified boxes, and secondly, the harvest of honey which they afford is by no means so abundant. From the objections to storifying made by Mr. Nutt, he appears to be unacquainted with the rationale of the system which he condemns, for they apply only to an injudicious method of practising it; he confines his observations to nadiring, and does not at all advert to supering: and with respect to his animadversions on the leaf-hives of Huber and Dunbar, I must beg leave to say that they have fully answered the objects of their inventors; that of the latter is intended purely for experimental purposes, and a well-constructed Huber-hive has been found alike successful for conducting experiments and for affording a large supply of honey.

Thus far I have spoken from my own observation and inquiries; I shall conclude by presenting my readers with a calculation made by Mr. Dunbar, who has taken the trouble to put Mr. Nutt's statements to the test. "I think from his own showing," says Mr. Dunbar, "his statement will be found to be not founded in fact. Ex. gr. In his account of the several takings of honey from one set of boxes, in one season, he states:

May 27. Glass and Box	54	lbs.	Call this box A.
June 9. ..... Box	56	—	Call this box B.
—— 10. Glass	14½	—	
—— 12. ..... Box	60	—	This must of course be Box A. filled in 16 days.
—— 13. ..... Box	52	—	This must be Box B. filled in 4 days!!!
Collateral ..... Box	60	—	
	296½		

"When the last box was filled and taken, we are not told.

"To believe that a swarm of bees stored up fifty-two pounds of honey in four days, is out of the question. Moreover, a box measuring 12 in. × 12 × 9 = 1044 solid inches can contain only fifty pounds of honey-comb, making due allowance for the interstices. Thus an imperial quart contains 69⅓ solid inches; dividing 1044 by this gives a product of about fifteen quarts; each quart weighs 4$\frac{1}{20}$ lbs. giving 60$\frac{3}{4}$ lbs. Deduct from this $\frac{1}{6}$th for interstices, and there remain 50$\frac{1}{2}$ lbs. for the greatest possible quantity of honey-comb containable in one of Nutt's collateral boxes; yet, he says, he took from one of them (page 177) 65 lbs.! So much for matter of fact!"

CHAPTER XI.

COMPARATIVE ADVANTAGES OF STORIFYING AND SINGLE-HIVING.

FROM what has been said in the last chapter, a comparative estimate may be made of the advantages which storifying possesses over single-hiving; and they appear to be the following:

First, an œconomical division of labour, an advantage common to all bodies of artificers, whose works are conducted upon a large scale, and which causes a larger quantity of honey and wax to be collected in the season, than if the bees were to swarm, and to carry on their operations in separate families.

Secondly, the facility with which the bees may be deprived of a considerable portion of their honey, without having any unpleasant flavour communicated to it from sulphurous gas, and without the sacrifice of a single life.

Thirdly, the power which is afforded to the bees of employing themselves usefully during wet weather, in the manner before stated.

Fourthly, the saving of that time which is unnecessarily spent in the construction of fresh combs in the new habitation.

Fifthly, œconomy of space; for as every stock hive has generally more warehouse-room than its respective necessities require, the division into small families must increase that disproportion.

Sixthly, the saving of the time usually lost in prepa-

ration for swarming, when the bees hang idly in clusters, on the outsides of the hives, for many days, sometimes for weeks, particularly if the weather be unfavourable.

This clustering is very prejudicial, as it causes the family to be inactive in their principal gathering season, when every bee ought to be fully employed. It likewise obstructs the operations of those that are active, by interrupting the thoroughfare to the hive; and independently of the loss of time to the bees, a constant system of watchfulness must be kept up by the proprietor during the whole period of the bees clustering out, otherwise a swarm may be lost.

Bees have been known to construct combs under the floors of the hives when restricted for room within, their natural activity surmounting the impediments thrown in their way, by the want of inclosed space.

These disadvantages are admirably remedied by storifying; should it however prove unsuccessful in causing the clustered bees to enter the boxes, the guide-combs with which every duplet or triplet should be furnished, may be smeared with a little honey, which will generally produce an acceptance of the proffered room, as well as lead more certainly to the construction of combs at suitable distances.

Now and then the bees will prefer founding their combs upon the middle boards and building upwards; this proceeding should be nipped in the bud, by scraping off the waxen rudiments and directing the attention of the bees to the guide-combs, by filling their cells with syrup or honey.

Keys says that he has failed to make the clustered bees rejoin the family, if he has put the empty hive or

box *over* the colony; but that by placing the box *under* it the bees soon entered and worked vigorously. I have often noticed this reluctance of bees to ascend; it will however in general give way in a day or two, if no room be allowed them in any other direction. If it do not, the cluster may be swept into an empty hive *towards dusk*, and carried a short distance from the family, when they will gradually return, and finding sufficient accommodation generally join the family.

Super-hiving was constantly practised by the younger Thorley, and very successfully; and likewise by Mr. Walond, who found it afford him a supply of purer honey than *nadir*-hiving, for as the queen is generally found more disposed to descend than to ascend, by placing the box over the stock it will seldom be stored with brood-combs.

As a general rule I recommend *old stocks* to be *supered* and *swarms* to be *nadired*; but even stocks should rarely be supered more than one story high: what further room they may require, *whilst thus surmounted*, should be afforded by nadiring, for the following reason. Bees have always a disposition to carry their stores upwards, and to keep their brood-combs below; by placing a *super* upon a *swarm*, therefore, they might be induced to store that super, at the expense of the box they were hived in, by which the latter might be so impoverished as to be incapable of supporting the family through the winter; an evil which would be avoided by nadiring, though this nadiring will seldom afford any other advantage than that of preventing the bees from being incommoded for want of room. On the other hand, a *stock-hive*, being, it is to be presumed, sufficiently stored with honey when doubling is required,

may safely have a super placed upon it, and with a prospect of its being stored with pure honey; but from the indisposition of bees to ascend more than one story high, as well as for the reason assigned for *nadiring swarms*, whatever room may be required beyond the first duplet should be furnished below, and this may extend even to a second nadir, the lowest being introduced, for the reason just assigned, merely to prevent any inconvenience from being produced by a crowded population.

The storifying or colonizing plan has been much applauded for its saving the lives of the bees: though this preservation be well worthy of attention, yet it is an advantage very inferior to that which is derived from the œconomical division of labour, the consequent increase of honey and wax, and the facility afforded for extracting them. I trust that this remark will not expose me to the imputation of inhumanity, for I am fully sensible of the value of life to all creatures that exist, and have often felt strongly the force of Thomson's pathetic appeal on the sulphurous death of bees.

> "Ah! see where robb'd and murder'd in that pit
> Lies the still heaving hive! at evening snatch'd,
> Beneath the cloud of guilt-concealing night,
> And fix'd o'er sulphur . . . . . .
> Sudden the dark oppressive steam ascends,
> And, us'd to milder scents, the tender race
> By thousands tumble from their honey'd dome,
> Convuls'd and agonizing in the dust."

It is now ascertained that the bee is a short-lived insect. (*Vide* Longevity of Bees.) Whatever advantage can be derived, however, from preserving the lives of bees at the period of taking their honey, those who

keep them upon the storifying plan will have the full benefit of, and be spared that torture of feeling which the sensitive always experience when destroying life in any way.

"True benevolence extends itself through the whole compass of existence, and sympathizes with the distress of every creature capable of sensation. Little minds may be apt to consider a compassion of this inferior kind as an instance of weakness, but I consider it as affording undoubted evidence of a noble nature."—*Melmoth.*



CHAPTER XII.

THE BEE-DRESS AND OTHER APIARIAN APPURTENANCES.

Most practical writers on bees have regarded a bee-dress as a needful appendage to an apiary; but on the storifying system, when conducted with proper precaution, in a bee-house, it is quite superfluous, as all operations when thus sheltered, may be safely performed at any time without one.

They may be as securely performed by the storifier in a simple shed, if the time of operating be either early or late in the day, when the bees are all at home, and can be confined by pushing in the slide of the floor-board.

Still, as timidity may foster a feeling of insecurity, and as the armour of a bee-dress may give confidence to an operator, I shall describe one that appears to me very suitable.

It consists of a short dress of Scotch gauze or catgut, so formed as to inclose the head, neck, and shoulders, the former being covered by a hat, with a brim not less than two inches and a half deep: it should have long sleeves to tie round the wrists over a pair of thick gloves, and the body of it must descend low enough to tie round the waist. Bee-masters of former times recommended the protection of a double pair of thick woollen or worsted stockings, and a woollen apron; woollen being a texture from which the bee can readily extract its sting.

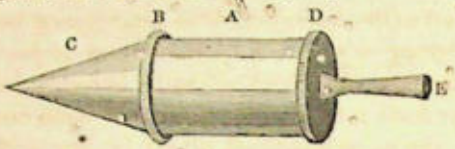
To the tyro in bee management, Keys's dividers will

be found to facilitate the various operations which he has to perform. They consist of two copper or brass plates about the sixteenth of an inch thick, fifteen inches wide, and fifteen and a half long; the odd half inch being turned up, serves for the operator to lay hold of when the plates are withdrawn. Care should be taken that the plates be perfect planes, well hardened by hammering, and of proper thickness. If they exceed the prescribed thickness, the bees may escape as soon as the plates are partially introduced or partially withdrawn; and if they be thinner, there will be the same chance of escape from their want of firmness and elasticity.

Such was the outfit which I recommended in the former edition of this work, and such to the timid apiarian I still recommend. Those, however, for whom bees have no terrors, and, perhaps, I ought to add, who are in the good graces of the bee community, after they have become so familiar with their little charges as to shake off any original timidity, may, by the aid of tobacco-smoke, accomplish all that can be effected by dividers; accordingly, these instruments have been discarded from the apiaries of my two friends Golding and Dunbar.

To carry the fumigating process into effect with those who are accustomed to smoke, nothing more is necessary than a cigar or a pipe of tobacco, so that the operator may be able to direct a few whiffs into the hive which he is desirous to examine or remove. If neither he nor his assistant be a smoker, recourse may be had to a fumigating box attached to the nozzle of a pair of bellows, and placed in the hands of an assistant, who, to prevent the fire from expiring, must keep up a *gentle* motion of

the bellows till the smoke is no longer required. The following is a sketch of the fumigating box.



It consists of a funnel-shaped bottom attached to a cylindrical box, to which latter a lid is fitted having a short tube in its centre to receive the nozzle of the bellows. A, is the cylindrical portion of the box, three inches in diameter and three and a half long, in which the tobacco is placed. B, a plate extending entirely across it, perforated full of holes of such a size as to admit the passage of the smoke only: C, the funnel-shaped portion of the box, having a hole at its point three-sixteenths of an inch in diameter, which, when in use, is applied to those parts of the hive where the introduction of smoke may be required: D, is the lid, which is received into the box when the tobacco has been lighted: E, is the tube, which should be adapted to the size of the bellows-pipe. The whole is made of tin, having the joinings all riveted as well as as soldered.

Whether the fumigation be effected by the action of the bellows, or by the issue of smoke from the mouth, no more should be employed than the necessity of the case requires; three or four good puffs will generally be sufficient, and it is better to repeat the operation two or three times than to overdo it in the first instance, for the stupefaction it induces may be pushed so far as not only to deprive the bees of the power of motion, but even of life.

In performing this as well as all other operations upon bees, it will be important to have a cool, steady assist-

ant, particularly on the first planting of an apiary; I have known various instances in which the want of it has proved so discouraging, as to deter young beginners from adopting or carrying forward those improvements in bee-management, which scientific bee-masters of modern days have introduced. Initiating some docile cottager in the neighbourhood, might be productive of a two-fold advantage; first, by affording a ready assistant at the swarming and harvest seasons; and, secondly, by introducing a better system of management among that class of persons who stand most in need of improvement.

In addition to the use of tobacco smoke on occasions when examining the interior of a hive, or when opening it to gratify the curiosity of friends, it may be prudent for *all* to drink or rinse their mouths with a little malt liquor, to wash their faces and hands with the same, and to approach the bees with a bunch of sweet herbs during the process of inspection, breathing at the same time as much as possible through the nose.

In case of an actual or threatened attack from the bees, (the latter of which may be known by the peculiar pungent noise which precedes it) a defence by striking at them would be highly imprudent. An attempt may be first made to put them quietly away; should that not succeed, the only resource is to retire *quickly*, and to conceal the face in shrubs or boughs, if any be near, if not with the hands spread over it. The bees will then generally desist from farther attack, and go home.

Every apiary should be provided with two iron instruments ten or eleven inches long, and about a quarter of an inch thick; the end of each should be turned up an inch and a half, at a right angle with the haft, and be double-edged that it may cut both ways, but with

this difference between them; the cutting edges of the one should be placed horizontally, whilst those of the other are perpendicular; one being designed to detach the combs from the sides of the hives or boxes, the other to separate them from their attachment to the floors or middle-boards. One of the long-bladed spatulas employed by apothecaries and painters will also, on some occasions, be a useful auxiliary.

CHAPTER XIII.

SWARMING.

THE swarming of bees may be compared to the migration of colonies from populous communities of men, and it is liable to similar uncertainty; for though an exuberant population seems to be a *sine quâ non* in both cases, it appears nevertheless in each of them to be finally determined by other circumstances.

However populous a stock of bees may be in the autumn, its numbers are greatly reduced during winter, perhaps six or seven-eighths. This loss is more than replaced in the spring, by the amazing fecundity of the queen. Hence arises the disposition to throw off swarms, which of course will issue more or less early, and in greater or less force, according to the temperature of the season, the populousness of the stock, and the attention that has been paid to early feeding.

March is the month in which the grand laying of the queen usually commences; yet, when January proves mild, the breeding will sometimes begin at the latter end of *that* month, and it is by no means an uncommon thing for the commencement to happen in February.

The queen-bee may naturally be expected to breed earlier in the season than insects in general, from the circumstance of the working-bee storing up food for the young, which other insects that breed later do not; as also from her living in the midst of a society where a summer heat is preserved during the coldest months of

winter. A thermometer in a bee-hive has ranged as high as 74° Fahrenheit at Christmas, and Bonner says, that he has often seen his hives with young brood in them in the midst of a severe frost. In the Transactions of the Society for the Encouragement of Arts, &c., Mr. Hubbard has stated that vigorous, well-stored hives breed even in the depth of winter. In this, perhaps, he was mistaken: his finding eggs and maggots in the cells is not conclusive, as they might have been laid late in the autumn, and have remained stationary till spring. Riem states, that in a bad season, the eggs will remain in the cells many months without hatching. Mr. H. was led to make the experiment of suffocating a strong stock in February, to ascertain the state of the brood-combs; in which he says that he found an abundance of brood in every state, from that of egg to the almost perfect fly; although the preceding January had been very cold, accompanied by frost and snow, a circumstance which in some measure confirms my supposition as to the suspended development of the brood. Mr. H. further adds, that, on examining two *weak* hives in March and April, he found not a single egg. From these very opposite states, Dr. Evans infers the great importance of leaving stocks strong in October, and feeding them in an ungenial autumn and spring; conceiving that the bees apportion the number of their young to the means they possess of supporting them; that

> "The prescient female rears her tender brood
> In strict proportion to the hoarded food."

This, however, does not correspond with what will be stated below, from which it will appear, that the queen sometimes lays eggs in reliance upon an *approaching*

season, and does not let the number altogether depend upon the stock of provision *actually* in the hive.

It has been generally supposed, that the commencement of the queen's breeding may be known by the bees carrying in pellets of farina on their thighs, and that it is for want of a sufficient supply of this, in cold, ungenial seasons, that many of the nymphs are cast out, having died of actual starvation. Should these dead nymphs be suffered to remain in the hive, disease might be produced; vide chap. 20. The statements of Riem and Hubbard show that brood may be regularly developed by the aid of *hoarded* pollen*. This, however, does not affect the desirableness, as I have elsewhere stated, of having in the immediate neighbourhood of the hives such early blossoming trees and flowers as afford plenty of farina; and also late blossoming ones, that the bees may be enabled to lay in a store of it ready for spring.

It is a prevalent opinion, that every swarm of bees consists entirely of those born in the current year; but this is an error; every swarm contains a mixture of young and old; the latter are distinguishable by being of a deeper hue, and having ragged wings.

CAUSES OF SWARMING.

The cause or causes which determine the issue of a swarm, seem to be enveloped in obscurity; probably there are none which can be said to determine the point

* Mr. Humphrey of Staplehurst, an apiarian of considerable industry and research, when examining a hive in the middle of *February* 1829, which was supposed to contain supernumerary drone-combs, found a circle of brood three or four inches in diameter, occupying both sides of one of the central combs, the two adjoining ones being similarly occupied on one side only, viz. the side next the centre one. He also thought that he saw a few bees that had recently come forth.

absolutely. The crowded state of the hives in hot weather has been generally considered as sufficient to account for the issue of swarms; but, on the one hand, bees, as is well known, will cluster out sometimes for weeks during the height of summer without swarming at all; and, on the other hand, affording room in whatever direction will not certainly prevent an issue, neither will it always encourage comb-building. This latter will depend upon the productiveness of the gathering season, for, if the hive contain a sufficiency of cells for the reception of eggs, and the prospect of the honey harvest is not such as will require additional store-houses, no fresh combs will in all probability be constructed. Looking at these two well-known facts, viz. the uncertain result of clustering as well as of affording room, I was led to think, in common with several of my apiarian friends, that some preliminary step was adopted by the bees in contemplation of swarming, which determined the point so absolutely, that no after proceeding on the part of the proprietor could arrest its progress; that if this step were not taken, neither a crowded population nor a high temperature would induce a swarm to issue; and that, if it were taken, no accommodation in point of room would prevent it. This theory, which, had it been correct, would probably have led to important practical results, must however be abandoned, for subsequent reflection and experience have shown that it is not well founded.

The most advantageous period for a swarm to be thrown off, is from the middle of May to the middle of June, though it will occasionally take place as early as April, and continue to the latter end of August. In the 6th volume of the Philosophical Transactions, an instance is recorded by Richard Reed, Esq., of Lug-

wardine, of a swarm issuing on the 9th of March: in consequence, as he supposed, of there being an insufficient supply of food for the whole family, a part were sent forth to seek their fortunes, lest the whole should perish. The day, he says, was fine, but does not mention the temperature. Probably this was a stock which had bred in the month of February, the swarm issuing from one of the usual causes, a disproportion between the size of the family and the size of the habitation. This, I believe, is the earliest instance of swarming on record; the latest that ever came to my knowledge occurred on the 13th of September 1835, at Llanstephan: it was a small swarm, and the owner did not think it worth hiving; the bees remained clustered on the branch of a protected nectarine tree for about a week, gradually diminishing either by death or return, and left no evidence on the tree of their having clustered there. Very late swarms, whether first or second, are seldom worth preserving, for want of time to lay in an adequate supply of honey for the support of the family during the ensuing winter and spring.

The usual time of issuing is from ten in the morning till three in the afternoon; I have known a swarm rise as early as seven in the morning, and as late as five in the evening. Butler mentions an instance of one rising later than five.

In favourable seasons and situations, three swarms will not unfrequently issue from a single stock; even a swarm of the current year will sometimes throw off another swarm. In this latter case there is but a small collection of honey, compared with the great number of bees which have been called into existence. This I have endeavoured to account for in a former chapter. In the

Monthly Magazine for September 1825, an instance is recorded of five swarms being thrown off and hived before the end of July, from planting a single stock; the season was favourable, and the situation (High Armaside, in Lorton,) particularly so. They did not all issue from the first or parent stock, but from that and the earliest swarm. Swammerdam tells us he was informed by a bee-keeper, that a single hive which was left him after the Count de Mansveldt overran Embden (60 years before), became the parent and grand-parent of thirty families within the year following; and Bose, the French Consul in Carolina, told Feburier that he had eleven swarms in one season from a single stock, and that these, one with another, threw off as many more; so that at the end of the year he had twenty-two families, besides losing several for want of hives to receive them!!!

First-swarms are much more particular in selecting a fine day for their emigration than after-swarms; it is the old lady, as Mr. Golding observes, that shows the greatest dislike to leave home in bad weather. This fastidiousness may arise from first-swarms being the most important to the preservation of the species, which in all probability renders them instinctively more careful of themselves than after-swarms. This view of the subject is confirmed by the disposition occasionally shown by first-swarms to select a suitable residence, prior to quitting the parent hive.

If the weather be sultry, bees are apt to rise after a storm, being anxious probably to escape from the heat of the hive, rendered more intolerable by the confinement which the storm has occasioned.

The space which *usually* intervenes between the first

and second swarm, is from nine to thirteen days; between the second and the third the period is shorter, about seven days; and if there should be a fourth, it may depart the day after that which has preceded it; it hardly ever exceeds two days. Feburier says he never knew an instance of more than two swarms issuing from a hive, where the second was accompanied by more than one queen.

Though I have stated the average period betwixt first and second swarms to be from nine to thirteen days, it may be extended to eighteen or twenty days. Such extraordinary intervals are most apt to occur in backward springs, in which, breeding being retarded, a swarm issues on the first fine day after the deposit of royal eggs, in order that as little time as possible may be lost during the important season for storing the new habitation with honey*. In these cases first swarms are apt to be small, seconds large; a part of the bees which in favourable seasons enter into the first swarm being, from the circumstances already stated, left behind, and thus augmenting the second.

The frequent succession of swarms, to which I have adverted, must be owing to the great number of mature princesses that are allowed to quit their cells. From several obtaining their liberty at nearly the same time, two, three, or more will often accompany a second swarm, thus occasioning a departure from the usual law of primogeniture, as respects the families from which they have issued; for if the swarm be not returned, the elder of the unhatched princesses left behind, will, when ma-

* This subject will be entered on more fully in the following chapter.

ture, assume the sovereignty. As a succession of after swarms greatly weakens the parent stock, and as they are naturally weak themselves, recourse has sometimes been had to the union of two or more of them into one family (vide Chap. XVII.); but, unless some especial reason exist for this union, it is best to return all but first swarms to the parent stock, especially those thrown off late in the year, or in a season unfavourable for honey-gathering, as one strong stock is more valuable than several weak ones. If, however, a second swarm should issue early, and the apiarian wish to increase the number of his families, and if he have ascertained that the parent stock has stored a sufficient quantity of honey, or nearly so, to carry it through the winter, a second swarm may be preserved, and make a flourishing family the following year, provided it be put into a hive or box of moderate size, and a due supply of food be afforded, either by the favourableness of the season, the near neighbourhood of heaths, or by the provident hand of the proprietor, in the ensuing autumn and spring. Such a family will always have the advantage of possessing a young queen.

It is the usual practice among the cottagers who do not reside in the neighbourhood of late autumnal supplies of food, to suffocate such late swarms, as well as the stocks from which they issue, early in the autumn, in forward situations and seasons, during the first week in August, in order to secure whatever honey and wax may have been collected up to that time. But in general, as I have already said, the most advantageous practice is re-union, returning all but first swarms to the stocks from which they issue. The easiest mode of accomplishing this is, at the close of the evening, to super-

hive the stock-box with that in which the swarm has been placed. With common cottage hives, the swarm must be dislodged by a smart blow with the hands upon the top of the hive, which should be previously placed on a cloth close to the stock, when if the edge of the cloth be raised to the mouth of the stock hive, the bees will soon ascend and join the family.

Mr. Golding effects re-union by catching the emigrant queen. The newly hived swarm being carried to a shady situation, is dislodged in the manner just described; the bees will then generally diffuse themselves; if they do not, they may be *gently* spread about by a wooden spoon or stick, and wherever there is the greatest disposition to congregate, there, in all probability, will be found the queen, for being more agitated than the rest she will generally endeavour to bury herself in a cluster of workers. Having detected, lay hold of her gently, and if there be any wish to preserve her for a few hours, quickly invert a glass over her, with or without a few workers. This accomplished, if operating on a first swarm, nothing more will be required; the bees will of themselves gradually return to the stock, and perhaps there will be no re-issue, or at any rate not for several days, not till the usual period of after-swarming. If it be an after-swarm that is operated upon, and the bees instead of returning home, after the removal of the queen, still show a disposition to congregate, it may be presumed that they have been accompanied by more than one princess, therefore a fresh search must be instituted, and a fresh capture made, and this extending even to a third or fourth, or as many as may be required.

As many persons doubt *the queen's importance* to the harmonious union of a swarm, I shall give an instance

or two to show how essentially necessary her presence is to produce this effect. Dr. Warder, being desirous of ascertaining the extent of the bees' loyalty to their sovereign, ran the hazard of destroying a swarm for that purpose. Having shaken on the grass, all the bees from a hive, which they had only tenanted the day before, he carefully searched for and gently caught the queen: then placing her, with a few attendants, in a box, he took her into his parlour, where, the lid being removed, she and her attendants immediately flew to the window, when he clipped off one of her wings, returned her to the box, and confined her there for above an hour. In less than a quarter of an hour, the swarm ascertained the loss of their queen, and instead of clustering together in one social mass, they diffused themselves over a space of several feet, were much agitated, and uttered a plaintive sound. An hour afterwards they all took flight, and settled upon the hedge where they had first alighted after leaving the parent stock; but instead of hanging together like a bunch of grapes, as when a queen is present, and as swarms usually hang, they extended themselves thirty feet along the hedge, in small bunches of forty, fifty, or more. The queen was now presented to them, when they all quickly gathered round her with a joyful hum, and formed one harmonious cluster. At night the Doctor hived them again, and on the following morning repeated his experiment, to see whether the bees would rise: the queen being in a mutilated state, and unable to accompany them, they surrounded her for several hours, apparently willing to die with her rather than desert her in distress. The queen was a second time removed, when they spread themselves out again, as though searching for her: her repeated reso-

ration to them, at different parts of their circle, produced one uniform result, "and these poor loyal and loving creatures always marched and countermarched every way as the queen was laid." The Doctor persevered in these experiments till, after five days and nights of voluntary fasting, they all died of inanition, except the queen, who lived a few hours longer, and then died. *The attachment of the queen to the working bees* appeared to be equally as strong as their attachment to her; though offered honey on several occasions during the periods of her separation from them, she constantly refused it, "disdaining a life that was no life to her, without the company of those which she could not have."

Swammerdam tried the experiment of fastening the queen, by one of her legs, to the end of a pole, by which he induced the bees to follow him wherever he chose. Reaumur relates a somewhat similar instance of a bee-man mentioned by Father Labbat in his Travels, who had the address to conceal the source of his dexterity. Wildman's expertness in this way was celebrated far and near. Vide page 190.

In confirmation of the evidence I have already given of the queen's importance to the well-being of the community, I will advert to some experiments of Huber. He removed a queen from one of his hives: the bees were not immediately aware of it, but continued their labours, watched over the young, and performed the whole of their ordinary occupations. A few hours afterwards agitatjon commenced; at first near the spot which the queen had occupied in the hive, then over a wider circle, the bees apparently communicating their mishap to their uninformed companions by the crossing of their antennæ, and thus the alarm was quickly diffused through

the whole hive: all now appeared to be a scene of tumult; a singular humming noise was heard, the bees deserted the larvæ which they had been feeding, and rushed over the surface of the combs with delirious impetuosity. On replacing the queen, tranquillity was instantly restored; and from what will be said presently, it appeared that they knew her individual person. Huber varied this experiment with other hives, in different ways; instead of restoring their own queen, he tried to substitute *a stranger queen*; the manner of her reception depended upon the period at which she was introduced. If twenty-four hours had elapsed after the removal of the native queen, the stranger was well received, and at once admitted to the sovereignty of the hive. If not more than eighteen hours had elapsed, she was at first treated as a prisoner, but after a time permitted to reign. If the stranger was introduced within twelve hours, she was immediately surrounded by an impenetrable cluster of bees, and commonly died either from famine or suffocation. It appeared therefore, in the course of these experiments, that from twenty-four to thirty hours were required for a colony to forget its sovereign; and that if, before the lapse of that period, no substitute was presented, they set about constructing royal cells, as stated in page 21; and moreover, that if, during the time they were so occupied, a princess was brought to them, the fabrication of royal cells was instantly abandoned, and the larvæ selected to occupy them were destroyed. On the admission of a welcome stranger queen, more regard is perhaps shown to her, at first, than to a restored natural queen, at least there are more conspicuous demonstrations of it: the nearest workers touch her with their antennæ, and passing their proboscis over every part of

her body, give her honey. In the cases above related, the bees all vibrated their wings at once, as if experiencing some agreeable sensations, and ranged themselves in a circle round her. Others in succession broke through this circle, and having repeated the same process of touching her with their antennæ, giving her honey, &c., formed themselves in a circle behind the others, vibrating their wings and keeping up a pleasurable hum. These demonstrations were continued for a quarter of an hour, when the queen beginning to move towards one part of the circle, an opening was made through which she passed, "followed and surrounded by her customary guard." Such is the substance of Huber's account: but subsequent observations have shown the latter part of it to be incorrect; queens have no customary guard. Vide page 20.

The loyal *attachment of bees to their queen* is however very remarkable. HUBER states that he has seen the workers, "after her death, treat her body as they treated herself when alive, and long prefer this inanimate body to the most fertile queens he had offered them." And Dr. EVANS relates the following affecting anecdote. "A queen in a thinly-peopled hive lay on a honey-comb, apparently dying: six workers surrounded her, seemingly in intent regard; quivering their wings, as if to fan her, and with extended stings, as if to keep off intruders or assailants. On presenting them honey, though it was eagerly devoured by the other bees, the guards were so completely absorbed in their mournful duty, as entirely to disregard the proffered banquet. The following day, the queen, though lifeless, was still surrounded by her guard; and this faithful band of attendants, as well as the other members of the family, remained at

their posts till death came kindly to extinguish both their affection and their grief: for, though constantly supplied with honey, not a bee remained alive at the end of four days. "Rege mortuo" (regina mortua), says Pliny, "mœret plebs ignava, non procedit, tristi tantùm murmure glomeratur circa corpus ejus." Another instance in which this strength of insect attachment to a defunct sovereign was evinced, occurred in the apiary of Mr. Golding, and a still stronger one is recorded by Gould in his history of ants.

Wildman has told us that, if the queen of a swarm be lost, though it happen several weeks after leaving the mother hive, the bees will return to it, carrying their honey with them. He might have added, and leaving the drones behind. In all cases of this kind, it is pretty clear that there is no egg or larva that could be converted into a queen. Both Reaumur and Wildman tried the experiment of introducing a *royal* larva into a queenless stock, when the bees immediately set to work again, on the inspiration of *hope* alone.

But it does not appear that either of these naturalists were in possession of Schirach's knowledge; and with respect to the return of a family to the parent stock after it has lost its queen, though such is usually, it is not uniformly the fact, as will appear from the circumstances detailed under the head of Longevity. In the instances there recorded, no desertion of the hive took place in consequence of the abduction of the queens, but the cases were peculiar ones.

Among the instances of desertion the following may be recorded. "Mr. Harman at the usual time of destroying the drones, in order to save trouble to the workers, set about rapping the former, as they made their

appearance on the alighting board; whilst thus engaged, the queen came forth, and being mistaken for a drone, became involved in the slaughter: the family was a populous one, but containing probably no ovum nor larva of a suitable age, in about a fortnight they abandoned the hive. Another case of desertion occurred to Mr. Golding. He had a vigorous family, from which a swarm issued the third week in May; on the twenty-ninth of the same month a second swarm also issued, which Mr. G. returned to the stock, in consequence of which the hive contained of course two queens. This family deserted the hive in July; *most likely* from the two young queens having waged a war of mutual extermination*. I also had a swarm that lost its queen a day or two after hiving, which nevertheless filled the hive nearly half full of combs, and then forsook it. In this instance, as well as in the two former, the drones were left behind.

If the bee-keeper be desirous of having early swarms, early breeding must be promoted, by feeding with sugared ale in February and March, and by keeping the stocks warmly housed in well-shaped hives, and of course, by withholding from them the accommodation which storifying affords.

Should several days of rainy weather succeed the hiving of a swarm, feeding must be had recourse to, otherwise the stores they carry with them from the parent hive may be exhausted, and famine ensue.

It is well-known that the issuing of a swarm may be prevented by bad weather; it is also clear that super or

* Such an instance of *bellum internecinum* once came to the knowledge of Mr. Dunbar.

nadir-hiving will generally prevent it, and that not only when the accommodation has been given early, but in some cases even where it has been deferred to a late period; till near the time, for instance, at which single hives have commenced swarming.

From a very close observation of what has taken place in Mr. Golding's apiary and my own, we are both decidedly of opinion that *no step is ever taken*, preliminary to swarming, which determines that event so absolutely, as not to leave the bees at full liberty to change their purpose, at any period betwixt that of depositing the first egg in a royal cell, and the perfect maturation of the royal insect. Mr. Golding had a family in his apiary with ample room, being three stories high, which nevertheless threw off a swarm on the 11th of June: in the evening he returned it to the stock. Being a first swarm, there was of course no rivalry; on the following day, and probably for several succeeding ones, it is reasonable to conclude they would undergo no particular change of circumstances. Still there was no subsequent issue, the royal brood having probably been destroyed, on the return of the queen; thus showing that the decision made one day, in favour of swarming, could be withdrawn on the next; and if on one occasion, why not on all? I have said there could be no royal rivalry on the return of the swarm; of this abundant evidence has been afforded, as the minutest examination has been made by Messrs. Golding and Humphrey, in families from which first swarms had issued; never did any one of them contain a princess that was not several days short of maturity, usually from eight to nine.

Swarming is an occurrence which can never be calculated upon with any degree of certainty; the most

patient and observant practical apiarians have, hitherto, been unable to discover any *infallible* criterion, from which can be inferred anything beyond an *intention to swarm*: there is, however, a tolerably sure indication of a determination not to do so, viz. when an early expulsion of the drones takes place, an event which sometimes happens even as early as May.

The imperfect state of our knowledge on this portion of the laws by which the bee community is governed, has led some apiarians to have recourse to what has been called

ARTIFICIAL SWARMING.

This is a mode of multiplying bees which is said to have been long in use, though the knowledge of it seems to have been confined to certain localities. The only written accounts of the practice that I have seen refer to it as being in use at Candia, Syra, and other islands of the Archipelago, from whence the knowledge of it probably found its way into some of the Sicilian Islands, Lusatia, &c. Swammerdam, as I have noticed in page 21, was acquainted with the practice of producing artificial swarms, but only by means of natural queens.

Under some circumstances, perhaps, the number of families may in this manner be increased with advantage; where, for instance, the apiary is situated inconveniently for being watched, or when the season is unfavourable for natural swarming. Still I think it not likely to become a favourite practice. There is a degree of animation and excitement, connected with natural swarming, which is exceedingly interesting to most bee-keepers, and which I think they would very much regret the loss of. The swarming of bees has long been the theme of admiration to the poet and to the admirer

of nature in general, and rural life would seem, if it were superseded, to be robbed of one of its varied charms.

"Up mounts the chief, and to the cheated eye
Ten thousand shuttles dart along the sky;
As swift through æther rise the rushing swarms,
Gay dancing to the beam their sun-bright forms;
And each thin form, still Eng'ring on the sight,
Trails, as it shoots, a line of silver light.
High pois'd on buoyant wing, the thoughtful queen,
In gaze attentive, views the varied scene,
And soon her far-fetch'd ken discerns below
The light laburnum lift her polish'd brow,
Wave her green leafy ringlets o'er the glade,
And seem to beckon to her friendly shade.
Swift as the falcon's sweep, the monarch bends
Her flight abrupt; the following host descends.
Round the fine twig, like cluster'd grapes, they close
In thickening wreaths, and court a short repose."

EVANS.

The vacancies, which must occasionally occur, in every apiary, may be efficiently supplied by keeping two or three stocks, in well-shaped single hives or boxes, and thus render a recourse to artificial swarming unnecessary: and as this latter mode of increasing families requires a degree of intelligence and practical adroitness, and a better knowledge of the natural history of the bee, than the great majority of bee-keepers (the cottagers) can be expected to possess, failures, arising from the want of such requisite knowledge and dexterity, would be very apt to put an extinguisher on the practice. Still, for the benefit of the curious, and of those who may differ with me in opinion, as to the advantage of artificial swarming, I will describe what I consider as the most eligible mode of accomplishing the business.

The practice itself is founded upon the power possessed by the bees of raising a queen, at any time, from an egg or very young larva, whether it have been laid in a royal or a worker cell, as explained at page 21; and this they may be induced to do in various ways, which will readily suggest themselves to the thinking apiarian, to whom the rationale of this system has been made clear. The most simple mode of proceeding, and the most in accordance with the system of bee management I have recommended, is the following. Towards noon of a fine day, or almost at any time, if the bees cluster out much, let a stock hive be removed to a distance, and a spare hive or box be put in its place, to one bar of which is attached a comb containing worker eggs, or very young larvæ of the same sex, (better still if the hive or box contain also one or two other worker-combs,) the outliers or the bees that are abroad, or both, as the case may be, will then enter the new habitation, cluster round the brood, construct one or more royal cells, to inclose one or more of the eggs, in the manner described at page 21, and raise a young sovereign, and thus, if the season be favourable, form a flourishing stock, whilst the old removed family, with beneficially diminished numbers, will soon be reconciled to their new situation, and attend to their usual avocations, as if nothing had happened.

The brood-comb, which should not be less than two or three inches in diameter, may be supplied from any hive which can spare it; but if not taken from a loose-barred box of suitable dimensions, it may be separated from its original attachments, and secured to a central bar, by some strong twine or fine wire, care being taken not to alter the original position of the cells. If the ad-

justment be tolerably correct, the bees themselves will cement the comb firmly to the bar.

Natural swarms, as I have already stated, if bad weather supervene soon after they are hived, require feeding; much more will those that are artificially obtained; as the bees that are separated from the parent stock, being taken unawares, will not have provisioned themselves for the occasion.

Feburier warmly advocates artificial swarming by *separation**, resting his arguments in favour of it upon the advantages of choosing your own time, being able to fix upon a fine day, and running no risk of losing a swarm. Still he admits that from the general indisposition of cottagers to quit the beaten track, they will be very likely to prefer the old system, as that requires on their parts only a little sacrifice of time and patience, Nature accomplishing the rest.

In attempting to raise artificial swarms, if there be no mature drones *in the apiary*, it will be obvious that it should possess drone nymphs, in a state of considerable forwardness.

It is not necessary to the fecundation of a young queen that the family, of which she is a member, should contain drones; it is sufficient that there be drones in or near the apiary.* This fact was clearly ascertained by Mr. Humphrey, who having examined the bees of a second swarm *seriatim*, by dislodging and spreading them out on a cloth, perfectly assured himself of its not containing a single drone; but found nevertheless that her majesty became impregnated, and actually witnessed the visits paid to the hives by neighbouring drones. The period of impregnation appears to have been retarded

* By means of hives that can be divided into two equal parts.

by this lack of males in the family; for on the tenth day after hiving not a single egg had been deposited in the cells, and on the sixteenth, eggs only were to be found in them.

The success of artificial swarms will very much depend upon the time at which they are formed; for if it be late in the season, or that season prove unproductive of honey, both divisions may require feeding; whereas the conjoined family might have flourished without it.

CHAPTER XIV.

SYMPTOMS PRIOR TO SWARMING.

"See where with hurried step, th' impassion'd throng
Prize o'er the hive, and seem with plaintive song
T' invite their loit'ring queen; now range the floor,
And hang in cluster'd columns from the door;
Or now in restless rings around they fly,
Nor spoil they sip, nor load the hollow'd thigh.
E'en the dull drone his wonted ease gives o'er,
Flaps the unwieldy wing, and longs to soar."—EVANS.

THE symptoms indicative of swarming may be divided *into those which precede first swarms, and those which precede after-swarms*, each kind having some precursory symptom peculiar to itself; whilst there are other symptoms which may be regarded as common to both; these are,

1. The inactivity of the working bees, which neither gather honey nor farina, though the morning be sunny, and the weather altogether inviting. Reaumur regarded this as the most indubitable sign of preparation for swarming.

2. Unusual silence in the hive, during which the separatists are supposed to be taking in a cargo of honey before their flight, as well for a security against bad weather, as to be in a state of forwardness for the secretion of wax. Mr. Hunter opened the crops of some bees that remained in the parent hive, and also those of some emigrating bees, when he found the latter quite full, whilst the former contained only a small quantity: they are generally supposed to stock them-

selves with a sufficiency for about three days' consumption.

The Symptoms prior to a first Swarm are,

1. Clustering or hanging out. This, though a fallacious symptom taken singly, does certainly indicate that there are bees sufficient to throw off a swarm, and when conjoined with other indications, may be regarded as the precursor of a first swarm, particularly if accompanied by the signs enumerated at the commencement of my motto; still more so, if the bees which return with pollen from the fields remain with the cluster, instead of carrying their loads into the hive. Yet, however distressed they may be for room, unless the hive or box contain a young princess, the queen regnant will not go off with them; the clustering therefore will sometimes continue for a considerable time; in hot, dry seasons it may last till the middle of August. The presumptive evidence of a family, thus circumstanced, having made no provision for rearing a young sovereign, is strengthened by the experiments of Reaumur: he drowned several such hives, and examined all their inmates most minutely, but could never find more than a single queen, and this the old one; in none of these hives did he find royal larvæ.

2. The drones being visible in greater numbers than usual, and in great commotion, especially in the afternoon, and particularly, as has been observed by Butler, if they hang out with the cluster.

Mr. Dunbar regards the construction of drone-cells as indicative of an intention to swarm, and this is probably sometimes the fact when it takes place in swarms of the current year, for there appears to be no other reason

for bringing drones into existence. Still it is by no means an infallible token, drone-combs being often constructed purely as depositories for honey, and as respects the combs of old stocks, these having been constructed during the first year's occupancy, can afford no indication for any subsequent year.

Distinctive Symptom of an After-Swarm.

A singular noise called PIPING for two or three nights previous to the swarm's issuing. "Cum migrandum est," says Aristotle, "vox solitaria et peculiaris aliquot ante diebus intùs mittitur." This, by apiarians of former days, was variously described and accounted for, and gave birth to much fanciful theory. It is now however, ascertained beyond a doubt, that the sharp, clear notes uniformly proceed from a princess that is at liberty, and that the notes which are uttered in a hoarse key, as uniformly proceed from one that is still imprisoned. A very satisfactory confirmation of this fact occurred to Mr. Golding. On the 7th of June a first swarm issued from one of his hives; on the 14th *piping* commenced, two days sooner than it is usually heard; but what appeared still more singular, the piping was not in a clear and plaintive but in a short hoarse key. Nevertheless the notes proceeded from the senior princess, this unusual cadence being found to arise from her piping, before she had obtained her liberty. After it had continued for two days, she emerged from her cell, when the hoarse notes immediately gave place to the plaintive ones. Soon afterwards another princess hoarsely responded; they piped together for the usual term of three days, the notes of each being marked throughout by the usual distinctive intonation. The first piping was

manifestly premature, but it clearly shows the cause of the different sounds that usually precede an after-swarm. The queen that is at liberty, when piping, stands, or rather squats, and exhibits a tremulous motion with her body and wings, the latter moving slowly in a horizontal direction; the motion resembles the working of a pair of bellows, with their edges held vertically. On the first day, the sound which she utters is rather indistinct, on the second it becomes clearer and louder; it is long and plaintive, particularly the starting note, and is repeated five, six, or more times in succession, in a clear shrill key, but becomes shorter and shorter each time. The note of the imprisoned princess, which generally commences on the second day, is hoarse, dull, and short throughout.

Out of this assemblage of symptoms, the attentive apiarian will, generally, be enabled to judge not only when a swarm may be expected, but also whether he shall be presented with a prime or an after-swarm.

It has been said that if the issue of a prime swarm be delayed by unfavourable weather, it is sometimes preceded by the vox regalis. Mr. Howatson mentions an instance of the kind in his Apiarian Manual, in which are some ingenious observations on the cause of piping, which Mr. Howatson attributes to fear, and considers this opinion to be supported by its having been induced on one occasion, by a bee-cultivator's imprisoning a queen in his hand, and also by its being uttered whenever her majesty is much harassed by the workers.

This royal clacking, *if the bees be prepared, or are preparing, for the issue of an after-swarm,* continues during the day as well as the night, and is sometimes so loud as to be distinctly audible, at the distance of several

yards from the apiary. It generally commences about the ninth day after the departure of the first swarm, and *in this case* continues at short intervals till the twelfth or thirteenth. Within this period of four days, if the weather permit, a swarm may be expected to issue; in very fine weather, it usually takes place on the tenth or eleventh day. After the third night's warning, the bees swarm, even though the weather be but indifferent, and such as would deter a *prime* swarm from leaving the hive.

Unless the royal voice can be heard *about* the period above stated, no after-swarm will issue. From an extensive observation made by myself and friends, in our respective apiaries, I may confidently state, therefore, that this sign may be regarded as the invariable precursor of an after-swarm, and that its absence, in any stock from which a swarm has issued, as infallibly denotes that its swarming is over for the season.

I have said that the period at which piping usually takes place is the ninth day after the departure of a first swarm; in this there is however a degree of uncertainty, depending in some measure upon the state of the weather, and perhaps on other circumstances. It may take place *a few* days earlier and several days later than the average time. It has been known to occur within a day or two of the issue of the first swarm, and it is by no means an uncommon thing for it to happen as early as the seventh or eighth day after it; piping is also now and then delayed to the fifteenth or sixteenth day; whether late or early, it continues the usual time, namely, three or four days, so that when *deferred* to the latest period I have named, the second swarm will not come forth till the eighteenth or twentieth day after the

issue of the first. Both these extremes, however, may be regarded as very rare occurrences.

In order to understand the rationale of what I have said, it is necessary to advert to the period at which a young princess begins piping, namely, as soon as she has arrived at maturity, and to compare this with the average periods of first and second swarming. A first swarm *generally issues soon after the cells of the embryo queens have been sealed over*, therefore when the latter are about eight days old; in about eight more they are mature: either then or on the morrow piping *usually* commences, and betwixt *this* (which constitutes the ninth day of the queenless stock) and the thirteenth day, the second swarm *generally* takes its departure. When the weather, however, and other circumstances have proved peculiarly favourable, a first swarm, as I have already observed, has been known to issue almost immediately after the tenanting of the royal cells. Several instances of this early departure of first swarms occurred under Mr. Golding's observation in 1829, in which year, piping did not commence, in any one of his stocks, earlier than the thirteenth day after the departure of the first swarm.

This will account satisfactorily for the apparently late issue of some *second swarms*, or more properly speaking for the time which intervenes betwixt a first and second swarm. It likewise illustrates the cause of the occasional variations in that period, and also accounts for a first swarm being so much more particular than a second or third, respecting the state of the weather at the time it issues. It has the whole period, from the time of securing a royal succession to that of the maturation of the royal brood, from which to choose, which may under

peculiar circumstances be extended to nearly three weeks; whilst in the case of after-swarms, the embryo queens, in their progress to maturity, advance so closely upon the heels of each other, as to compel the bees to issue, though the weather be but indifferent, or to have the senior princess engage in mortal combat, with her rapidly maturing rivals. In 1830, the rapidity with which second swarms succeeded the first was as remarkable as their tardiness in 1829. Mr. Golding in the former year had two families in which piping commenced on the third day, and in one of them the second swarm issued on the fourth. The weather had proved so very unfavourable, that the old queens deferred emigrating, as long as they well could.

It has been already stated, that in favourable seasons and situations, a prime swarm will sometimes send forth another swarm. In this case it usually occurs between the twenty-eighth and thirtieth day of its establishment*, and the only indication of the approach of such an issue, besides those already enumerated, is the worker-combs, with which first swarms generally store their hives, becoming edged with drone cells.

Swarming is usually preceded by a considerable number of bees sporting, with great activity, in the air, in front of the hive, as though waiting for their queen. The moment before their issue exhibits a very lively agitation, which quickly pervades the whole of the family, exciting such a tumult among them, that they abandon their labours, and rush in disorder to the outlets.

* I had a swarm from an excessively crowded mirror-hive on the fifteenth day after hiving: this may be regarded as a very unusual occurrence; a solitary one, so far as my knowledge extends.

In this agitation it has been generally supposed that the queen participates; indeed Huber asserts positively his having ascertained by direct experiments that she commences it. This, however, cannot be uniformly the case, or swarms would never issue without a queen, which we know they sometimes do, and in consequence return to the parent hive; nay, in one instance, which fell under the observation of Mr. Golding, a second swarm issued twice from a hive in which the queens were still in embryo.

When detained by bad weather, the queen may now and then be seen pacing a turn or two before the entrance, as if impatient of delay, and will sometimes re-enter, but only to return and take flight with those bees which have been roused to the requisite activity. On other occasions she does not make her appearance till after the issue has begun. When joining in the flight, she seems to be borne along by the torrent which streams out of the hive. After having spread themselves somewhat diffusely in the air for a short time, some of the bees usually alight upon a bough or bush, where they are soon gradually joined by the rest, and having knit together, assume the form of a cone, pine-apple, or cluster of grapes.

We hear now and then of a swarm of bees being lost, of its having eluded the vigilance of the proprietor. In these cases the bees are said to have issued without any previous notice: I think, however, that if due attention were paid, no such losses would be sustained, but that some one or more of the symptoms, I have mentioned, would *generally* be observable, for several days prior to swarming, and that the loss is frequently attributable to negligence. I suggest as a probable exception to

this, that after several wet days a swarm may, on the first fine day, issue rather suddenly. If, after issuing, it either quit the place on which it first congregates, or decamp from a hive in which it has been lodged, it hovers in the air for some time, as if undetermined what to do, and then flies off with a shrill whizzing sound, in a direct line, and with great velocity, to a distance; in the language of some apiarians, to a spot which it has already selected.

Bees in their *wild* state seek a snug housing in some hollow tree or rifted rock, where they fix their permanent habitation.

> "And oft ('tis said) they delve beneath the earth,
> And nurse in gloomy caves their hidden birth,
> Amid the crumbling stone's dark concave dwell,
> Or hang in hollow trees their airy cell."
>
> SOTHEBY'S GEORGICS.

Many instances are also recorded, of *domesticated* bees seeking an asylum, in some hollow part of an old building or tree. Butler, Dr. Warder, Mr. Knight, Dr. Evans, Duchet, Ducarne, Dubost, Della Rocca, and other writers, think that the bees about to swarm, *regularly* send out scouts, to explore an eligible situation for their future residence; though Dr. Evans admits that this disposition to resume wild habits, like many of the instinctive faculties of the animal creation, has its intensity weakened by domestication. Dr. Warder asserts that the bees always send out providers, to select a residence for them, several days before swarming, and considers that their clustering upon a bough, &c. soon after they issue forth, proceeds from their desire to be all congregated together, prior to their last flight: this is likewise the opinion of Mr. Knight. If the place se-

lected be a deserted hive, it is *generally* first cleared by the bees of all heterogeneous matters, the old combs alone being allowed to remain. An observance of this conduct probably led Columella to recommend the placing of empty hives, during the swarming season, in appropriate situations near the bees. Keys gives a similar recommendation, and I think the practice a judicious one, particularly if the hives be wholly or partly furnished with combs, having known several instances in which it has saved the trouble of hiving, by inducing swarms to enter the decoy hives spontaneously. Reaumur, on the other hand, ridicules the idea "of spies and quarter-masters" as ingenious fable, and is supported in his opinion by Buffon, Bonnet, and Huber: the former says that the swarming bees form a cloud round their queen, and set off without seeming to know the place of their destination; "the world before them, where to choose their place of rest." As in some measure confirming the opinion of these eminent naturalists, it may be observed that bees have been often known to commence comb-building upon the boughs on which they have alighted when swarming. I have several times seen rudiments of comb under such circumstances, and am now in possession of a thorn-spray with a piece of comb appended to it, two inches in depth; thus showing that these emigrating insects intended (so far as credit can be given them for intention,) to take up their abode permanently, upon the very spot on which they first clustered round their royal mistress. As I am desirous of doing justice to both opinions, I will now proceed to detail a few cases that strongly countenance that of selection.

In the Philosophical Transactions for 1807, Mr. Knight,

writing to Sir Joseph Banks, relates several instances confirmatory of bees sending out providers. On one occasion he observed from twenty to thirty of them, paying daily visits to some decayed trees, about a mile distant from his garden; the bees appeared to be busily employed in examining the hollow parts, and particularly the dead knots around them, as if apprehensive of their admitting moisture. In about fourteen days, these seeming surveyors were followed by a large swarm from his apiary, which was watched the whole way, till it alighted in one of these cavities, having been observed to journey nearly in a direct line to the tree. On several similar occasions the bees selected that cavity which Mr. Knight thought best adapted to their use. He also noticed that a stock being nearly ready to swarm, one of these hollow trees was daily occupied by a small number of bees; but the swarm from that stock being lodged in a *hive*, the tree was wholly deserted. This preference of a *hive* when offered, to a place previously chosen, Mr. Knight ascribes to a habit acquired by domestication, which generating a dependence upon man for providing a dwelling, descends hereditarily from the parents to their offspring. Another instance, in support of Mr. Knight's opinion, is related by Dr. Evans: he suffered a hive, whose tenants had died in the winter, to remain upon the stand till spring; he then observed several bees paying it daily visits, and busily employed within, but leaving it at the close of evening. These soon appeared, like Dr. Warder's providers, to be the harbingers of a swarm; for early in June an immense body of these insects were seen rapidly approaching, and then surrounding the hive: they took possession as quickly as its narrow entrance and crowded

combs would permit*. The same result was noticed after the mild winter of 1806–7, which untenanted one of his hives by famine; he was present when the swarm issued, (from another hive in his garden,) to take possession of the empty one, which on his endeavouring to

* An instance of this kind, but of a still more interesting nature, occurred to Mr. Estlin of Bristol, no bees being kept within a mile of his house. He had lost the whole of his stocks during the autumn of 1836; one of the families thus lost having been procured from a friend's apiary, situated two miles from Bristol, with which it seems probable that some sort of recognition was maintained. The year 1836 was very unproductive of honey, and Mr. Estlin's bees, in all probability, not having collected enough to support them through the winter, transferred what they did collect to the stock from which they issued, and then took refuge there themselves. This may be inferred from the clean state in which the deserted combs were found in the spring of 1837. This latter year affording better promise than its precursor, when the swarming season arrived, those among the emigrants that survived the winter, recollecting, no doubt, the comfortable quarters with which they had been accommodated during the previous summer, would very naturally explore the spot, and finding their former habitation not only *in situ*, but still provided with the fittings they had left behind them, as soon as they had brushed out the apartment, and given the furniture a fresh polish, left the temporary winter quarters with which they had been kindly accommodated by their friendly neighbours, and resuming the rightful possession of their former mansion, fairly hummed themselves in, of course escorting with them a reinforcement from the family of their hosts.

A family of my own once acted in a precisely similar way; but in this case having only a few yards to fly when migrating in the autumn and returning in the spring, the whole of the proceedings fell under my own eye. In Mr. Estlin's case something is necessarily left to inference. The result, however, of an inquiry into the circumstances which occurred in the family, from which the swarm of 1837 was supposed to issue, fully justified the opinion that it had, unknown to its proprietor *at the time*, actually thrown off a swarm, and that Mr. Estlin's acquisition and his friend's loss were simultaneous.

raise it, to give facility to their entrance, he found already cemented to the floor. The Doctor also relates a case, in which a swarm of bees made its way, either over the tops of some very high houses, or through several winding streets, to an old house in the centre of Shrewsbury, and passing through an aperture in the wood-work to a room on the first floor, were there hived by the family. Butler, in his *Feminine Monarchie*, mentions the case of a poor woman, whose hive being depopulated by famine, was allowed to remain out of doors till the ensuing summer, when a swarm took possession of it, from which she afterwards established a considerable apiary.

Thus far, in the former edition of this book, I stated the facts on both sides of this disputed question. Subsequent observations made by Mr. Knight have led him to conclude that those bees which are often seen hovering about, and apparently examining a selected residence, are not, as he originally supposed, the same, but a succession of different members, either of the same, or of two distinct families; for it seems clear from Mr. Knight's statement, as well as from the observations which his paper on the subject before referred to, has led myself and others to make, that two swarms will occasionally issue pretty nearly at the same time, and congregating either on the same bough or in the same hive, place themselves under one sovereign. As well in these cases, as where no such union takes place, Mr. Knight is of opinion, that previous to each swarm issuing, it is not only decided what bees shall enter into it, and what remain behind, but that the first place of rendezvous, as well as the intended place of residence, has been decided on and visited separately by all the bees that intend to emigrate, prior to the simultaneous issue of the swarm;

to this cause he attributes the succession of visitors just alluded to. Though it would be difficult to disprove this theory, still there are some circumstances which render the uniform correctness of it improbable, as well with respect to its being decided, prior to the issue of a swarm, what bees shall enter into it and what remain behind, as to their preconcerted congregation on a bough. On the first point, I may remark, that when bees cluster out prior to swarming, it is not to be supposed that those which would enter it, if the swarm rose early, would not many of them be abroad if it rose at an advanced period of the day; nor that those members of the swarm which have pollen on their thighs had not arrived from the fields so recently as to make it probable that they were but just in time. To take any other view than this would be to hold an opinion that in those cases where swarming is delayed by untoward circumstances, the clustered bees would neglect the necessary collection of food. And with regard to the second point, I will state an occurrence in my own apiary. On the second of June 1829, a swarm issued from one of my hives: the bees hovered about for ten or fifteen minutes rather diffusely in the air, but with an evident disposition to cluster upon an *apple-tree* (a general favourite with my swarms); they however gradually returned home without clustering. *On the ninth* they issued again, and clustered kindly on a *laurel bough*: they were soon hived, but in a few minutes returned home a second time. *On the tenth* they re-issued for the third and last time, and congregated upon a *branch of hawthorn*: the branch being cut off, a box was placed over it, into which the bees ascended and remained quite contented. If the place of congregation is an

object of previous choice, these bees must have made a selection of three different boughs, and betwixt the second and third issue there would scarcely be time enough to justify the notion of a consentient choice. It seems highly improbable, if bees are in the habit of making such consentaneous selection, that they should in this instance have been so whimsical that the whole swarm should within so short a period have occupied themselves in an examination of three distinct selections, neither of them, to all appearance, being superior in value to the rest. A case closely resembling this occurred to Mr. Golding in 1836; and in a correspondence which I have had with Mr. Knight upon this subject, he has given up his opinion, to a certain extent, accounting for the different results of our respective observations, by remarking that, his had been made upon the habits of bees in their wild state, whilst I had occupied myself in noticing the habits of domesticated bees.

It must be admitted that among those persons whose supply of honey depends solely upon the plunder of the *wild* bees, we do not hear of any families being lost for want of a suitable shelter. An instance has also come to my knowledge in which there was evidently a preconcerted arrangement among *domesticated* bees. It occurred to Mr. Harman in 1828; a swarm having issued from one of his hives clustered upon a bough, from which it was found exceedingly difficult to dislodge it. He however contrived to hive the major part, leaving about a pint upon the bough. Having placed the *hived* bees upon a floor-board, he prepared to clear the bough of its small detachment, when out rushed a swarm from another family. Apprehending from their proceedings that a union was meditated, he promptly con-

veyed those that had been hived, to a distance, and soon perceived that his apprehension was well-founded, for the second issue quickly coalesced with the small cluster that remained upon the bough. Mark the sequel: Mr. Harman had removed the great bulk of the first swarm (which, as it afterwards appeared, contained the queen,) beyond the reach of the second issue, which, as it will also appear evident, contained no queen, for after remaining a short time with the small detachment they had joined, the united mass rose from the bough and entered in one continuous stream, not the hive from which the *last*, but that from which the *first* issue had taken place, vainly expecting, no doubt, to find that the queen they were in quest of, had been left behind. This case strongly confirms Mr. Knight's theory, for if *two* families of bees can have credit for a preconcerted union and a preliminary congregation upon a selected bough, *à fortiori*, a *single* family may have credit for choosing a final residence. This view of the matter receives confirmation from the opinion of Bonner, who states "that he knew for certain, that a swarm would not fly a mile to an empty hive, whereas," says he, "they will fly four miles to take possession of an old one with combs in it."

These spontaneous unions do not always arise from a dearth of queens, for cases have occurred to Mr. Dunbar, Mr. Golding, and myself, in which the united mass has contained two queens, and others are mentioned by Lagrenée. The disposition to unite seems, in many instances, to be produced purely by the commotion of the swarming bees of one stock communicating their fervour to others that are ready to swarm, thereby causing a simultaneous issue and consequent coalition. This effect was strikingly exemplified in a case which oc-

curred to Mr. Golding. One family sent forth a swarm, which was satisfactorily hived; on the day following a neighbour's stock also swarmed; the excitement of this one was quickly communicated to the other, which sallied forth from its new domicile and mingled in the throng, and that notwithstanding the queen of the first issue had begun to lay. Mr. Golding divided them, and succeeded in keeping the two issues apart, thus showing that each possessed a queen.

From the whole of the facts which bear upon this question, I think it seems pretty clear that the bees do *sometimes*, but not *uniformly*, make choice of a residence. Mr. Dunbar, after discussing the pros and cons upon this question, and taking a similar view of it to my own, concludes his observations in these words: "The truth is, that writers on bees, like writers on other subjects, are fond of classing the acts and proceedings of their favourites under certain fixed and uniform rules, from which they are supposed never to deviate; whereas, daily observation may convince us that bees, like ourselves, are often the slaves of circumstances, and that their instinct is frequently at fault. That a swarm often takes possession of a retreat previously selected, is, I think, an undeniable fact; but that it oftener blindly follows its queen, which flies heavily, and generally perches on the first bush in the line of her flight from the hive's mouth, and perhaps within the distance of three or four yards, is quite consistent with constant observation and experience."

With respect to the heaviness of the queen's flight, as compared with the workers, this statement is clearly correct; and Swammerdam accounts for it from the circumstance of her pulmonary tubes being not so fre-

quently divided or expanded into bladders as theirs, and an old quzen has the additional impediment of having her ovaries burthened with eggs. But, as regards her being the first to perch upon the place of congregation, I must observe that she quite as often joins the cluster while forming, and that now and then it begins to form before she has quitted the hive.

In apiaries of some standing, it has been observed, that the descendants of the aboriginal bees are prone to settle on a particular tree or bush when swarming, whilst swarms from those recently introduced do not; also, that after-swarms are apt to congregate further from the parent stock than prime swarms, and I believe that I may add that they are much less apt to select a residence; I never knew nor heard of an after-swarm being thus provident. These differences may arise from young queens being lighter and more adventurous than old ones. The latter flying heavily are glad to alight as soon as possible; and the precautionary prudence of prime swarms may be ascribed to the time for deliberation and research which usually intervenes between their determination to issue forth and its fulfilment; perhaps also to the experience and caution of old queens.

CHAPTER XV.

HIVING OF SWARMS.

The hiving of bees is a proceeding so well known that it seems unnecessary to offer any observations on the particular method of effecting it.

In every apiary there should be a stock of hives, boxes, &c., always ready beforehand, either for storifying or for single hiving, properly surmounted with lids and furnished with guide-combs; a neglect of this precaution will often be productive of great inconvenience and confusion. The weight of each hive and board should also be ascertained prior to their being used, that the weight of the contents may at any time be known.

It is always desirable, in the purchase of swarms, to have them put into *new hives*, as old ones, if not taken good care of, often contain the larvæ of moths and other embryo insects, which may prove injurious to the bees. If straw be the material with which they are made, every rough straw should be removed from the interior, otherwise the bees will lose that time in rendering it smooth which they could employ to greater advantage in gathering honey and constructing combs. For a similar reason, if boxes be preferred, these should be made air-tight with putty or other cement, that the bees may not consume their time in filling the crevices with propolis. If on any occasion the apiarian be induced to have recourse to *an old hive* for receiving a swarm, it should have been previously dipped in boiling

water to destroy the eggs of moths and other insects, after which it should be made perfectly dry.

Dressing the insides of the hives was by Wildman strongly reprobated, as it gives the bees the trouble of making the hive clean again. If anything be used, in compliance with custom, sugared or honeyed ale is the most alluring.

A tinkling noise is generally, though erroneously, considered to be useful in inducing bees to settle; it is usually made by drumming smartly upon a frying-pan with a large key; and the cottagers call it *Tanging* or *Ringing*. It was probably practised *at first*, as Butler says, to proclaim to the neighbours that a swarm was up, serving as a public notification to them from whence it proceeded.

This view of the matter is confirmed by the opinion prevalent in some districts, that unless the apiarian can prove the tanging, he cannot justly lay claim to the swarm, if it happen to cluster on the premises of a neighbour. The original object of this proceeding seems, however, to be lost sight of, and what was founded on reason has been continued from habit; consequently the practice is regarded by most of the cottagers as quite necessary to effect a speedy and satisfactory settling of the bees. Most scientific apiarians discountenance it, and I am convinced that it is wholly unnecessary. Mr. Dunbar, during a period of nearly forty years, has only lost one swarm, and that, contrary to his own opinion, was most sonorously tanged. It is, however, a very ancient practice, older than the days of Aristotle.

When bees are disposed to stray, *throwing handfuls of dust or sand amongst them* will on some occasions

cause them to descend and cluster, these missiles being probably mistaken for rain. Mr. Golding says he has known many swarms arrested in this way by labourers in the field.

Bees, when swarming, are generally peaceable, and if treated gently, may be hived without danger or difficulty. *A remarkable instance of their inoffensiveness at this time* is related by Mr. THORLEY. Wanting to dislodge a swarm from the branches of a codlin-tree, he placed the hive in the hands of his maid-servant, who being a novice, covered her head and shoulders with a cloth to guard her face; on shaking the tree, most of the bees alighted upon the cloth, and quickly crept under it, covering the girl's breast and neck up to her very chin. Mr. T. impressed her with the importance of neither flinching from nor buffeting the bees, and began immediately to search for the queen; which on finding, he gently seized and removed, but without effecting a dislodgement of the swarm: thus disappointed, he suspected that there was a second queen, which actually proved to be the case. On securing, and placing her in the hive, with a portion of the bees, the rest followed in multitudes, till in two or three minutes not one bee remained upon the girl, who was thus released from her state of apprehension and alarm without feeling the point of a single sting.

The following is extracted from M. LOMBARD. "A young girl of my acquaintance was greatly afraid of bees, but was completely cured of her fear by the following incident. A swarm having come off, I observed the queen alight by herself at a little distance from the apiary. I immediately called my little friend that I might show her the queen; she wished to see her more

nearly, so after having caused her to put on her gloves, I gave the queen into her hand. We were in an instant surrounded by the whole bees of the swarm. In this emergency I encouraged the girl to be steady, bidding her be silent and fear nothing, and remaining myself close by her; I then made her stretch out her right hand, which held the queen, and covered her head and shoulders with a very thin handkerchief. The swarm soon fixed on her hand, and hung from it, as from the branch of a tree. The little girl was delighted above measure at the novel sight, and so entirely freed from all fear, that she bade me uncover her face. The spectators were charme with the interesting spectacle. At length I brought a hive, and shaking the swarm from the child's hand, it was lodged in safety, and without inflicting a single wound."

All persons, similarly situated, may not be so fortunate, as, notwithstanding the greatest precaution, bees may be provoked to draw their swords. Dr. EVANS relates a case of this kind: a swarm having settled on the branch of a larch-tree, and its long tufts of narrow leaves flapping the bees as the bough was shaken, the woman who hived them received above thirty stings.

If the weather be windy at the time of swarming, they are often irritable, and apt to sting; and though clustered, will frequently return home: this last occurrence is generally caused by the absence of a queen, but it may also be produced by a sudden shower, or the transit of a dark cloud. In these cases the swarming is merely deferred.

A queen has sometimes a defect in her wings, or is disabled by some accident; either of these misfortunes may cause the return of a swarm, or produce symptoms

of discontent after hiving. Should such symptoms be observed, the queen will probably be discovered on the ground or somewhere apart, surrounded by a small cluster of attendants, whom nothing but violence can separate from her. If she be taken up either singly or with the cluster, and placed near the entrance of the hive containing the swarm, all will be harmony.

Sometimes a swarm divides into two portions, which settle apart from each other; should this happen with an after-swarm, it may be presumed that each portion has a distinct leader. The conduct of the apiarian in this case must be governed by the size of the two divisions, and the season at which they emerge; unless both be large and the swarming early, they had better be hived in separate boxes, and joined together in the manner recommended in page 184. If near enough together, they may be hived in the same box.

The branch on which the swarm settled is sometimes rubbed with wormwood, or smoked with disagreeable fumes, to drive away all remaining loiterers. The readiest and simplest mode of procedure, however, is to keep up a constant agitation of the bough by means of a long hooked pole, till the whole or nearly the whole of the bees have forsaken it.

No attempt should ever be made to introduce a swarm into a hive or box till the cluster is nearly settled, nor should the hiving be long delayed, lest the bees rise and fly to a distance.

The general practice is not to remove bees to their intended station till night, but Bonner and Mr. Golding recommend their removal as soon as the swarm seems to be pretty well settled; and I am of opinion that this plan is judicious, as the bees of a *full* swarm

begin to explore the fields soon after hiving, and it is on that account desirable that their earliest proceedings should be associated with the spot upon which all their future operations are to be conducted; it will prevent that puzzling and impediment to their labours which are apt to be produced, by delaying the removal till night. Let the newly-tenanted hive therefore be placed as soon as possible upon a floor-board and at once removed to the site which it is intended to occupy. Should any sufficient reason prevent the adoption of this early removal, let it be placed as near to the intended site as convenient, and unless it stand in the shade, be covered with boughs or a cloth.

Notwithstanding what I have said as to the early location of a swarm, there are still some intelligent apiarians who prefer the ancient practice of deferring the removal till night; Mr. Knight stands in this class, and says he does not believe that bees ever have any difficulty in finding their way from the fields to their new habitation, provided it be fixed before the next morning, and he considers late removal as securing the congregation of all stragglers. "A young bee," says he, "when she first issues from a hollow tree in the midst of a wood is as unerring in her return, as the fall of a stone to the earth, in obedience to laws of which we are and must ever remain ignorant. It seems to be simply an act of her will."

In every operation it is desirable to avoid crushing a single bee, as, in case of discovery, the rest are excited to anger. See Chapter on the *Senses of Bees*.

CHAPTER XVI.

ON DRIVING AND DISLODGING BEES.

MANY plans have been suggested for transferring bees from hives to boxes; but excepting in the case of a recent swarm, I would not recommend any but an experienced apiarian to attempt an immediate transfer.

In the case of a recent swarm, the method of effecting the object is simple and easy. All that is required is to spread a cloth upon the ground towards the close of evening, and placing the full hive upon it, to strike the top and sides *very* smartly with the hands, when the bees will be instantly dislodged and fall down. An assistant must now lay down a couple of round, or still better, triangular sticks, on each side of the conglomerated mass of bees, and place the box thereon, when the bees will quickly ascend and soon be ready for removal to their proper site. The hive, from which the bees have been dislodged, should be laid on its side close to the box, to give any stragglers that may remain behind a ready opportunity to join their companions. If the bee-master be too timid to adopt this safe and simple method, he may, when the bees have retired for the night, place the hive upon a middle board, with a divider underneath it, and invert the whole upon a small tub or peck measure; then placing a box furnished with guide combs, imbued with honey upon the divider, withdrawing the latter, and securing every opening but what is necessary for admitting air, the bees will all probably have ascended into the box by morning, particularly if

the inverted hive be a little agitated as soon as the whole has been fixed, when with the assistance of the dividers or a whiff of tobacco smoke, they may be placed in the bee-house or anywhere else that the proprietor chooses, just as if they had been originally hived in the box. Should they not have ascended in the morning, they may be induced to do so by drumming smartly with two sticks upon the sides of the hive: in this way, the ascent may be known by the loud humming noise by which it will be accompanied.

I have said that the above plan is only to be recommended for cases of recent swarming: by this I mean for swarms of the day on which it is to be attempted, and before any works are constructed in the hives to such an extent as to attach the bees to their new habitation; for wherever they form a settlement and have begun to build combs, they are very tenacious.

Having thus pointed out what appears to me to be the best and simplest method of removing *recent* swarms from hives to boxes, I shall now enter upon the subject of

DRIVING.

The term *Driving* has been applied to that operation by which bees are impelled to quit their settled habitation, and to exchange it for one that better suits the purposes of their proprietor. From what I am about to state, it will be found to admit of a more extensive application. Both Reaumur and Gedde appear to have been well acquainted with it, and the former has given a plate representing the whole process. Still it is an operation which up to the present time has received much less attention from the apiarian than it deserves,

and has accordingly been practised to a very limited extent, and then only to deprive a hive or box of the whole or a portion of its honey. For this purpose it may certainly be made a most useful auxiliary; but it may also be rendered subservient to a variety of other uses, such as the regulation and removal of combs, searching for and catching a queen, forming artificial swarms; in short, for objects of such paramount necessity to the profitable, as well as to the scientific management of an apiary, that I should say, not to be acquainted with it, and not to be capable of performing it, will hereafter be regarded as an *opprobrium apiarium*. I shall now therefore proceed to describe the process.

Towards the dusk of the evening*, when the family will be all, or nearly all at home, and no annoyance be experienced from stranger bees, let the hive or box be raised gently from its floor-board, and supported on three thin wedges; let an assistant be at hand, provided with a tobacco pipe or the fumigating box and bellows, from one of which, at the moment of raising the hive, let a few whiffs of tobacco-smoke be blown into it all round, and a few more after it has been raised. This expedient will soon induce the bees to ascend and congregate at the upper part of the hive. It is next to be inverted steadily on a small tub or a peck measure, puffed again, and then quickly and accurately surmounted by an empty hive or box, as nearly of its own shape and size as possible. After securely closing the two hives, by tying a cloth firmly round them above and below the junction, so that not a bee may escape, it will be proper to place an empty decoy hive upon the

* Reaumur recommends before sun-rise or after sun-set.

stand where the full hive stood, to amuse any straggling bees that may have staid out late or that may escape during the operation. The conjoined hives are then to be removed into a darkened room in the manner already described, when if the hive be *well peopled* and the *weather warm*, by drumming at first gently and then smartly with the open hands or a couple of sticks on the outside of the hive, the bees will be so alarmed that in a few minutes they will have ascended into the super. The ascent may always be ascertained by the humming noise attending it. The impulse thus communicated to the bees should be given in the direction of the combs, and by no means upon those parts of the hive which are opposite to their sides, as this might separate them from their attachments.

The exchange of habitations having been effected, the ulterior proceedings must be regulated by the object in view. If it be wished to have possession of the full hive, it will simply be necessary to leave the decoy hive in its place, and after covering the honey-combs with a cloth to prevent them from being scented, to carry the bees with their temporary abode towards their usual place of entrance, when by spreading a cloth on the ground or on a table, all the bees may be dislodged and made to fall upon it by a smart stroke with the hands upon the top of the hive, and if one side of the cloth be raised to the resting-board, the bees will gradually ascend and re-occupy their original station.

If the object of the proprietor be to restore the bees to the old hive, after removing the requisite number of honey-combs, or the supernumerary drone-combs, the only difference in the mode of proceeding will be an exchange of the decoy-hive for the original domicile,

inverting the former as well as that into which the bees have been driven, and placing them near the entrance.

It will be obvious that if the decoy-hive be intended for the future residence of the bees, it should be furnished with as many worker-combs as can be spared, and if possible some of them should contain fresh honey; if they do not, a little milk-warm honey should be poured into some of the cells before the commencement of the operation; and if transportation be not meditated, feeding must be had recourse to afterwards, for a longer or shorter period according to the season and situation.

Some recommend inverting the hive from which the bees are to be driven, upon a metal pot, and applying the drum-sticks to that, in order to increase the noise.

If the contents of the old hive are to be appropriated, it may remain in its inverted position till the next morning, when if any bees remain in it, by raising the cloth a little and renewing the drumming, they will fly away to join their companions.

In cases where the hive is not well-peopled, nor the combs worked down to the floor, driving can seldom be satisfactorily accomplished. If an unsuccessful attempt have been made, and the dislodgement of the bees be imperatively required, the hive may be fumigated by burning puff balls underneath it, and the bees knocked out upon a cloth; or they may be fumigated with tobacco, the combs cut out, and the bees brushed off upon the cloth: in either case the cloth should be placed very near to the edge of the decoy-hive, when the bees, on their recovery from the fumigation, will gradually crawl up into their new habitation.

Should the operator be appalled at the idea of turning up a hive strongly peopled with bees, he may first tie

his cloth round the empty hive, invert that upon a peck measure, placing the full one correctly over it, draw the cloth up tightly round it, and after securing the whole as before directed, reverse the position of his hives, and then proceed to drive the bees.

Driving succeeds best, as I have already hinted, in warm weather, and with strong populous stocks; for if the combs be not worked down to the floor-board, the bees are apt to congregate in the open space between the margin of the hive and the termination of the combs, instead of ascending into the super

CHAPTER XVII.

UNITING SWARMS OR STOCKS.

THE occasional union of swarms with the stocks from which they issue has already been adverted to and recommended in page 146; the union of two weak swarms, or of stocks which have become weak, has also been strongly recommended. It has been attempted in various ways, and with various success, depending perhaps, in some degree, upon the skill and adroitness of the operator. Upon the storifying plan this operation will rarely be necessary, excepting in the case of weak stocks, as it is not a very common occurrence for storified bees to swarm, and when they do the swarms are generally strong ones. Still there may be apiaries in which the object will occasionally be desirable; it therefore merits some attention, for well-peopled hives are always the most productive.

The three usual methods by which union has been attempted, and indeed their advocates say accomplished, are, *fuming them, immersing them in water*, and *aspersing them with sugared or honeyed ale*. To these I may add a fourth, namely, *operating upon their fears*, by confining them for a time, and then alarming them by drumming smartly upon the outside of their domicile. It was in this way that Wildman was enabled to perform such extraordinary feats with bees.

"When under a strong impression of fear," says he, "they are rendered subservient to our wills, to such a degree as to remain long attached to any place they after-

wards settle upon, and will become so mild and tractable as to bear any handling which does not hurt them, without the least show of resentment. "Long experience has taught me, that as soon as I turn up a hive, and give some taps on the sides and bottom, the queen immediately appears." "Being accustomed to see her, I readily perceive her at the first glance, and long practice has enabled me to seize her instantly, with a tenderness that does not in the least endanger her person. Being possessed of her, I can, without exciting any resentment, slip her into my other hand, and, returning the hive to its place, hold her, till the bees missing her, are all on the wing, and in the utmost confusion." When in this state he could make them alight wherever he pleased, for on whatever spot he placed the queen, the moment a few of them discovered her the information was rapidly communicated to the rest, who in a few minutes were all collected round her. In this way he would sometimes cause them to settle on his head, or to hang clustered from his chin, in which state they somewhat resembled a beard. Again, he would transfer them to his hand, or any other part of his body, or if more agreeable to the spectators before whom he exhibited, would cause them to settle upon a table, window, &c. Prior to making his secret generally known, he deceived his spectators by using words of command, but the only magic that he employed was the summoning into activity for his purpose the strong attachment of the bees to their queen.

"Such was the spell, which round a Wildman's arm
Twin'd in dark wreaths the fascinated swarm;
Bright o'er his breast the glittering legions led,
Or with a living garland bound his head.

His dextrous hand with firm yet hurtless hold,
Could seize the chief, known by her scales of gold,
Prune 'mid the wondering train her filmy wing,
Or o'er her folds the silken fetter fling."—EVANS.

Cautioning his readers as to the hazard of attempting what he himself accomplished only by long experience and great dexterity, Wildman concludes his account with a parody of the reply of C. Furius Cresinus, a liberated Roman slave, who, being accused of witchcraft, in consequence of his raising more abundant crops than his neighbours, and therefore cited before a Roman tribunal, produced his strong implements of husbandry, his well-fed oxen, and a hale young woman his daughter, and, pointing to them, said, "*These, Romans! are my instruments of witchcraft; but I cannot show you my toil, my sweats, and anxious cares.*" "So," says Wildman, "may I say, *These, Britons! are my instruments of witchcraft; but I cannot show you my hours of attention to this subject, my anxiety and care for these useful insects; nor can I communicate to you my experience, acquired during a course of years.*"

I consider the mode of effecting an harmonious union of weak families, recommended by Gelieu, as the simplest and most effectual: he assures us that, if the bees of a *recent* swarm be dislodged, upon a cloth, by a smart blow upon the top of the hive, and another swarm of the same day, or at any rate only a few days old, be placed carefully over them, "in the evening, when the bees are grouped together, those that have been displaced will alight upon and take hold of the others, and thus merely extend the cluster, now composed of two distinct masses, the one covering the other, their peace will not be disturbed, and next day they will work together in perfect

harmony." "For," says he, "when the whole of a new swarm, suddenly displaced, ascends precipitately into a hive peaceably occupied by another, the bees of each colony cannot recognise each other, and having no field to fight after their own fashion" (bee to bee), "they pass the night together, and, doubtless, acquiring the same smell, live happily together." The success of these unions would of course be more assured, if the queens of the dislodged bees were captured, in the mode recommended at page 147, thereby reducing them to the state of a simple swarm. Towards night they will have congregated at the roof, and may be dislodged in the manner already described, the undisturbed bees prior to being placed over them having been aspersed with syrup of honey or sugared ale.

CHAPTER XVIII.

SUPER- AND NADIR-HIVING.

When one hive or box is to be raised upon another, *in a bee-house*, the operation may be performed when convenient; the best time is about ten or eleven o'clock in the morning of a fine day, when a great portion of the bees will be ranging the fields. If the operation is to be performed in an out-door apiary, the dusk of the evening, or early in the morning, will be the most suitable time, as then the whole family, being at home, they may be shut in, and thereby prevented from annoying the operator.

If *super-hiving* be the object in view, the four screws must first be withdrawn out of the top board of the stock-hive or box, so as to allow one of the dividers to be pushed from back to front, between that board and the box which it covers; the top may then be safely taken off, and screwed down upon an empty box, which being placed upon a middle board, both are to be carefully laid upon the divider, that covers the stock: when accurately adjusted to each other, if an assistant hold firmly in their places the two boxes, or the inferior box and the middle board, the divider may be withdrawn, and thus a communication between the two boxes will immediately be effected, without the escape, and perhaps without the destruction, of a single bee.

When I have had no assistant near me, upon whose steadiness I could rely, at the time of withdrawing the divider, I have fixed a strong pole, with one of its ends

against the inferior box, and the other against the wall opposite to it, and have thus effectually prevented the boy from moving, whilst with one hand I held firmly the middle board, and drew out the divider with the other. My readers are to suppose me operating in a bee-house, for in an out-door apiary an assistant will always be required, whenever any important operation is to be performed.

Nadir-hiving is accomplished by introducing both dividers between the floor-board and the box or hive which it supports, the first with its turned edge downwards, and the other upon it, with its turned edge upwards. The box or boxes are then to be removed on one side, or upon a table, together with the upper plate or divider, which will form a temporary floor to the box, while the lower plate covers the wooden floor, and those few bees that may be lodged upon the sunk entrance.

In removing the box or boxes for nadir-hiving some caution is requisite, to prevent the escape of the bees. The safest plan is gradually to draw forward the boxes, with their temporary copper floor, till they hang nearly half over the wooden floor, and then, by spreading out the fingers, and applying them under each side of the divider, the whole may be removed wherever it be most convenient, till raised upon the nadir. When the box has been drawn nearly half off, a weight should be placed upon the divider that covers the floor-board or box beneath it, as the case may be, to prevent it from tilting up.

The removal being accomplished, an empty box should be quickly placed upon the divider which covers the floor, and upon the box a middle board, to receive the full box or boxes that have been temporarily removed: the adjustment being complete, the dividers are to be

withdrawn separately, and with the same precautions as in super-hiving.

If the apiarian wish to practise *centre-hiving*, that is, to introduce an empty box between a superior and an inferior one, he can easily apply the preceding directions to that particular case.

In an out-door apiary, nadir-hiving may be accomplished in an evening, by simply raising the stock upon thin wedges, before the introduction of the nadir. In about an hour, the bees, that might otherwise have settled upon the floor-board, will have mingled with their companions; the stock may then be raised sufficiently high to admit the operation to be completed without a divider, the use of which it would be always well to avoid, unless absolutely required, as its introduction is sure to produce more or less agitation.

This unirritating mode of procedure may be adopted in all cases, with the aid of tobacco-smoke, even without the delay, occasioned by the use of wedges. The box or boxes should, on these occasions, be raised gently from the floor-board, and placed upon two sticks, as directed when hiving a swarm. The bees that may happen to remain on the floor-board should now be brushed off gently, or a fresh one substituted, when the nadir, being placed upon it, must be surmounted with the stock. The stragglers that have been brushed off will soon rejoin the rest.

Even when dividers are employed, a puff or two of tobacco-smoke will not only cause the bees to withdraw, but render them less irritable.

CHAPTER XIX.

FEEDING BEES.

This is a business which is, in general, very injudiciously managed, not only by cottagers, but by persons who, with more knowledge, ought to be more particular. The former often content themselves with presenting raw sugar or sugar mixed with oatmeal, to their bees, in which cases the power of consumption must depend upon the moisture of the atmosphere, for such is the mechanism of the bee's mouth as to disable it from feeding even upon *candied* honey. (See *Anatomy and Diseases.*) But even those who are aware of this peculiarity, and make a syrup for their bees, administer it in such an open manner as to tempt neighbouring families to commit depredations and enter on destructive contests.

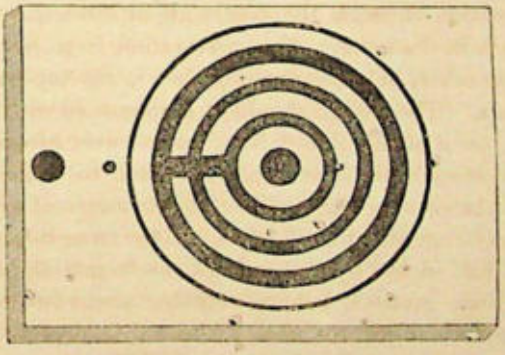
The common mode of presenting them with food is to introduce it through the mouth of the hive, in a long boat, formed by scooping out the pith from an elder-stem. Upon this plan no more is introduced than the present occasion requires, and frequent opportunities are afforded of learning the condition of the bees, from the manner in which they receive the boon. If a little irascibility be exhibited it is a symptom of health; and though indifference to the proffered bounty may not actually betoken mischief, yet it deserves attention, and should induce vigilance in the apiarian.

This plan of feeding, independently of other objections, can only be adopted in mild weather; for whenever the thermometer, generally speaking, ranges below 45° Fahrenheit, the bees are indisposed to descend, and, in

severe weather, none of them will quit the *central* combs, betwixt which they cluster, even to feed upon their own collected treasures, but will rather hang together and starve, unless those very combs be the depositories of these treasures. To guard against this evil, a supply of *warm* food, placed *over* the hive or box, will tempt them to quit the cluster, and partake freely of the donation, secure from all danger of the food being scented by other families, as well as from the destructive effects of exposure to cold while partaking of it.

My own mode of presenting it to them, *in the spring*, is by means of a trough, formed out of a board of close-grained wood, such as sycamore or beech, grooved by a turner into concentric circular channels, and having a perforation through the centre about three quarters of an inch in diameter. This perforation is to be placed over another, of corresponding size, in the top board of the box. The trough should be surmounted with a bell-glass, on a small glazed box, and a cover of cartridge paper or such like contrivance, adapted to exclude the light, placed over the whole. The diameter of my bell-glasses being about five inches, and the trough-board six and a half inches by nine, admits the formation of three concentric grooves, holding together about two ounces. These circular grooves, as well as the circular walls which separate them from each other, should be about a quarter of an inch wide, and the former should be half an inch deep; the box or glass placed over them must be of such a size as to admit a landing place not less than three eighths of an inch in breadth all round, or the bees, when the trough is full, will be often much incommoded, perhaps drowned. Thus accommodated, they will stand in circles upon each of the interstitial walls, and lap the syrup in perfect comfort and security, without soiling

wing. If a narrow channel be cut across the walls, and a receiver be sunk in one end of the board, exterior to the glass cover, and made to communicate, by a horizontal gimlet-hole, with the external groove of the trough, the whole may then be readily filled from the receiver, without removing the glass cover, which should be kept steady in its place, by means of a shallow groove adapted to its size, exterior to the grooves of the trough. A perpendicular gimlet-hole, exterior to the glass, should communicate with the horizontal one, into which a plug must be introduced, to prevent the bees from creeping into the receiver when the trough is empty. The following diagram will serve to illustrate my description.



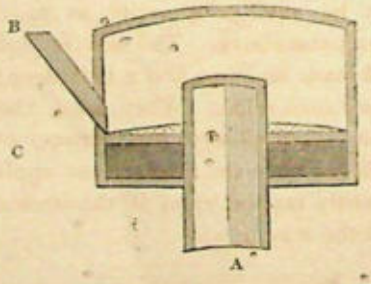
If feeding be required in cold weather, which should always if possible be avoided, it will be prudent to allow access *only* to the *inner* groove, and over this to invert a small glass that will dip *nearly*, but not quite, to the bottom of it, so as to allow free ingress to the probosces of a bee, to the exclusion of its body. This will prevent those chills which are apt to be experienced when the food is only accessible where the warmth of the family

cannot reach it, and will secure any incautious bee from drowning.

This trough is more particularly suited to *spring* feeding. At this season, if the bees have had a sufficient winter's supply, feeding will only be required upon a small scale, it being chiefly intended as a cordial to promote early breeding.

The *autumnal* supply, on the contrary, should always be afforded in ample donations, for feeding by driblets, at this season, keeps up a continual excitement, and increases the heat of the hive to such a degree as to cause increased consumption, and probably to injure the health of the bees.

For this wholesale feeding the number of grooves in the trough might be increased, though I consider that which has been invented by Mr. Dunbar to be more suitable for autumnal use: the following is a perpendicular section of it. The down pipe, as shown in this sketch, is unusually large.



It is turned in a lathe out of a solid piece of close-grained wood, is about five inches in diameter, and four deep, holding half a pint of syrup. A is a turned wooden tube, through which the bees ascend from the hive into the trough, passing over the top, and down the outside

of it, till they reach the float C C, which is pierced with small holes, and has a round hole in the centre large enough to admit the tube. That part of the tube marked A, is inserted into a corresponding aperture in the top of the hive; the trough itself is covered with glass. There is a small tin spout, B, for replenishing it, and it must be evident that it can be filled as high as the top of the tube, to which a cork should be fitted to confine the bees.

For those who, from any cause, are obliged to feed their bees at the mouth of the hive, Mr. Howatson, a Scotch apiarian, whom I have before alluded to, has contrived a very convenient trough for the purpose. It consists of an oblong box, in one end of which is a reservoir containing honey that is allowed to flow from the bottom, under a thin float buoyed up with cork and perforated with small holes, through which the bees, standing on the float, supply themselves with honey. The lid of the box is a glass pane. On pouring the honey into the reservoir, the float rises, whence there should not be such a quantity, as to raise it close to the lid or pane above. The box is about ten inches long, four broad, and two and a half deep; and the reservoir is one inch wide. When used, the hole in the side is to be placed close to the entrance of the hive, to admit the bees above the float; when applied, the hive must be gently rapped upon, if the bees do not immediately find the way down.



In this, as well as all other cases in which outside feeding is had recourse to, I recommend the syrup to be made chiefly, if not altogether, with sugar, as its odour is much less likely to attract marauders from other families.

If the weather be sufficiently warm, when a supply of food is required, the safest plan is to present it at night, and to keep the entrances closed till morning. But, in cold weather, it should not be afforded earlier than ten in the morning, nor later than four in the afternoon, and should be given warm. Winter feeding should, however, always be avoided, if possible, for, independently of its exposing the bees to the benumbing, and sometimes fatal effects, of a low temperature, according to the experiments of Dr. Marshall Hall, the hearts of hybernating creatures undergo, during their state of hybernation, such an increase of irritability, that an artificial excitement of them, at that period, will often prove fatal. "They are roused into a painful activity, and then plunged into *a fatal torpor*;" and though, as the temperature maintained by bees, during winter, is several degrees higher than the surrounding air*, they may not be strictly said to hybernate, still they make such an approach to that state as to render them liable to suffer, in some degree, from being roused into activity in the depth of winter.

From its having been observed that bees consume a much smaller quantity of honey during a cold, than during a mild winter, some have recommended and practised immuring them in a vault or in a dark underground cellar. This plan was approved of by Mr. Gedde, who even suggested the use of an ice-house for the pur-

* See the interesting and ingenious experiments of Mr. Newport, Phil. Trans., Part II. 1837.

pose, having found that bees survive the cold in Siberia, and render Russia somewhat remarkable for its productiveness of honey. Dr. Darwin also tells us, that a very observing gentleman, at his request, put two hives for many weeks into a dry cellar, and observed, during all that time, that they did not consume any of their provisions, for their weight did not decrease, as it had done when kept in the open air. The same observation is made in the Annual Register for 1768, p. 113, and in the Edinburgh Journal of Natural History, No. II. p. 9. This method is adopted by some apiarians of the present day; by Mr. Lee, of Barrow-on-Soar, for instance, and Mr. Dewey of Melton Mowbray. The results of the practice, so far as they have come to my knowledge, have not satisfied me; *à priori*, I should doubt the success of it, for if the bees partake of any food during their confinement, there would be danger of disease from retention of their fæces, which their natural cleanliness, under such circumstances, might induce them to abstain from voiding; or else from the long continuance of their excrement on the hive floors. I should also apprehend that the external combs would become mouldy, offensive, and unfit for use: and if the interment were had recourse to before mid-winter, the mortality which regularly takes place towards the close of every year, would be productive of great and fatal evil, from the hive floor being so strewed with dead bees, as to cause both putrefaction and an obstructed portal. This is a condition of the bee-hive which I once experienced. Having sent my apiary down the Bristol Channel late in October, the vessel was wind-bound for nearly two months, during the whole of which time the bees were confined to their respective boxes; and on reaching their destination three-fourths

of them lay dead on the floor, completely obstructing the ingress of air through the regular passage, and, but for a wire gauge opening in the lids of the boxes, I have no doubt but that every bee would have perished. In this case the exterior combs had become mouldy, and the bees on obtaining their liberty, and being relieved from the putrid mass which covered their floors, immediately set about clearing and repairing their store-houses.

From what has been stated above, it must be obvious that but little, if any, evil is to be apprehended from a cold winter, though much may arise from a mild one, as, during the latter, the stock of honey is often exhausted, from its encouraging the bees to be active without affording them any resources beyond their own domicile. This has led some apiarians to recommend a northern aspect *simply*; the Rev. Stephen White observes, that if hives be placed on the northern side of a building, the bees will seldom be induced to come out, and will eat much less than if exposed to the winter's sun; but unless a northern aspect be accompanied either by immuring or by closed entrances, there is this objection to it: when the bees have been tempted on a sunny day to roam abroad, and return home loaded and fatigued, they often drop on the ground beneath the entrances, when sun or no sun makes the difference to them between life and death.

A stock of bees will generally consume from a pound of honey to a pound and a half per month, betwixt the 1st of October and the 1st of March: from this time to the end of May they will consume double that quantity. If the spring be unfavourable for gathering *early*, or, having been favourable, be succeeded by a cold May, or if the preceding winter have proved mild, the

bees may not only require to be fed early, but even *through a considerable* part of the month of May.

As a general rule, every family of bees to stand the winter, as I have elsewhere said, should weigh about seventeen pounds, exclusive of the box, allowing a pound or two more for old stocks; the deficiency below this, should be made up to each family, soon after Michaelmas.

Though the experience of Mr. Humphrey* shows that a family of bees may be carried through the winter, upon sugared ale alone, yet, where the store of honey in a hive is small, I think it desirable that a part of the winter's supply should always consist of *pure honey* in a liquid state, fresh from another hive, if convenient. In this latter case, if administered in a super, the cells should be previously unsealed, that the bees may remove the contents into that story which they are to reside in for the winter, for, if not unsealed, the honey will not be removed, and therefore of no use to the bees. After the requisite quantity has been carried away, the box which contained the supply should be removed, as it is important to leave every stock *single-hived during the winter*. For the same reason it is advisable, in case any family of bees should store small quantities of honey, in more than one hive or box, to remove the uninhabited hive or box, and make up from it the quantity of honey in which the other is deficient; as, independently of the objections to keeping stocks doubled through the winter, it is better not to leave them an unnecessary quantity of honey.

* Mr. H. drove the doomed stock of a cottager into a box in the autumn of 1832, fed them as above, and they formed as flourishing a family as any he possessed.

In default of a supply of honey *in combs*, stored honey may be clarified over a gentle fire, and presented to the bees in one of the troughs, or on the upper side of a pile of drone-combs, in separate layers, about half an inch apart, placed across the bars of the hive, with a super inverted over them.

I believe the best *Spring* food for bees, and also the best substitute for honey in autumn, is the following COMPOUND. A pound of coarse brown sugar and three quarters of a pint of ale or sweet-wort*, boiled to the consistence of a syrup, to which should be added a tea-spoonful of salt. According to Huber, *the coarsest sugar enables the bees to form the whitest wax.* For the purpose of forming a closer imitation of honey, by increasing the pungency of the compound, Mr. Golding combines with his syrup a portion of wine and rum: his proportions are, sugar 1lb., honey ¼lb., salt a tea-spoonful, beer of moderate age one pint. Boil for a minute, and as the syrup cools, add to it half a glass of wine and a table-spoonful of rum.

Towards the middle of February, or as soon as the bees come freely forth, it will be advantageous to treat them with one of the above compounds, which, as I have already observed, will tend to promote early breeding, and may sometimes obviate the death of the first brood; and for the sake of early swarming this is the most important. This bounty should be continued, to the amount of about a table-spoonful a day, till the bees disregard it, which will be as soon as the flowers afford a supply of honey.

Mr. Knight considers pears very much baked as constituting a valuable food for bees.

* Sweet-wort is only proper for present consumption.

I have spoken at page 200 of the different extent to which food should be administered in spring and autumn; but circumstances may occur in which the treatment of bees in spring should be assimilated to that of autumn: Feburier gives some striking instances of this. The weather in February, 1810, having been very mild, the bees about Versailles, in reliance upon its continuance, were in a state of great forwardness with their brood; but the temperature afterwards became cold, and continued so, till the store of honey in some hives was exhausted, and nearly so in all. Two neighbours of his adopted opposite lines of conduct on this occasion: one fed his bees liberally, the other not at all; whilst Feburier himself, with an ill-judged œconomy, adopted a middle course. The result was remarkable and highly instructive. The neighbour who fed not at all lost three-fourths of his families: out of twenty-two stocks, Feburier lost two, the remainder swarmed very late, and some of the swarms were very feeble, insomuch that in the autumn he lost two more from the ravages of the wax-moth: whilst the liberal feeder saved all his old stocks, and his first swarms issued so early as to be succeeded by several strong after-swarms; and the bees throughout his apiary were so vigorous that they defended themselves successfully against the wax-moths, by which three of his hives were attacked.

In the spring of 1828 and 1829 a similar state of the hives existed in this country. Owing to the want of rain during the preceding summers, which probably prevented the nectaries of the flowers from yielding a due supply of honey, and from inattention in the autumn to making up the deficiency, there was a great mortality among the bees.

CHAPTER XX.

DISEASES OF BEES.

I SUSPECT that much which has been written upon this subject is fanciful, and that most of the ailments of bees originate from want of cleanliness or want of food; for if bees be not kept clean, and be not supplied with food in backward springs, particularly in those which succeed mild winters, a mortality among them is usually experienced; and it is in spring that their alleged maladies prevail.

"For late the lynx-ey'd scout, in nice survey,
Had mark'd the ravage of ungenial May,
Where the lorn bee-herd wail'd his empty shed,
Its stores exhausted, and its tenants dead."

"So mourn'd Arcadia's swain* his honey'd host,
By keen disease or keener famine lost,
Till his fond mother, on her glassy throne,
Heard through deep-Peneus'† wave the filial moan."

EVANS.

The sudden transitions from heat to cold, and from cold to heat, experienced in this country, are I think often unpropitious to the success of an apiary; but if the bees be well sheltered, and have a convenient supply of water, salt, and sugared or honeyed ale in the early part

* Aristæus, the son of Apollo and the nymph Cyrene, to whom mankind were said to be indebted for the art of curdling milk, *managing bees, making hives,* and cultivating olives; on which account he was worshiped as a god by the Greeks. He was the father of the unfortunate Actæon.

† A river of Thessaly.

of the spring, no loss would in general be sustained by such vicissitudes.

Keys thought that bees were not fond of salt: from my own experience, as well as from that of my apiarian friends, I am satisfied that he was mistaken; their frequenting stable-drains at certain seasons affords evidence of this. During the early part of the breeding season, till the beginning of May, I keep a constant supply of salt and water, (about a teaspoonful to a pint,) near my apiary, in a shallow dish, covering the bottom with small pebbles, and find it thronged with bees, from early morn till late in the evening. About this period the quantity they consume is considerable, but afterwards they seem indifferent to it. Crevecœur in his Travels mentions having seen them eagerly visit drops of brine, and carry it away with them, at which he expresses much surprise. The eagerness they evince for it at one part of the season and their indifference towards it at another, may account for the opposite opinions entertained respecting it.

In the winter of 1782–3, *a general mortality* took place *among the bees* in this country, which was attributed to various causes: want of honey was not one of them; for in some hives considerable store was found after the bees were gone. Some were of opinion that it arose from the preceding being a bad breeding year, and thought that the bees died of old age. Others attributed it to the moistness of the spring of 1783, which rendered the providing of pollen difficult, for without pollen no brood can be raised. The difficulty of collecting pollen was ascribed to the continual closing of the flowers over the anthers, the want of sun to burst the anthers, and the washing away of the pollen by the frequent showers

after they did burst. The fatal influence ascribed to the wetness of the spring of 1782 seems to be improbable; though it might have affected the quantity of bees bred, it was not likely to put a stop to their breeding altogether, and the young bees ought at any rate to have escaped the desolating evil, if it were from old age alone; yet wherever the mortality once made its appearance, every bee became its victim.

A similar incident occurred among the wasps in the year 1824. The queen wasps were unusually numerous in the spring of that year, and yet scarcely a wasp could be seen of any sort in the ensuing summer and autumn, though there was a great deal of fine weather and plenty of sunshine, the fruits having ripened remarkably well. In both cases it seems probable that the mortality arose from some unfavourable circumstance at the breeding season, with which we are unacquainted. I am not aware that it has been attributed to any specific distemper of an epidemical nature. Mr. Knight *noticed a similar occurrence, as to wasps, in the year* 1806 (Philosophical Transactions, 1807, p. 243); and *in* 1815, Messrs. Kirby and Spence *made the same observation*. Mr. Knight supposed the scarcity to arise from a want of males to impregnate the queens. By Butler it was attributed to the queens having been killed by a preceding cold and wet winter or spring. This, however, was evidently not the case in 1824. In the summer of 1611, Butler says that they multiplied exceedingly, and the succeeding mild winter had preserved the queens, which (as in 1824) were very numerous; but the spring and summer of 1612 were rainy, and no small wasps were seen till September, and then very few. So rife were these destructive insects in the prolific summer of 1611, that Butler,

besides having destroyed twenty-two queens in the spring, had above fifty nests extirpated within the space of two or three furlongs in his garden. In 1620 there was a similar abundance, succeeded by so great a dearth in 1621, that during that year, Butler observes, "I saw not a single wasp." It may not be unworthy the attention of the entomologist, that betwixt the years of scarcity, here recorded, there was a lapse of exactly nine years, viz. from 1612 to 1621, from 1806 to 1815, from 1815 to 1824, and from 1824 to 1833. But in this latter case, instead of being *preceded* they were succeeded by an abundant year, for in 1834 the wasps were so exceedingly destructive as to cause whole families of bees to be exterminated in various quarters.

I shall now proceed to notice the maladies of bees, and state their causes, symptoms, and remedies, as I have collected them from ancient and modern authors.

DYSENTERY.

This malady was attributed by Columella to the bees extracting and feeding upon honey from the blossoms of elms and spurge; he regarded it as an annual distemper. By others it has been ascribed to their feeding too freely upon the vernal honey, from whatever source derived. Madame Vicat supposed it to arise from the feeding upon honey that had been candied, in consequence of the hive being exposed to a severe winter. Reaumur instituted some experiments to ascertain the cause of dysentery, but they were not satisfactory.

The presence of this disorder is indicated by the appearance of the excrement, which, instead of a reddish yellow, exhibits a muddy black colour, and has an intolerably offensive smell. Also by its being voided upon

the floors, and at the entrance of the hives; which bees, in a healthy state, are particularly careful to preserve clean.

VERTIGO.

Vertige, as Du Carne de Blangy calls it, was supposed by him to arise from the bees extracting the honey of deleterious plants. I have treated fully upon this subject under the head of Pasturage. In addition to what has been there stated, I will give an extract from Dr Barton's *Paper*, who, after observing that there is more poetry than philosophy in the following lines of Pope—

> "In the nice bee what sense so subtly true
> From poisonous herbs extracts the healing dew?"

says: "It is, however, much to be questioned whether this noxious honey proves so to the bees themselves." Sir J. E. Smith asserts that "the nectar of poisonous plants is not poisonous to bees." *Syllabus to Botan. Lect.* And Dr. Barton, though disposed to adopt the contrary opinion, gives instances to the same effect. Thus a party of young men, induced by the prospect of gain, having removed their hives from *Pennsylvania* to *the Jerseys*, whose vast savannahs were finely painted with the flowers of the *Kalmia angustifolia*, could not use or dispose of their honey, on account of its intoxicating quality; yet, "the bees increased prodigiously," an increase only to be explained by their being well and *harmlessly* fed.

This disorder is said to occur more especially between the end of May and the end of June, and to be marked by a loss of power in the hind quarters, by a dizzy manner of flying, and by irregular motions, such as starting, falling down, &c. when the bees are pursuing their usual occupations. To these symptoms succeed lassitude and

death. Della Rocca suggests that it is no malady at all, but that the effects produced arise from the wings of the insects having been accidentally mutilated. Mr. Golding thinks the bees thus affected are bees that have been worsted in combat, as he has often seen such spinning round upon the ground, after an unsuccessful attempt to plunder a neighbour's stores. Be this as it may, no remedy has hitherto been discovered for it.

Huber *says that vertigo attacks ants*, causes them to lose the power of moving in a straight line, and occasions the performance of rapid gyrations, always in the same direction: he observed one insect make about a thousand turns in an hour, describing a circle of about an inch in diameter; this continued for seven days: he does not say whether he ever knew any instance of a recovery.

In Dr. Barton's ingenious paper, to which I have already referred in the chapter on Pasturage, the plants enumerated as yielding poisonous honey are, *Kalmia angustifolia, latifolia*, and *hirsuta; Rhododendron maximum, Azalea nudiflora*, and *Andromeda mariana*. The honey of these is stated to have proved injurious both to dogs and the human species. The *symptoms* it usually produces *are dimness of sight or vertigo, delirium, ebriety, pain in the stomach and bowels, convulsions, profuse perspiration, foaming at the mouth, vomiting and purging*; in some instances, *temporary palsy of the limbs*, but very seldom *death*. The best mode of treatment is not yet ascertained; though the similarity of the symptoms, the Doctor says, would induce us to pursue the the same plan as in counteracting other narcotic poisons. In those cases, *early vomiting*, whether spontaneous or induced by art, removes the disease at once; and *cold*

bathing, so useful in other spasmodic or convulsive affections, is employed with considerable advantage by both natives and Europeans. This should seem to be one of those cases in which *the stomach-pump* would be peculiarly beneficial from the promptness and certainty of its action.

TUMEFACTION OF THE ANTENNÆ.

The antennæ in this disorder become swelled at their extremities, which resemble the bud of a flower ready to open, and they assume a yellow colour, of which the forepart of the head shortly partakes; the bees becoming gradually languid, and dying if they have not timely assistance. This malady occurs about the month of May.

PESTILENCE, OR FAUX COUVAIN (*as Schirach calls it*).

Pestilence has been reckoned among bee-maladies, and attributed to the residence of dead larvæ in the cells, a very probable cause; and this state of the larvæ has been supposed to arise from a careless deposition of the ova by the queen. It has also been ascribed to cold, and to bad nursing, that is, feeding with unwholesome food; but I think it more likely to arise from a deficiency of *suitable* food, and suspect that such a case fell under the notice of Mr. Dunbar, in the summer of 1835. *Vide Treatment of Faux Couvain.*

TREATMENT.

The remedies which have been found most successful in all these maladies, excepting vertigo, are *cordials*, namely, *wine* and *sugar*. This circumstance, taken in

conjunction with their occurring at the spring of the year, tends to confirm my opinion that the ailments of bees arise from hunger and filth.

Cleanliness and timely supplies of sugared ale, particularly *during the months of February and March*, are the preventive remedies which have hitherto preserved my bees in a state of healthful activity. The apiarian is sometimes astonished that he should lose his bees at so advanced a season as the end of May, when but a short time before he had seen them in full health and activity. Had he afforded that food which his bees could not obtain, from a comparatively immature and honeyless vegetation, their hives would still have gladdened him with the spectacle of a thriving population.

> "If e'er dank autumn, with untimely storm,
> The honey'd harvest of the year deform,
> Or the chill blast, from Eurus' mildew wing,
> Blight the fair promise of returning spring,
> Full many a hive but late alert and gay,
> Droops in the lap of all-inspiring May."—EVANS.

The reader must now perceive the importance of feeding, and that the transition from health to languor and death is less frequently to be ascribed to disease, than to the want of the necessary means to continue the vital energy. The suddenness of the unhappy change may reasonably lead the uninformed or improvident to suppose that an incurable malady has visited their hives:—so long as the store of honey lasted, there were health and prosperity; but that gone, famine commenced its ravages, and an extinction of the bees of course followed. A little foresight and a little trouble would have kept off the calamity. I am, perhaps, tediously particu-

lar in this notice: I wish to impress my readers with the necessity of thus providing for their hives, that the most frequent agent of mischief,—hunger,—may be kept out of them. Still further let me also recommend to them, on the approach of winter, to have the floors of their hives or boxes well cleaned from insects and their eggs, and from all heterogeneous matter. This is a business which the bees themselves, when the weather admits of it, are particularly attentive to; indeed they refrain, as much as possible, from dropping their excrement upon the floors, taking advantage of every fine day in winter to sally forth and get rid of it. This was proved by the experiments of Mr. Hunter: indeed, they sometimes fall a sacrifice to their personal neatness in this respect, their bodies becoming so swelled, from the accumulation of fæces, as completely to disable them from flying, when the weather has become sufficiently favourable and admits of their going out; in consequence of which, they fall to the ground and perish.

As a preventive of bee maladies, Feburier recommends the floor boards of the hives to be washed in winter with stale urine, (seven or eight days old,) with the addition of a little strong vinegar and ground pepper, to destroy the eggs and larvæ of moths; and when what has been called *faux couvain* actually exists, Schirach and others recommend us to cut out the infected combs, and to clean and fumigate the hive by burning aromatics under it. Indeed, Feburier recommends the regular excision of old combs, removing one half one year, and the other half the year following: this, however, is a practice which experience by no means warrants. The removal of one or more combs may occasionally be required, and

this with barred hives or boxes is a very simple process.

In page 214 I have referred to what occurred in one of Mr. Dunbar's hives: it was a Huber family, which in the previous autumn possessed a fertile queen and was very strong, but in the spring, says Mr. Dunbar, "it failed unaccountably and did not swarm." On examination, he found the four central leaves full of *abortive brood*, by the presence of which the queen seemed paralysed, though she did lay a few eggs at the edges of the combs. As the population seemed gradually diminishing, Mr. D. cut out the whole of the abortive brood, removed the old queen, and added an after-swarm to the family. The conjoined bees soon betook themselves vigorously to work, replaced the old combs by new ones, and laid in an ample store of honey. This is an operation which the French call castration, and in all such cases it will be prudent, in order to prevent contagion, to have the infected combs burnt or buried.

Butler, in his *Feminine Monarchie*, relates a story from a credulous Roman Catholic author, (evidently for the purpose of ridiculing it,) of a certain bee-mistress, who, finding her hives fruitless, and their tenants pining away with sickness, by the advice of another female, more simple than herself, went to receive the Eucharist, and having kept the consecrated wafer in her mouth, placed it, on her return home, in one of the diseased hives. The plague ceased; honey accumulated; and, on examining the inside, she found a waxen chapel and altar, of wondrous architecture, and even a steeple and bells of the same materials. Such conduct in an ignorant old woman, may excite little surprise, particularly when

we consider the time at which she lived. But what must we think of the following anecdote related by an Italian physician (Baldus), in the middle of the seventeenth century? He says, to prove the real presence in the Eucharist, that a number of bees being found on holy ground, they paid homage to the consecrated wafer, and carried a portion of it respectfully to their hive!!

To show that there is much of fancy in the traditional accounts respecting bee-maladies, I will mention *the various hypotheses concerning* dysentery. COLUMELLA speaks of its arising from the bees feeding upon honey collected from elm and spurge blossoms: my own neighbourhood abounds with both; but I never met with nor scarcely heard of dysentery among the bees here. EVELYN, in his *Sylva*, expresses doubts upon the subject; and Dr. EVANS says he made particular inquiries of some friends in Worcestershire, which (like this county, Herefordshire,) abounds with elms, without obtaining satisfactory information.

Dysentery has also been said to be produced by a surfeit of vernal honey, simply as such, from whatever flowers derived: were this true, it would occur in all neighbourhoods. (With respect to its proceeding from their eating wax, I am decidedly of opinion that wax never constitutes any part of their food, under any circumstances; not a tittle of evidence can be adduced in support of such an assertion. Wax is an excrementitious matter, secreted among the abdominal folds of the bees for the sole purpose of constructing the honey and brood combs: the scraps of wax that are observed in winter and spring upon the hive floors, and which to the minds of common observers, convey the idea that they are crumbs caused by the bees consuming the wax for food,

are produced by their nibbling away the lids of the cells to uncover the honey.) And if Madame VICAT's *theory* were correct, what would become of all the bees in Siberia and other northern regions? Huish says he never found honey in this country to candy in the combs, but adds, that Bonner assured him that *he* had experienced it. So likewise says Feburier, who further adds that he has known hives lose their tenants from famine, when there was plenty of candied honey which the bees had unsealed. He also says that after their death, the visits of moths, ants, and neighbouring bees, produced no sensible diminution in the weight of the honey. *Vide chapter* 26.

Messrs. KIRBY and SPENCE have given it as their opinion, that dysentery arises from the bees having an insufficiency of pollen or bee-bread to eat with their honey. We have no evidence that pollen constitutes any part of the food of *adult* bees; and if it did, they have generally opportunities of storing it very abundantly, in the autumn, as well as in the spring: and such is the provident industry of bees, that a considerable surplus is always found in every stock-hive. Bees that have been long confined appear to have a little diarrhœa, but this seems merely to arise from an accumulation of their fæces, and ceases on the return of a fine day.

I will close this chapter on the diseases of bees with an extract from Nicholson's Journal, vol. xxiii. p. 234. Scientific Intelligence.

"A large swarm of bees having settled on a branch of *the poison ash* (*Rhus vernix*,) in the county of West Chester in America, was taken into a hive of fir at three o'clock in the afternoon, and removed to the place where

it was to remain at nine. About five the next morning the bees were found dead, swelled to double their natural size, and black, except a few, which appeared torpid and feeble, and soon died on exposure to the air." This was attributed to their being poisoned by the effluvia of of the *Rhus vernix*.

CHAPTER XXI.

ENEMIES OF BEES.

Among the enemies of bees have been enumerated various kinds of birds, poultry, mice, wax-moths, slugs, hornets, wasps, woodlice, ants, and spiders.

Their most destructive enemies in this country are *wasps*, whose superior strength, boldness and number, enable them to commit great ravages in a hive. One wasp has been supposed to be a match for three bees, and to filch a belly-full of honey, will brave a host of them in a very daring manner.

The *wax-moth* (*Tinea mellonella*), or according to Fabricius, the gallery-moth, so called from its being hatched and bred in a gallery or hollow passage, is also a dangerous enemy. It usually appears about weak hives in April, and may be seen till the end of October. It is of the papilio tribe, (Phalænæ) flies only by night, and is of a whitish or brown grey colour. A small number of these diminutive insects, having formed a settlement in a hive, perforate and break down the cells, and with the fragments construct new edifices (galleries), for their own lodgement and accommodation.

These insects are remarkably active in their movements; "they are," says Reaumur, "the most nimble-footed creatures that I know," and if the approach to the apiary be observed of a moonlight evening, the moths will be found flying or running round the hives, watching an opportunity to enter, whilst the bees that have to guard the entrances against their intrusion, will

be seen acting as vigilant sentinels, performing continual rounds near this important post, extending their antennæ to the utmost, and moving them to the right and to the left alternately. Woe to the unfortunate moth that comes within their reach! "It is curious," says HUBER, "to observe how artfully the moth knows how to profit, to the disadvantage of the bees, which require much light for seeing objects; and the precautions taken by the latter in reconnoitring and expelling so dangerous an enemy." Adroitly gliding between the guards, the moths will often contrive to insinuate themselves, unperceived, into the hives, and make good a lodgement there. When they have obtained possession, they deposit their eggs upon the sides of the combs; a small caterpillar is formed some days afterwards, and inclosed in a case of white silk, which it spins round itself: at first it is like a mere thread, but gradually increases in size, and during its growth feeds upon the cells around it, for which purpose it has only to put forth its head and find its wants supplied. It devours its food with great avidity, and consequently increases so much in bulk, that its gallery soon becomes too short and narrow, and the creature is obliged to thrust itself forward and lengthen the gallery, as well to obtain more room as to procure an additional supply of food. Its augmented size exposing it to attack from its surrounding foes, the wary insect fortifies its new abode with additional strength and thickness, by blending with the filaments of its silken covering, a mixture of wax and its own excrement, for the external barrier of a new gallery, the *interior* and partitions of which are lined with a smooth surface of white silk, which admits the occasional movements of the insect, without injury to its delicate tex-

ture. In performing these operations, the insect might be expected to meet with opposition from the bees, and to be gradually rendered more assailable, as it advanced in age: it never however exposes any part but its head and part of its neck, both which are covered by stout helmets or scales, impenetrable to the sting of a bee, as is the composition of the galleries that surround it. As soon as the caterpillar quits the pupa state, it becomes a winged moth or butterfly, and is exposed to great danger before it can make its exit from the hive: probably great numbers lose their lives in the attempt. If, however, a single female escape, and be able to deposit her eggs, she will, by her fertility, soon undermine the commonwealth of bees.

It seems very extraordinary, and would be almost incredible if the fact were not well attested, that such tiny creatures should live in the midst and at the expense of myriads of such formidable insects as bees, protected as they are by coats of mail, armed with weapons of offence, and ever watchful of their treasure. Such, however, is the havoc sometimes made by these apparently insignificant but active enemies, as now and then to compel a colony of bees to emigrate, and seek another habitation. In my own apiary, I have never sustained such a grievous evil, though they annually cause me some inconvenience: with moderate care however, in this temperate climate, I should never expect them to be very formidable in their depredations. They are most apt to attack old strong-scented combs, and will force their way through new ones containing honey, to reach such as contain exuviæ.

In this country, where the apiary is generally situated near the dwelling, *birds* do not commit any great ra-

vages. Mr. Espinasse thinks that in general they come only for *dead bees* and *larvæ*, which may have been thrown out of the hives, and this I have frequently witnessed. But in America, according to Mr. Hector St. John, *the king bird*, the protector of corn-fields from the depredation of crows, is a great destroyer of bees. After shooting these birds, Mr. St. John has found bees in their craws, from one of which he took as many as a hundred and seventy-one: on laying them all on a blanket in the sun, fifty-four of them returned to life, licked themselves clean, and joyfully went back to their hives. Many wonderful tales of this kind have been told,—such as the recovery of flies that had been inclosed for a considerable time in bottles of liquor (Madeira). An instance of this is related by Wildman, who says his informant was a very ingenious and accurate gentleman; that the Madeira had been brought, in bottle, from Virginia to London; and that the flies when exposed to a warm sun for an hour or two, were so completely reanimated as to take wing; thus putting to the test, as Wildman's friend observed, the truth of the opinion that a fly cannot be drowned. A very marvellous tale was related a few years ago in the newspapers, of the recovery of some apparently dead bees after the substance containing them had been submitted to a considerable heat or to a chemical process! Mr. St. John's statement is within the bounds of credibility: it seems to have been a case of suspended animation of short continuance, not produced by exposure to gas or to any liquid likely to prove deleterious to them; and it is well known that bees often recover even after suffocation with sulphurous gas.

Bees may be immersed in water for a long time, with-

out loss of life. Reaumur saw them recover after nine hours' immersion. Dr. Evans accidentally left some eighteen hours in water; when laded out with a spoon and placed in the sunshine, the majority of them recovered. Other animals, of analogous species, exhibit still more wonderful resurrections. De Geer has observed one species of mite to live for some time in spirit of wine; and Mr. Kirby states that being desirous of preserving a very pretty lady-bird, and not knowing how to accomplish it, he immersed it in Geneva. "After leaving it," says he, "in this situation a day and a night, and seeing it without motion, I concluded it was dead, and laid it in the sun to dry. It no sooner, however, felt the warmth than it began to move, and afterwards flew away." This circumstance laid the foundation of Mr. K.'s study of entomology.

Of this adherence to life, advantage has been taken at the time of deprivation, recourse having been had to immersion for removing a portion of the combs; the bees were afterwards spread on a cloth in the sun, and became reanimated. Dr. Derham says that he has known bees revive after remaining twenty-four hours under an exhausted air-pump. After long submersion the proboscis of the bee is generally unfolded and stretched to its full length. The first symptom of returning animation is a motion at its extremity, succeeded by a similar motion at the extremities of the legs. Having so far progressed towards recovery, the proboscis is soon folded up again, and the bee prepared to resume its customary occupations.

Moths and *spiders* should be watched and destroyed in an evening, as the former are then hovering about, and the latter laying their snares; at that time, too, there

would be less danger of annoying the bees, or of being annoyed by them. Wherever moths have gained possession of a hive, it is always necessary to destroy the bees, or to drive them into another hive.

Attention to the following particulars may guard the bees from many of their enemies. A frequent cleaning of the hive-floors; the use of new or well-cleaned hives; the timely renewal of the coverings, and keeping the ground bare around the apiary, particularly in front of it. This last precaution may also prevent the entanglement of the bees in rubbish or long straggling vegetables, should they on their return home fall down through fatigue or the weight of their loads.

Rats and *mice* are chiefly formidable as attacking the bees at that season of the year when the cold renders them inactive: the surest safeguard against them is an appropriate position of the hives; traps may also be laid, and in winter the entrances into the hives contracted. It will be prudent likewise to case the legs of the bee-benches with tin. Bees in a healthy vigorous state will attack and kill an intruding mouse; but in winter it might commit great depredations, and cause the emigration of the bees on the return of warm weather. (Mr. Espinasse says that he has known a mouse take up his winter quarters in a hive without destroying the bees.)

Some have been of opinion that bees might require to be protected against ants, but Reaumur says that ants never originate the pillage of a hive, but are ready to join in it, after it has been commenced by others. In this I quite agree with him, having never known an instance to the contrary. When therefore ants are seen entering in a predatory manner, it may fairly be sus-

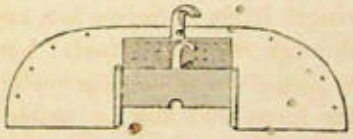
pected that some other enemy has been at work. M. Reaumur was of opinion that ants are not to be reckoned among the enemies of bees; and he relates an instance of their living as very close neighbours, yet in perfect harmony. The ants established themselves between the glass panes of his bee-box and the wooden shutters which covered them; and as a similar circumstance occurred to Bonnet, and in other of Reaumur's hives also, it seems probable that the ants took up their quarters in this situation for the sake of the equable warmth that the bees would impart to their eggs. "Ants were without the hive," says Reaumur, "and bees within; a single glass only separating two nations, so different in manners, in customs, and genius. The bees were abundantly provided with a dainty of which ants are exceedingly fond, I mean honey. The ants had just reason to be apprehensive that the bees would be uneasy, and jealous to preserve so precious a treasure. Nevertheless, the utmost harmony and concord prevailed between the two nations. Not a single ant was tempted to enter the hive, how strongly soever she might be invited by the fragrance of the honey; nor did any bee disturb the ants, though superior to them in power; the several individuals, on each side, went in and out peaceably; they would meet in the way without teazing or molesting one another: respect on one side, and complacency on the other, were the foundation of this peace."—Nat. Hist. of Bees, p. 352.

The destruction of *queen wasps* in the spring, and of wasps' nests in the summer, will prove the best security against those formidable enemies. None but queen wasps appear in the spring. Every one which is then annihilated would probably have been the founder of a

kindred colony, and every colony of wasps, at a moderate computation, may be calculated to produce 30,000 in a season. These destroyers may often be watched to their homes and exterminated in the night, by brimstone, gunpowder, or boiling water.

The wooden guards of Mr. Espinasse, the tin guards of Mr. Huish, and the wooden ones of Mr. Golding, have been found useful in cases of a formidable attack, but my own experience induces me to prefer that recommended by Mr. Knight. It consists of a block of wood an inch and a half or two inches square, and the diameter of the box in length, (if applied to a hive, at least nine inches in length). Across the under side of this block one two or more channels are cut of sufficient size to admit the passage of a bee: each of these channels is of course either an inch and a half or two inches long. The great advantage of Mr. K.'s guard is this: a wasp dropping down on the alighting board at the entrance of a hive, that is only furnished with a thin guard, of whatever material, will easily ascertain the amount of strength likely to oppose her, and often make a bold push through several sentinels; but if this freebooter have to look down a long narrow channel, being ignorant of the force that may be posted near its extremity, she will pause ere she proceed, and if it be her first essay will not in general run the hazard. If, however, an attack have unfortunately commenced, prior to the application of the guard, and the honey has been tasted, though it will always act as a check, it may not wholly prevent intrusion. If all the channels cut from without meet at their termination within, one set of sentinels would suffice to guard them. The entrances at their junction may be twice the width of the separate

ones. If bees be kept in a shed or house these blocks will keep the boxes from the wall, and will thereby moderate the vicissitudes of temperature, and for this latter purpose open blocks have been long used by Mr. Golding, at all times. For winter guards the slides in the floor-board are sufficient; for common straw-hives, whatever the material employed, the guard should be as nearly as possible flush with the bands of straw; projecting guards causing a good deal of puzzling and loss of time owing to the attempts of the bees to find admission at the angles. It is for this reason that I have recommended Mr. Knight's guards to be made so long. Mr. Payne, in his Apiarian Guide, suggests the use of guards made with thin copper, stitched round the hive entrance with copper wire. Each of them has two slides, one pierced with many small holes for shutting up the bees entirely, the other with a single hole, allowing only the passage of a single bee at a time. Of this guard he gives the following sketch.



Whatever guards be had recourse to, they should be contracted no longer than the occasion calling for it demands, or the evil alluded to at page 203: under feeding may prove destructive to the family. A week or two of cold weather, occurring at the period of the autumnal death of the bees, may prevent the removal of the dead bodies, till the entrance becomes fatally obstructed.

Powder and shot are the only protectors from the visits of *birds*.

The exclusion of poultry must be left to the ingenuity of the apiarian.

In an ungenial autumn, it is not uncommon for *bees to plunder the hoards of their own species*, and cause so much annoyance as to render speedy measures necessary to preserve the families attacked. On these occasions, spies are said to be sent out, to ascertain the respective strengths of neighbouring colonies, and to select the weakest for attack. They have been said to make similar attacks upon the nests of humble-bees, as well as upon the bees themselves; in the former case, they will carry off almost the whole of the stores that have been collected, unrepulsed by its proprietors; and in the latter case, says Huber, "the humble-bee, accustomed to such exactions, yields up its honey, and resumes its flight." In both cases it renews its labour in the fields, and repairs with its surplus treasure to its usual asylum, and that even after repeated robberies. Mr. Hubbard says that he has known repeated instances of weak stocks being expelled from their hives by strong ones. *The best remedy* for this evil is *a contraction of the entrances*, as for guarding against wasps, *or a change in the situation of the hives*.

Dr. DARWIN in his *Phytologia* has related an instance of a besieged hive being removed to a distant and more easterly part of the same garden: the assailants in this case did not follow, and the bees resumed their usual occupations. Removal to a still greater distance would seem to promise more certain relief. In order to raise their courage above its natural height when thus at-

tacked, Schirach *recommends uniting a little wine or brandy with honey, and presenting it to the bees that are besieged*, and the idea of administering a cordial to them under such circumstances is I think a good one.

Huber has called the attention of naturalists to what he designated as *a new enemy of bees*, the *Sphinx Atropos* or *Death's-head Hawk-moth* (*Acherontia Atropos*), to which his attention seems to have been first directed in 1804. This gigantic moth, which is from three to five inches in length, and of proportionate size, derives its name from having upon its back a mark somewhat resembling a death's head; it has from this cause, together with its size, which at first caused it to be mistaken for a bat, produced great alarm amongst the people of some countries: it was regarded as the harbinger of some calamity. KUHN speaks of its having been noticed in the apiaries of some monks at the close of the last century, as well as in the bee-houses of other persons; and Campbell, in his *Travels*, mentions it as plundering the wild bees *in Africa* of their honey. The plants upon which the caterpillar is *usually* found are not natives of Britain, for though it has been seen on the Bitter-sweet (*Solanum Dulcamara*), and the Spindle Tree (*Euonymus Europæus*), it is most commonly found on the foreign plants, the Potatoe (*Solanum tuberosum*), the Jasmine (*Jasminum officinale*), and the Thorn-apple (*Daturâ Stramonium*). In this country it is rarely met with; I have seen a few. At the close of the hot summer of 1825 the larvæ were very commonly found feeding on the potatoe-leaves about Edinburgh, but, owing probably to the wet weather in the ensuing month, very few came to maturity.

This insect has the faculty of emitting a shrill mournful cry, which, when threatened by the vengeance of the

bees, has the power of disarming their fury. It operates upon them like the voice of their queen, and thus enables the moth to commit the greatest ravages in the hives with perfect impunity. Huber ascertained that it could not produce the same effect upon humble-bees, for whenever *their* nests are entered by one of these insects, it is immediately attacked and driven out. One, that Huber introduced into a nest of humble-bees, was actually stung to death by them, but not till many wounds had been inflicted upon its most sensible part, the belly. On dissecting one of these moths, he found a table-spoonful of pure honey in its abdomen. The proceedings of bees, when attacked by the *Sphinx Atropos*, as detailed in the Chapter on Instincts, will suggest to the apiarian the best plan to be adopted, whenever this formidable insect shall invade their territories.

CHAPTER XXII.

TRANSPORTATION OF BEES.

This is a practice which many apiarians have recourse to for the purpose of removing their bees to fresh pasture, to districts where buckwheat is cultivated, or to the neighbourhood of heaths, or to any other place where such late blossoming flowers abound as afford honey.

Mr. Isaac assures us that he once had a poor swarm of a month's standing which only weighed five pounds four ounces, and that on the 30th of July he had it removed to *Dartmoor Heath*, from whence it was brought home, two months afterwards, increased in weight twenty-four pounds and a half. He moreover states that the increase of others that were sent there was nearly proportional, and is of opinion that the whole addition was made during the month of August.

In Lower Egypt, where the flower harvest is not so early, by several weeks, as in the upper districts of that country, this practice of *transportation* is carried on to a considerable extent. About the end of October the hives, after being collected together from the different villages, and conveyed up the Nile, marked and numbered by the individuals to whom they belong, are heaped pyramidally upon the boats, prepared to receive them, which floating gradually down the river, and stopping at certain stages of their passage, remain there a longer or shorter time, according to the produce which is afforded by the surrounding country. "After tra-

velling three months in this manner, the bees, having culled the perfumes of the orange flowers of the Said, the essence of roses* of the Faicum, the treasures of the Arabian jessamine, and a variety of flowers, are brought back, about the beginning of February, to the places from which they had been carried. The productiveness of the flowers at each respective stage is ascertained by the gradual descent of the boats in the water, and which is probably noted by a scale of measurement. This industry procures for the Egyptians delicious honey and abundance of bees'-wax. The proprietors, in return, pay the boatmen a recompense proportioned to the number of hives, which have thus been carried about from one extremity of Egypt to the other." Latreille states that between Cairo and Damietta a convoy of 4000 hives was seen upon the Nile by Niebuhr, on their transit from the upper to the lower districts of that country. Floating bee-hives were formerly common also in France. One barge was capable of containing from sixty to a hundred hives, which, floating gently down their rivers, enabled the bees to gather the honey which is afforded by the flowers on their banks. Reaumur likewise states it to have been the practice, in some districts, to transport them, with similar views, by land, in vehicles contrived for the purpose. Febufier tells us it is still continued, and that the environs of the forest of Orleans are at certain seasons covered with bee-hives. M. Olivier, a member of the Institute, also states that in Provence there are honey merchants who purchase bees for the purpose of transportation. These dealers take all the

* Whatever inducement the bees of Egypt may have to ply the roses of that country, with us they pay very little attention to those beautiful flowers.

honey that the bees can spare prior to setting out, and when the plains can no longer afford a supply, convey them to the foot of the mountains, and sacrifice them, after they have collected their second harvest. In Savoy, Piedmont, and other parts of Italy, the practice is also common. It is indeed of very ancient origin. Columella speaks of it as a very general custom among the Greeks, who used annually to send their bee-hives from Achaia into Attica.

The practice prevails to a considerable extent in Scotland. About six miles from Edinburgh, at the foot of one of the Pentland Hills, stands Logan House, supposed to have been the residence of the Sir William Worthy, celebrated by Allan Ramsay in his "Gentle Shepherd." This house is at present occupied by a shepherd, who, about the beginning of August, receives above a hundred bee-hives from his neighbours resident beyond the hills, that the bees may gather honey from the luxuriant blossoms of the mountain heather. The present proprietor of Logan House, W. Robertson, Esq., informs me that he has counted nearly two hundred in a season, and that other shepherds in the neighbourhood undertake similar charges, among the rest, his own gamekeeper, who has accommodation for fifty or sixty families. They remain as long as the heather continues in bloom, usually rather more than two months. "A lover's plaid and a bed of heath," says the poetical Allan Cunningham, "are favourite topics with the Northern Muse: when the heather is in bloom, it is worthy of becoming the couch of beauty. A sea of brown blossom, undulating as far as the eye can reach, and swarming with wild bees, is a fine sight." Sir Walter Scott, in his Pirate, makes an Orkney husbandman speak of having imported nine skeps

of bees for the improvement of the country, and for turning the heather-bloom into wax and honey.

These, however, are advantages which very few situations can afford; probably but few of my readers may reside in the neighbourhood of heaths, and still fewer may be disposed to incur the trouble and expense of removal. If, therefore, incorporation be desirable in any particular case, I can only recommend that attention be paid to supplying the bees with proper food in a feeding-trough, by the assistance of which, indeed, I should not be afraid of carrying even a weak stock, very safely, through the winter and early spring. "Give your bees," says Mr. Isaac, "two harvests in one summer," (alluding to the practice of transportation), "and you may make almost any swarm rich enough to live through the following winter." This second harvest may be very efficiently supplied by an attention to FEEDING.

I ought here to state, upon the authority of Mr. Dunbar, that if the weather prove wet and unfavourable, as it did in the autumn of 1829 and 1836, the transported hives are sometimes found to diminish in weight during their sojourn on the moors.

In Scotland, prior to the bees being sent to collect their second harvest, recourse is had to the practice of *Drumming* or *Driving*, and the bees being thereby expelled from their stores, and secured in a new habitation, are sent on the morrow to their station on the moors, sometimes to a distance of fifteen or twenty miles. There they remain for a month or six weeks, a shilling a hive being the usual compensation to the shepherd who superintends them.

For the above information I am indebted to Sir J. G. Dalyell of Edinburgh, the translator of Huber.

Those who have recourse to Driving prior to transportation will perceive the advantage of adopting the system of management recommended in Chap. 10, as in case of any brood being left in the old hive, it will admit of easy removal to the new one, and thus prevent any impediment to the regular increase and welfare of the family. This method is successfully adopted by Mr. Dunbar.

CHAPTER XXIII.

EXOTIC BEES.

Bees are, in all probability, the most universal of all animals; and notwithstanding their impatience of cold, they seem adapted to live in all climates. They are accordingly to be met with in every quarter of the globe, and in every quarter they seem to flourish, if duly attended to.

We are told by *travellers*, that *in all tropical climates there are little black bees without stings*, only half the size of those in Europe, and rounder in form. They build in hollow trees, or in the cavities of rocks by the sea-side, where they lay up their honey in cells about the size and shape of a pigeon's egg; these cells are of a black or deep violet colour, and joined together, so as to leave no space between them; they hang in clusters, almost like a bunch of grapes; each cell somewhat resembles a small bottle or bladder; when filled with honey the cell is closed up.

The honey collected by these bees is said to be more agreeable to the palate, and not so surfeiting, as that of Europe, having less of that peculiar flavour which European honey possesses. A writer in the 15th volume of the Philosophical Transactions, states that their honey is always in a fluid state, and as clear as rock water (it has been called rock-honey), forming an agreeable beverage, which taken on an empty stomach in the quantity of about half a pint, acts medicinally in about two hours, but not so when taken with the meals.

The stingless bees are said to be inhabitants of Gua-

daloupe, Guiana, &c.; but their existence requires confirmation, for an indisposition to wound affords no evidence of inability to do so: queens were formerly supposed to have no sting. According to Sir J. G. Dalyell, *there are bees in India that construct under the boughs of a tree a single comb of very large dimensions.*

The most interesting account of exotic bees that I have met with is in Captain Basil Hall's highly instructive and entertaining Journal written on the coasts of Chili, Peru, and Mexico, in 1820, -1, and -2, of which I shall here give a transcript.

"From the Plaza we went to a house where a bee-hive of the country was opened in our presence. The bees, the honey-comb, and the hive, differ essentially from those in England. The hive is generally made out of a log of wood from two to three feet long and eight or ten inches in diameter, hollowed out, and closed at the ends by circular doors, cemented closely to the wood, but capable of being removed at pleasure.

"Some persons use cylindrical hives, made of earthenware, instead of the clumsy apparatus of wood; these are relieved by raised figures and circular rings, so as to form rather handsome ornaments in the verandah of a house, where they are suspended by cords from the roof, in the same manner that the wooden ones in the village are hung to the eaves of the cottage. On one side of the hive, half-way between the ends, there is a small hole made, just large enough for a loaded bee to enter, and shaded by a projection to prevent the rain from trickling in. In this hole, generally representing the mouth of a man, or some monster, the head of which is moulded in the clay of the hive, a bee is constantly sta-

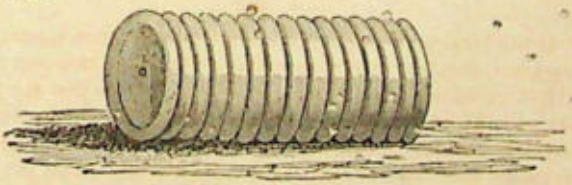
tioned, whose office is no sinecure*, for the hole is so small, he has to draw back every time a bee wishes to enter or leave the hive. A gentleman told me that the experiment had been made, by marking the sentinel; when it was observed that the same bee continued at his post a whole day.

"When it is ascertained by the weight that the hive is full, the end pieces are removed, and the honey withdrawn. The hive we saw opened was only partly filled, which enabled us to see the œconomy of the interior to more advantage. The honey is not contained in the elegant hexagonal cells of our hives, but in wax bags, not quite so large as an egg. These bags or bladders are hung round the sides of the hive, and appear about half full, the quantity being probably just as great as the strength of the wax will bear without tearing. Those near the bottom being better supported, are more filled than the upper ones." (Mr. Jesse, in his Gleanings, upon the authority of a naturalist residing in Demerara, states that the honey sacs in the lower tier rest on the floor, and resemble the broad-bottomed long-necked bottles used in Holland.) "In the centre of the lower part of the hive we observed an irregular-shaped mass of comb, furnished with cells, like those of our bees, all

* If the Mexican bees enter the hives with as much rapidity and in as great numbers as Reaumur states they do in this part of the world, it would indeed be no sinecure. He observes that the population of a hive amounts to 18,000, and that a hundred enter in a minute; if as many go out in the same time I think the sentinel must rather stand on one side of the entrance than within it. Captain Beechey states that it withdraws on one side to a recess, adapted for the purpose, and that a Mexican family of bees is not believed to amount to more than one thousand.

containing young ones, in such an advanced state that when we broke the comb and let them out they flew merrily away."

The naturalist just referred to says, that these breeding-combs are suspended from the roof of the hive in separate pieces, about two inches in diameter, and that the cells are on one side only. Captain Beechey states that these combs vary in their position, some being perpendicular, others horizontal, and the bees being smaller than those of Europe, the brood-cells, as might be expected, are smaller also. "During this examination of the hive the comb and the honey were taken out, and the bees disturbed in every way; but they never stung us, though our faces and hands were covered with them. It is said, however, that there is a bee in the country which does sting; but the kind we saw seem to have neither the power nor the inclination, for they certainly did not hurt us; and our friends said they were always '*muy manso*,' very tame, and never stung any one. The honey gave out a rich aromatic perfume, and tasted differently from ours, but possessed an agreeable flavour." This honey does not readily ferment, but has remained perfectly sweet and grateful after its importation to this country.



The following account of the mode in which the Persian villagers make use of the earthenware hives, one of which I have sketched above, is given by Sir Robert

Ker Porter. The hives are thrust horizontally through the walls of the dwelling, with the circular door or lid (shown at one end), luted and placed next the interior, an outlet for the bees being formed at the opposite end. The hives project more than a foot into the room, and when the honey is taken, the projecting ends being well drummed for a few minutes, causes the bees to withdraw to the other. The lid is then removed, and as many honey-combs as can be spared being quickly cut out, it is again replaced and re-luted. Captain Beechey leads me to suppose that the greater portion of the Mexican bees are domiciled in hollow trees, and that in many instances these trees are cut asunder above and below the hollow portions, and that these latter are suspended in the manner described by Mr. Basil Hall, and used as habitations for the bees.

It was proposed a few years ago to import the stingless bees into this country. If such bees there be, I doubt its ever being attended with success, as the fruits of their labours must very soon become a prey to the wasps and bees of the country; for in a dearth of honey, or when, from a paucity of numbers, a hive is weakly defended, bees, as has been already noticed, will commit depredations upon one another, and the stingless bees having no weapon of defence to enable them to cope with armed assailants, would soon be exterminated, when there was a scanty supply of sweets in the fields. In their native clime, where those sweets abound, no temptations to predatory attack may occur; but in our hemisphere, as Buffon has observed, there are hundreds of lazy creatures, fond of honey and disliking labour, that would, but for the weapons of defence possessed by our bees, invade their hives and carry off the treasures.

Honey-bees do not appear to have been among the native productions of North America, though they have now become general throughout that continent. When established there, they extended themselves somewhat in advance of the white population, in consequence of which they were called by the native Indians the white man's flies, and were regarded as the harbingers of civilization. "In proportion as the bee advances," says Irving, "the Indian and the buffalo retire."

An elegant modern writer has observed upon this subject, that a few years ago the hum of a bee had never been heard on the western side of the Alleghany mountains; but that a violent hurricane having carried several swarms over that lofty ridge, they found there a new unexhausted country, singularly favourable to their propagation, where they have multiplied, till the whole of those boundless forests and savannahs have been colonized by these indefatigable emigrants.

CHAPTER XXIV.

HONEY-HARVEST.

The chief resources of the honeyed race are available during only a short period of the year; for though their collections are extended through seven or eight months, they are rarely made in sufficient quantity to admit of storing, earlier than the month of May, or later than July, excepting in peculiar situations and seasons. Their principal stores are laid in betwixt the middle of May and the end of June. In Scotland and the north of England, and in backward seasons, the commencement and termination are three or four weeks later. After the scythe has cut down the flowers which adorn our meadows and fields, and afford the bees such a plentiful supply of honey and farina, there is a very manifold relaxation in their activity; their excursions are not only less extensive, but less frequent, although the weather be in all respects propitious. During the other portions of the year, peculiar situations and seasons, as I have before observed, present them with autumnal resources; so likewise do they with vernal ones, where willows abound for instance, and the spring is particularly forward. Mr. Golding's apiary was placed under these circumstances in 1830, when his bees began to collect abundantly so early as the 20th of March, and in a single day, viz. on the 26th, one of his families increased in weight three pounds and a quarter, and also worked as vigorously in wax as in the height of summer.

A variety of experiments have been made to ascer-

tain the quantity of honey consumed during the respective months of winter and spring; and they all lead to one conclusion, namely, that upon an average it amounts to eight pounds, taking the season through, from the beginning of October to the end of May, when the spring proves ungenial. During the first six months the consumption was not more than five pounds upon an average, and the colder the weather the less was the consumption; the quantity here stated, however, is too small to be depended on by two or three pounds.

As a general rule,—no honey should be taken from a colony the first year of its being planted, though there may be an extraordinary season now and then, which may justify a departure from this rule; but neither in such an uncommon year, nor even in the second year, should the whole of the combs in any box be taken, (unless it be clearly ascertained that the centre combs contain no brood,) but only the external ones, which should be examined carefully one by one, and the brood combs, if any, be returned in the box to the stock. The apiarian, as Huber observes, if he wish to obtain a considerable quantity of honey, should endeavour to secure his object rather by the number of his colonies, than by plundering a few of a great proportion of their treasures. *A moderate participation is the most infallible means of preserving the stock.*

. . . . . Should "Summer signs auspicious ride,
And tubes unfailing pour the balmy tide,
A full rich harvest, bee-herds, may ye claim
From the blithe tenants of your crystal'd frame.
But long ere Virgo weaves the robe of sleet,
Or binds the hoar-frost sandals round her feet,
Close seal'd and sacred, leave your toil-worn hosts,
The last kind dole their waning season boasts,

Lest coop'd within their walls, the truants prey
On hoards reserv'd to cheer stern winter's day."

EVANS.

Mr. Hubbard says that he has found *colonized bees frequently fail, in consequence of their having been robbed of too much honey*; it prevents early breeding. Wildman also *particularly recommends cautious deprivation after July*, to avoid the attention which might be required in feeding, if the autumn should be unfavourable.

It should be an invariable rule with the apiarian never to remove an upper hive or box till an under one be quite full, nor to diminish the weight of a stock box below seventeen or eighteen pounds, exclusive of the box itself and its appurtenances. If at Michaelmas it do not weigh so much, a sufficient quantity should be supplied either by restoring a part of the combs that have been removed, previously unsealing them, or by the presentation of liquid honey, or syrup, in a feeding trough.

The loose bars recommended at page 82, render the system of partial deprivation more available than any other, and from ten to fifteen pounds of honey may by their means be *sometimes* taken away even from a swarm of the current year.

The second year of a family's establishment is the first in which any *considerable* harvest of honey can be expected; it may then be regarded as in the very height of its productiveness, and if the summer of that year, as well as the summer preceding, have been favourable for honey-gathering, one or more boxes may in general be safely removed.

So much for the first and second season: as to the best mode of proceeding in future years, some difference of opinion prevails. On the one hand it must be ad-

mitted that, owing to the successive linings which the brood cells periodically receive, during the breeding season, they gradually become so contracted as to prevent the perfect development of the bees that are bred in them, besides having their capacity for holding honey diminished. By long residence also the brood-combs are apt to acquire a strong odour, whereby they attract vermin, and impart an unpleasant flavour to the honey, with which, as the season advances, they are generally stored. Those who are influenced by those apprehensions never allow a box or hive to retain the same combs beyond three years*. On the other hand, it may be remarked that persons, who to great experience and much observation add very great success in the management of their bees, are of opinion that a box suitably furnished with brood-combs should be superhived as long as its tenants prosper.

In the conduct of my own apiary I have never been a rigid follower of either system, and shall not presume to decide this debateable point, or lay down any precise rule; each respective bee-keeper must determine for himself, by an occasional examination of his hives in spring and autumn.

Feburier recommends extensive deprivation four or five days after the issue of a swarm, as then the finest honey of the season will be obtained, and the issue of a second swarm in all probability be prevented; and the stock will still be in a more forward state than the swarm which issued from it, so that in a month's time, there may be a second deprivation, to a moderate extent.

* I have already adverted to the opinion of Feburier, at page 216. Those who choose to adopt it must be careful to substitute worker-combs, either entire or in properly dependent pieces.

The judicious removal of a super, or of a few of its bars, seems to stimulate the bees to frequent the fields more vigorously when the harvest of honey is abundant, therefore the former should always be had recourse to as soon as the cells are sealed over. When however the season is but moderately productive, a few of the exterior combs only should be taken, the remainder having their lids sliced off, that the bees may remove the contents into the stock hive. If a comb containing brood be at any time removed, it should either be immediately returned or transferred to a weak family, after brushing off all the bees. This leads me again to point out the advantage of boxes surmounted with loose bars. By their means, assisted by the use of tobacco-smoke, in the manner already described, the removal, replacement, or exchange of combs is accomplished with great facility, and these will often be found to be matters of great importance to the well-being of an apiary. They likewise enable the bee-master, under some peculiar circumstances attending a crowded population, to afford relief to the bees without prejudice to their proceedings: where a family, for instance, after having been accommodated with a super or two, appear to be nevertheless in want of room, *at an advanced period of the season*. In such a case the application of a nadir would naturally suggest itself; but this is a step which would prove injurious, as the bees would be apt to occupy themselves in that space nearest the entrance, and by quitting the super before it was completely furnished be thus prevented from properly concentrating their stores. The best mode of obviating this inconvenience is to afford the required room by removing two or three loaded bars from the super.

Virgil, probably copying his predecessor Aristotle, describes *two harvests of honey every year*, namely in spring and autumn.

"The golden harvest twice each year o'erflows,
Thou, twice each year the plenteous cells unclose,
Soon as fair Pleïas, bright'ning into day,
Scorns with indignant foot the wat'ry way,
Or, when descending down th' aërial steep,
She pours her pale ray on the wintry deep."

SOTHEBY'S GEORGICS.

"Varro mentions three harvests: namely, at the rising of the Pleiads, about the twenty-second of April; the latter end of summer; and when the same stars set, towards the end of October. Columella recommends them to take place about the 25th of April and the 29th of June; Pliny in May and July; and Palladius in June only."—EVANS. But the practice of these foreigners is no guide for the inhabitants of so variable a climate as ours.

Having entered upon the most eligible time for depriving bees of a portion of their treasures, and stated how far it can be safely extended, I shall now proceed to the mode of carrying it into effect.

Timid operators and others, at the commencement of their apiarian career, will probably be induced to employ Dividers when they have occasion to remove a box of honey; I have already noted their utility when adding *empty* boxes to a family, and it will at once be perceived that they must be no less applicable to the removal of *full* ones. In this case, the two dividers must be introduced between the middle board of the box to be removed and the box below it, precisely as in nadir hiving.

In the act of deprivation some additional force will be required to push in, as well as to withdraw the divider, as the middle board will very frequently be found cemented with propolis to the box beneath.

The above directions apply to the removal of an upper box, which will, *in general*, be the only one for which they will be required. When any other is to be taken, the plan of proceeding must be varied; but it would be tedious to give directions for every case. By an attention to the instructions already given, and his own reflection, an intelligent operator will be able to adapt his mode of proceeding to the particular exigency. Only one divider should be introduced till the situation of the queen be ascertained: if she be in the box intended for removal, the divider must be withdrawn, and the experiment tried again in a week or two. If in half an hour after the introduction of the divider*, the bees in the box intended to be taken should exhibit symptoms of inquietude, it may be assumed that the queen is not within that box, the disturbance being caused by the anxiety of the bees to have access to her; whereas if she *be* in the box, the bees, in company with her, will be tranquil, and the *excluded* portion of the family will be in a state of commotion. Having, we will suppose, ascertained that the queen is in the desired place, the second divider should be introduced as before directed, when the box, with one of the dividers underneath it, must be removed. The apiarian, when performing this operation for the first time, may find it convenient to raise a stage of empty

* If the divider be accurately smooth and level, and the family populous, a thin wedge or two should be introduced between it and the box, or the bees may be suffocated.

bee-boxes or other convenient articles, on one side or at the back of the box to be removed, and upon a level with the bottom of its middle board; he can then, after having introduced the dividers, very easily slide the full box, with its middle board and divider, over his temporary stage. (This mode of proceeding may likewise be found applicable on other occasions.) The operation having proceeded thus far, a floor-board with its sliding shutter open, should be placed against the wall of the bee-house, where there is a spare opening for the exit of the bees. Being surmounted by an uncovered empty box, to prevent the honey from being scented by neighbouring bees, the full box and middle-board with the divider underneath them should be raised upon it. The divider being now withdrawn, a portion of the bees will immediately sally forth, to join the family from which they have been separated. I say a portion, for, notwithstanding their attachment to their queen, they will not all quit, without reluctance, so great a treasure as a box full of honey; if any of the combs contain brood also, this reluctance will be increased. When therefore the bees issue slowly, the sliding shutter should be closed, and re-opened in a quarter of an hour. This short imprisonment will produce some impatience and restlessness, and consequent eagerness to be set at liberty; and on re-opening the shutter there will be a fresh sally: this method must be pursued, at similar successive intervals, till all or nearly all the bees have quitted the box*; should a few still remain, the box, towards evening, may be taken out of doors, and the stragglers brushed out

* Towards the close of this proceeding, an occasional rap on the sides of the box will rouse its inmates to a sense of their isolated condition.

upon a board or cloth, with a small Bavarian broom (bees appear to have a dislike to wings, brushes, and all things into which animal substances enter,) and placed upon a support near the entrance to the stock; those that are not injured by the broom will soon find their way home: thus will the whole operation be completed. But if the upper story be taken, it is obvious that either an empty box or a top board should be placed over the stock.

Those who have an outhouse, or who can spare a room within their house for the purpose, will find that the most eligible plan for giving liberty to the confined bees, is to darken the apartment, so as to admit only a very small portion of light; the whole of such light communicating with the open air. This arrangement having been made, the full box should be inverted beneath an empty one, and the whole surmounted by a loose lid, that can be pushed aside, so as now and then to allow the bees to take wing and issue through the open space: when the first rush is over, replace the lid, and in ten or fifteen minutes push it aside again, reiterating this proceeding till all, or nearly all, the bees have departed. The combs may now be removed, by means of the instruments recommended at page 137, and those few bees that may remain brushed away with a Bavarian broom.

Thus far I have proceeded upon the supposition that a box or hive is to be removed from its situation, and its tenants dislodged, in order that the owner may obtain the whole or a part of their treasure. But I have in Chap. VIII. alluded to another, and, where partial deprivation is intended, a superior mode of effecting this object, as practised by Mr. Golding, whose method of removing side combs I shall now proceed to detail.

If it be a super that is to be operated upon, the lid must be unscrewed, and carefully loosened from its attachments: this first step will cause a little disturbance to the bees, which will not continue long. As soon as it has subsided, place a weight upon the lid to keep it steady; after which, let it be moved gently to one side, not to such an extent as to admit the escape of the bees, but merely far enough to allow a little tobacco smoke to be whiffed into the box. This will drive them from the outside of the comb; by pushing the lid about an inch and half further, they may, in like manner, be driven from the whole comb. Its attachments to the sides and bottom may now be severed by the cutting instruments already described in Chap. XII. If the under side of the lid be so much incrusted with propolis as to obstruct its being readily shifted from side to side, let it be raised gently, and the bees fumigated from beneath it; a smooth divider may then be easily and quietly pushed in, and substituted for the box lid. If any force be required to lift out the loaded bar, the operator should desist; as this resistance must arise from the imperfect separation of the comb from the box or floor board, from which it should be completely detached. It will not be right to attempt this operation in very hot weather, as the combs then will scarcely sustain their own weight.

The mode of deprivation to be adopted by those who surmount their hives or boxes with small glasses is as follows. When the glasses are sufficiently filled with combs and honey,—and this period will very much depend upon the season,—if the bees still remain in them, placing an empty hive under the full one will generally cause them to descend, and facilitate the removal of the glasses, which may take place as often as the harvest of

honey will admit, consistently with leaving a full winter's supply for the bees. The usual mode of taking the honey in these glasses, is first to separate them from their adhesion to the top board, by means of a thin spatula, and then to pass two flat pieces of tin or copper successively under each glass: the upper tin, with the glass, should be removed to a darkened room, or to a shady place, at a short distance; the glass should then be inverted upon a large tumbler or jug, and on the withdrawal of the tin the bees will soon quit and return to the family. The lower tins must remain on the apertures in the top board until empty glasses can be substituted for the full ones. The bees will rarely fill more than one set of glasses during the first year; though in future years, if the season be favourable, they may be expected to fill two sets, more or less according to their size.

The best time for removal is the middle of a fine day, when the greatest number of bees are roaming the fields. This method of management will not prevent the bees from swarming, unless it be combined with storifying, which it very easily may, by means of the adapting centre-board, as described at page 87.

If bad weather should set in, the glasses ought to be removed, or their communication with the hive cut off, otherwise the bees will have recourse to the honey they contain. On the return of fine weather, they should be furnished either with fresh glasses, or with the same *deprived of the honey*; for if replaced without this precaution, the bees, ever suspiciously vigilant, having become aware that their stores are accessible from without, will be very apt to remove the honey themselves.

Should such an accident occur as the destruction of a queen, the stock, when they discover their loss, will

appear very much distressed and very restless, particularly if they possess no female egg, or no very young larva; for in either of these cases they will soon become reconciled. But if neither of them be present, and the bees left to themselves, they, *in general*, either lose their wonted activity, gradually dwindle in number and pine away, or transfer their allegiance to another sovereign; and, in this case, convey all the treasured sweets of their own hive to that of the family they join. The remedy for such a misfortune is to unite the bees to another stock, in the manner already described, or else to procure either a supernumerary queen, or a suitable brood-comb from another family. This latter may be readily accomplished with a Huber or loose barred hive, in the manner described at page 155, under Artificial Swarming.

The suffocating system, adopted by the cottagers, is accomplished by setting the hive, late in an evening, over lighted brimstone matches, placed in a hole dug in the earth; the soil being quickly drawn round the hive, as well to prevent the escape of any of the bees, as to confine the sulphurous gas. In about a quarter of an hour, if the hive receive a few smart strokes on its sides, the bees will be found to have dropped insensible into the hole, where they are immediately buried; otherwise they would revive, such of them at least as were not singed or otherwise injured by the fire. The heaviest and lightest hives are usually selected for the purpose: the former as yielding most profit, the latter as being unlikely to survive the winter.

If, after a hive of bees have been suffocated, the apiarian wish to *search for the queen*, the best mode of doing so is to lay the whole of the bees on white paper, or in water on a white shallow dish, and examine them

singly. Her colour upon the back is not so remarkably different from that of the workers as to be very striking; but she may readily be distinguished by the greater length of her body and the colour of her under parts.

I adverted to this latter mode of robbing bees of their treasure in a former chapter, and there quoted the lamentation of Thomson at their fate. For this humane appeal he has been thus apostrophised by Dr. Evans.

"And thou, sweet Thomson, tremblingly alive
To pity's call, hast mourn'd the slaughter'd hive,
Cursing, with honest zeal, the coward hand
Which hid in night's dark veil the murd'rous brand,
In steam sulphureous wrapt the peaceful dome,
And bore the yellow spoil triumphant home."

CHAPTER XXV.

MANIPULATION OF HONEY AND WAX.

After deprivation, the box or hive containing the combs should be kept in a *warm* room, which the bees cannot enter, till it is convenient to drain it of its contents, as the more fluid the honey, the sooner and the more completely will it run off; this is of course a reason for not deferring the draining longer than can be avoided.

The combs should be separated from the boxes or hives with the double-edged instruments recommended in Chapter XII., and placed afterwards on a clean dish. The waxen covers, on both sides of the sealed combs, should be sliced off, when by placing them in an inverted position on a hair sieve, the honey will run through tolerably fine, and may be caught in an earthen pan. For prime purposes the purest combs should be selected, and their honey passed through a separate sieve. Mr. Isaac recommends letting this fine honey drop through the sieve into a silk sarse, such as is used by the apothecary for sifting fine powders, and from the sarse into an earthen pan; this would enable the apiarian to obtain his honey in a more depurated state. The sarse must be first wetted, or the honey will not run through it. If the weather be cool, the business should be conducted in a room where there is a fire. To those who require their honey in a state of the *utmost* purity, I recommend the mode of manipulation adopted by Mr. Dunbar.

"It consists of a tin vessel of an oval shape, and (having a spigot at the bottom) eighteen inches long, seven broad, and five deep. Resting upon this is another vessel of the same shape, and just so much smaller that its under edge slips within the other to the extent of an inch, and is prevented from sinking further by a raised beading. The bottom is pierced closely with holes, each the sixteenth or twentieth of an inch in diameter. *Above* the bottom inside, and at the distance of an inch from it, stands, upon four feet, a stage of the same shape and size, made of wire-cloth of a quarter of an inch mesh. *Under* the bottom is fixed a piece of fine muslin, the edges of which are brought out at the joinings of the two vessels. In using this apparatus, the combs being sliced horizontally through the cells, are laid with the cut side undermost upon the wire-cloth stage, which retains all the bulky part of the wax, and prevents it from clogging the holes below; the honey drops upon the bottom, and runs through the small holes, which prevent the lesser particles of wax from getting through, while the muslin below causes it to flow in almost perfect purity to the under vessel, from whence it issues through the spigot into stone-jars. A cover put upon the top vessel, after the sliced comb has been deposited, completes the exclusion of the external air, with which the honey never comes in contact, till it runs from the spigot."

The inferior combs, when freed from all heterogeneous matters, may be chopped up, or crushed with the hands, and set to drain upon a coarser sieve for ordinary purposes. The whole of the broken combs may, at last, be thrown into as much clear water as will float them, and remain in this state for some days, to dissolve

all the honey for making common mead, or boiling down with ale to make syrup for the bees.

The combs having been cleared as completely as possible, are usually boiled till they are thoroughly melted, with sufficient water to prevent burning, the melted mass being afterwards expressed, through a canvas bag, into a pan of cold water, from which the wax is afterwards separated, re-melted to purify it still further, and poured into moulds.

This business has generally been conducted in a very clumsy and wasteful manner. The grand difficulty in the process arises from the wax, and its heterogeneous admixtures, floating together on the surface of the water in which they are boiled. In the former edition of this work, I hinted at the use of a steam-kettle, for accomplishing the depuration, and, making some variation in the mode of employing it, I find it accomplishes that object very completely. The kettle I use is in shape like a flower-pot; the strainer is of the same shape, but only half the depth, and it drops into the larger kettle full half way, with an accurate fit. The bottom of this inner kettle is perforated, all over, with very fine holes, and has a couple of ring handles. The rough combs being placed in the large kettle, water is poured in, till it rises nearly half way up the inner kettle, and the whole is placed over a moderate fire. As the wax melts out of the crude mass, it percolates through the strainer and floats upon the surface, tolerably free from impurity, from whence, when cool, it is taken off in a cake, for being re-melted and still further depurated, which may be effected by the same apparatus, varying the use of it a little. The cake of wax, just referred to, is now put into the upper kettle, and water, to the depth of a few inches, into the lower; the wax is then slowly melted

again, when it will drop through the strainer and swim on the surface of the water, the impurities falling to the bottom. Having been separated from the water, and any still remaining impurities scraped off, the wax should be again re-melted, with just water enough to avoid burning, and poured into the moulds: the latter having been previously rinsed with cold water, to prevent the wax from adhering to them, the moulds should then be placed near the fire and covered over, to let the wax cool gradually, or the cakes will be liable to crack. This last melting should be conducted over a *very gentle* fire, such as wood embers and the like, or the wax will suffer materially in colour, fragrance, and tenacity. The cracking may be obviated, by detaching the wax from the sides of the mould, with a thin knife, when half hardened.

If it be desirable to have the wax in a very pure state, it may be boiled over and over again with fresh water; though much boiling will render it dry and brittle, and impair its colour.

Of the various other modes of depurating wax, I prefer that recommended by the Abbe Della Rocca. He directs the combs to be inclosed in a canvas bag, and immersed in a pot of hot water, in which it is to be simmered gently for a short time, when the wax exuding through the canvas, divested of its gross admixtures, will, as in the former instance, rise to the surface of the water, from whence it may be skimmed off, set to cool, and treated in the usual way. A few small pebble stones, inclosed in the bag with the combs, will keep it below the surface, and if but a few, will not endanger its burning. The process will be expedited by occasionally kneading the bag with a stout stick.

The new combs will melt almost entirely; but the old

ones, owing to their cells having received so many linings, will preserve their form, the wax running from them in very small quantities.

Whatever mode of depuration be adopted, care must be taken to let the vessel in which it is conducted be capable of containing a good deal more than is put into it, as the contents are apt to boil up suddenly, and may thus occasion loss and inconvenience, as well as danger.

CHAPTER XXVI.

HONEY.

Honey is a well-known, sweet, tenacious, substance, which in fine weather is continually secreting in the nectaries of flowers, chiefly from certain vesicles or glands, situated near the basis of every petal, from whence it is collected by bees and other insects. The domestic honey bees consume a portion of this honey for food, at or near the time of gathering; but the principal part of what they collect is regurgitated, and poured into the cells of the hive, for the use of the community in winter: so very abundant are these collections, in favourable seasons, as to afford to the apiarian an extensive share of them, without distressing the provident hoarders. Mr. Wildman states that in the year 1789, he purchased a glass filled with exceedingly fine honey-combs, weighing 63lbs., which had been collected within a month, and that the hive, which it had surmounted, still contained a full supply for the winter's consumption of the bees. This, however, was a very unusual product; a hive or box, of the dimensions recommended in this work, may be considered as well stocked when it yields from 30 to 35lbs. of honey.

The honey intended for early use, and for the nursing bees and drones, is deposited in cells which are allowed to remain open; whilst the finest honey, which is laid up in store for winter, is placed in the most inaccessible

parts of the hive, and closed in the cells with waxen lids.

"There cluster'd now clear wells of nectar glow,
Like amber drops that sparkle in the Po,
And now, (so quick the change) ere one short moon
Shrinks with waned crescent mid the blaze of noon,
All veil'd from view, these amber drops are lost,
And each clear well with waxen crown embost."

EVANS.

In the Philosophical Transactions for 1792, Mr Hunter has stated, that whatever time the contents of the honey bags may be retained, they still remain pure and unaltered by the digestive process. Mr. Polhill, a gentleman to whom the public are indebted for several articles in Rees's Cyclopædia appertaining to bees, is also of this opinion. Messrs. Kirby and Spence do not admit this statement: as the nectar of flowers is not of so thick a consistence as honey, they think *it must undergo some change in the stomach of the bee*. They are countenanced in this opinion by Swammerdam and Reaumur: the latter has observed that if there was a deficiency of flowers at the season of honey-gathering, and the bees were furnished with sugar, they filled their cells with honey, differing in no other respect from honey collected in the usual way, but in its possessing a somewhat higher flavour, and in its never candying nor even losing its fluidity by long keeping. The same has been observed when they imbibe the juices of sweet fruits, for bees do not confine themselves solely to flowers and honey-dewed leaves: they will sometimes very greedily absorb the juice of raspberries for instance, and thus spoil them for the table; they also visit in crowds the vats of the cider and wine maker. The naturalists just

named, highly and deservedly as they are celebrated, are not borne out in their opinions either by my own experiments or those of my apiarian correspondents: we have each tried supplying bees with syrup of sugar as a resource for winter, without finding any material change in it after it was stored. It might be somewhat clearer, but no other difference whatever was perceptible.

Reaumur has likewise remarked, that *in each honey-cell there is a cream-like layer or covering, of a thicker consistence than the honey itself*, which apparently serves to retain the more liquid collections that are from time to time introduced under it. Messrs. Kirby and Spence say, that if honey were the unaltered nectar of flowers, it would be difficult to conceive how this cream could be collected in proper proportions. This observation is made, in consequence of their presuming that some of this cream-like covering is conveyed into the cells with each deposition of fresh honey; and it has been supposed that this cream was the last portion disgorged. According to an article in Rees's Cyclopædia, probably written by Mr. Polhill, this cream-like matter is formed at the very first, and every addition of honey is deposited beneath it. The bee, entering into the cell as deeply as possible, puts forward its anterior pair of legs, and with them pierces a hole through the crust or cream: while this hole is kept open by the feet, the bee disgorges the honey in drops from its mouth; these, passing into the hole, mix with the mass beyond: the bee, before it flies off, new-models the crust, and closes up the hole. This mode of proceeding is regularly adopted by every bee that contributes to the general store.

The power of *regurgitation* in the bee is very remarkable: its alimentary organs, like those of the pigeon,

besides being subservient to the purposes of nutriment, afford it a temporary store-room or reservoir. Ruminating animals may be considered as regurgitating animals, though in them the operation is performed for different purposes. In some it is exercised for the purpose of digesting the food, in others for feeding the young; but in bees its use is to enable them to disburden themselves of the honey, which they gather, for the winter's store of the community.

The finest flavoured and most delicate *honey* is that which *is collected from aromatic plants*, and has been stored in clean new cells: it has been usually called *virgin-honey*, as though it were elaborated by a fresh swarm of bees; but this is not essential to the perfection of honey, for, provided the cells, in which it is deposited, have never contained either brood or farina, it is not material whether it have been collected by swarms or by old stocks; the season and the flowers having been the same, the quality of the honey will in both cases be alike. F. Lamberti asserts, that the best honey in the world is produced in Pontus, and that its superiority is attributable to the great quantity of balm growing there. In this quarter of the world, the *Narbonne honey* is regarded as the finest, owing to the rosemary which abounds in the neighbourhood of Narbonne.

But Mr. Duppa, in his Miscellaneous Observations, says that "the honey, for which *Narbonne* is so deservedly celebrated, is every year diminishing. Bees have ceased to be an object of attention to the peasantry; they now devote their time to the vineyards, and neglect the bees. The flowers of the wild plants, in the neighbourhood of Narbonne, are highly aromatic, and give the flavour which is peculiar to its honey: this pecu-

liarity is attributed exclusively to the wild rosemary, *Rosmarinus officinalis.*" Attempts are said to have been made to imitate Narbonne honey, by adding to other honey an infusion of rosemary flowers.

The honey of Hymettus has been much extolled, by Strabo and other writers, and is still in high estimation; its peculiar flavour being, no doubt, imparted by the wild thyme so luxuriantly growing upon the celebrated mountain from which the honey derives its name. Martial compares the nectar of the Gods to Falernian Wine mixed with the honey of Attica. The Maltese honey, which is chiefly collected from the blossoms of the orange trees, has also a fine scent and a peculiarly fine flavour.

The county of Hereford, (which has been the principal field of the author's observations,) yields a considerable quantity of honey, of very fine quality, a fact corroborative of a very ancient opinion, that the finest honey is collected in districts which produce the finest wheat and the finest wool, these articles being two of the five Ws for which Herefordshire has been long celebrated, women, wheat, wool, wood, and water. It is however, I conceive, principally from the pasturage of Dutch clover, luxuriantly clothing the fields and meadows of that county, that the abundance and excellence of its honey is derived; for independently of this natural clothing, which abounds in all the best sheep pastures, a considerable breadth of it is annually sown by the Herefordshire farmers.

The accounts which I have received from Leicestershire and Lincolnshire lead me to believe that they are highly productive of honey, and probably from the same cause, as they afford excellent sheep pasturage.

Owing to their abounding in heaths, commons, and woods, the borders of Cambridgeshire, Hertfordshire, and part of Hampshire afford much pabulum for bees; and some of the farmers in those districts have from a hundred to a hundred and fifty stocks of them, the largest number that I have ever heard of in this kingdom. In the Ukraine, some of the peasants have four or five hundred hives each, and find their bees more profitable than their corn. This is a number, however, which I should think would overstock most districts, and which could only be supported, naturally, by having recourse to transportation. This seems to be evinced by the inhabitants of Egypt, France, Savoy, Piedmont, and other places availing themselves of that practice, as already stated.

On the subject of *overstocking* different opinions prevail. M. Espinasse says that few parts of England which he has visited afford flowers, in sufficient profusion, and of sufficient variety, to support numerous colonies.

From what I have said at page 122 upon this subject, it will be evident that much depends upon locality. An American writer on bees calculates that where bee-pasturage is abundant, twenty hives, to an area of a mile, is a fair proportion. As a general remark it may be observed, that when the season is ungenial, bees do not flourish even in situations where the hives are thinly scattered; whilst very thickly stadded and numerously peopled apiaries, if the weather be warm and moist, and the fields clothed with verdure, will all, under judicious management, gladden their proprietors with a bounteous harvest.

I have already spoken, in the chapter on Pasturage,

of the deleterious qualities which some flowers impart to their honey: I will here add, however, what has been said of the *appearance* of this *pernicious* kind of *honey*. It is usually distinguished from what is innocent by its crimson or reddish brown colour, its bitter flavour, and thicker consistence; but in Florida and Carolina it is so similar, in all respects, to innocent honey, that the hunters depend upon experience only, and, knowing that bad honey soon shows its effects, they at first eat very sparingly. The converse of this would appear in the "blood-red honey" found by Mr. Bruce at Lixan in Abyssinia, to which he ascribes no evil properties. (Travels to the Nile, vol. v.) Linnæus informs us, that in Sweden, the honey of autumn is principally gathered from the flowers of the *Erica* or Heath, and that it has a reddish cast. The honey of our native heaths is also of the same colour. Dr. Barton has observed, that during his residence at Edinburgh, the Highland honey was often of a dirty brownish colour, which was supposed to be given to it by the "blooming hather," as Burns calls it; the people of Edinburgh, however, though great consumers of it, never complained of any ill effects from it. It produced upon the Doctor a soporific effect. The most innocent honey will often disagree with those who take it in large quantities, or who have irritable bowels; usually, in such cases, it produces purging, and sometimes griping pain. The mischievous qualities of honey have been said to be destroyed by boiling and straining, or even by long keeping only; yet when made into metheglin, it has been found as deleterious as ever.

The quality of honey varies with the time of gathering, and that even though the whole season may have been

vourable. The collection at the commencement of Summer is regarded as the prime honey of the year, woods, herbs being then most abundant, and in the full and prime of health; and that which is collected in spring is far superior to the gleanings of autumn.

Huber states that *the secretion of honey and the formation of wax are singularly promoted by electricity:* I have myself noticed this in a very remarkable degree; hence the works may always be observed to advance rapidly when there is a southerly wind, a moist warm air, and an impending storm; whereas the secretion is impeded, and sometimes suspended, by long-protracted droughts, (such as we had in 1826 and 1827,) cold rains, and a northerly wind.

Prime honey possesses a whitish colour, an agreeable smell, a pleasant taste, and a thick consistence. When taken from the combs it is in a fluid state, but gradually thickens by age, and in cold weather there will be deposited, if the quality be genuine, a firm and solid mass of honey, which it may be unnecessary to state is of more value than the softer portion which rises to the top. In England, honey has seldom been known to assume a solid state while in the hives; and even out of them, if it remain in the combs, it will preserve its fluidity, clearness, and fine flavour for at least a year, if not exposed to a low temperature. The honey of tropical climates is always in a fluid state. *Vide* chapter on Exotic Bees.

Much of the fine flavour of honey will depend upon the manner of its separation from the comb. That will be the most delicate which flows, spontaneously, from the purest and whitest combs; the next in excellence will be that which is expressed without heat; and the

coarsest, that which is obtained by the aid of heat and pressure.

Something will depend upon the time it has been allowed to remain in the hive. That which has been collected during the current year will always possess the finest flavour and run off the most freely.

Care should be taken in the selection *of the vessels used for storing honey*; the most appropriate are *jars of stone ware*, called Bristol ware. The principal *constituents of sugar and honey* are the same, viz. hydrogen, carbon, and oxygen. Besides these, their common elements, honey contains mucilage and extractive matter, and also an excess of oxygen: in plain English, honey possesses a greater proportion of acid than is contained in sugar, and in a state more capable of acting upon those bodies with which it comes in contact. From this the reader will perceive my reason for recommending stone jars for its preservation: the acid of the honey acting upon the lead, with which every other kind of earthenware is glazed, causes the honey to receive an impregnation from it, which may prove injurious to those whose constitutions are delicate; the stone ware, being glazed with common salt, cannot communicate any injurious property to the honey which is stored in it. *Honey should be kept in a cool and dry situation*, as warmth promotes fermentation and generates a sensible acidity. The circumstance of honey, when separated from the combs and put into jars, being disposed to ferment in a temperature much below the usual heat of a hive, is calculated to excite our admiration of the instinctive intelligence of the bee, which leads it to distribute its treasure in small cells and to seal them closely over,

whereby the honey can be preserved from fermentation for a long period, even in a high temperature. PROUST *says that the granulated honey is capable of being separated into two parts*, one of which is liquid, the other dry and not deliquescent, crystallizable in its manner, and less saccharine than sugar. *The Jews of Moldavia and the Ukraine prepare from honey a sort of sugar*, which is solid and as white as snow, which they send to the distilleries at Dantzic. They expose the honey to frost for three weeks, in some place where neither sun nor snow can reach it, and in a vessel which is a bad conductor of caloric, by which process the honey, without being congealed, becomes clear and hard like sugar.

The French chemist M. Cadet, of Vaux, adopts the following method of purifying honey, as a substitute for sugar, but which can only deserve attention when the price of honey is much lower than that of sugar, as there is a loss of one half of the honey during the process.

Take of honey four parts, water two parts; place them over a slow fire; when the honey is dissolved, add *fresh burnt* charcoal, crushed, one part; boil gently, occasionally pressing down the charcoal. The ebullition will commence in the centre, and the charcoal range round the sides with the scum, which must be taken off when the syrup begins to thicken. As soon as it is cleared, let it be allowed to cool and settle, after which pass the clear supernatant liquor through a flannel bag; the boiling and skimming must then be repeated, and continued till a small portion, dropped into a glass of cold water, will precipitate in small globules to the bottom. If the charcoal be not fresh and dry,

let it be brought to a red heat in a clear fire before it is used.

Prior to the discovery of sugar, honey must have been an article of great utility; and notwithstanding that discovery, if we may judge from the quantity imported into this country, and the price at which it sells, when of fine quality, it may still be regarded as a commodity of great importance, and worthy of more attention from our rural population than it in general obtains.

Amongst other purposes to which honey has been applied, it may not be amiss to mention its use for enveloping, and thereby preserving, grafts, birds' eggs, and valuable seeds, which have to be transmitted from one clime to another; a method which will render them available for a considerable time.

CHAPTER XXVII.

WAX.

Wax is a solid compact unctuous substance, generally of a yellow colour. It is secreted by animals and vegetables, but the vegetable secretion of it is often combined with resin.

Bees-wax may be said to be a concrete animal oil, holding the same relation to the fixed oils that resin does to the essential oils. It is secreted by certain small sacklets on the body of the bee, as occasion requires, for constructing the combs in which the family provision and the young brood are deposited; the wax of commerce is procured by melting down these combs in the manner already described.

Prime bees-wax is of a bright yellow colour and an agreeable odour, somewhat like that of honey. The best is procured from combs which have been either wholly unoccupied, or occupied by nothing but honey. When first secreted, it is white, semitransparent, and very fragile: it afterwards becomes stronger, and assumes more or less of a yellow hue. This deepening of colour is owing, partly, to its being covered with a yellowish varnish by the bees, (for an account of which see "Architecture" and "Propolis,") and is partly the effect of age.

Independently of its colour, the goodness of wax may be estimated by passing the thumb nail forcibly over its surface: if good, the nail will pass with a kind of jerk; but if no obstruction be felt, the wax may be

looked upon as adulterated with suet, or some similar substance.

The average *quantity yielded by a common hive* is about half a pound of wax to fifteen pounds of honey; the quantity of both may be considerably increased by storifying.

WHITE WAX is nothing more than the yellow wax that has been exposed in thin flakes or shreds to the action of the sun and air. There is an apparatus for melting and reducing the wax into shreds or ribands, but the process of conversion, under any circumstances, is tedious and dependent on the weather. "The following," says Mr. Parkes in his Chemical Essays, "is the usual process, as it is conducted in England. Common bees-wax is melted upon hot water; and when in a fluid state, it is laded out of the copper, together with a part of the water, into a wooden vessel; and in this it is allowed to remain a few hours, for the impurities to subside from it. The purified wax is then put, while still hot, into a colander full of holes, through which it runs, and falls upon a revolving metallic roller, which dips into cold water contained in a vessel placed underneath. As the melted wax runs through the colander upon the revolving roller, the motion of the cylinder forms it into thin shavings, which cool as they come in contact with the water, and fall in an accumulated heap into the water below. These shavings of wax, being now in a suitable form for absorbing oxygen, are taken out of the tub, and exposed in a field to the action of the atmosphere, till they become sufficiently white."

Bees-wax forms *a considerable article of commerce*, and large quantities of it are annually imported into this country from the Baltic, the Levant, the Barbary

Coast, and North America. In some parts of Europe and South America wax is very extensively employed in the religious ceremonies of the inhabitants. Some attention is paid to it in the peninsula of Yucatan, where there are Colmenares containing six or seven hundred hives; Mexico imports annually from two to three thousand arrobas, consisting of twenty-five pounds each; and Humboldt informs us that upwards of 80,000 pounds worth is annually imported from Cuba to New Spain, and that the total export from that island in 1803 was worth upwards of 130,000*l*. By far the greater part of this wax is the produce of the hive-bee, though no inconsiderable quantity is procured also from various species of wild bees, as well as from certain trees which I shall notice presently.

Upon this subject a modern writer, after lamenting the increasing neglect of bee-culture in this country, has not hesitated to use the following contemptuous, and somewhat extravagant, language. "There is hardly bees-wax enough produced in England to answer the demand for lip-salve alone; but importation from America supplies all our wants, for the quantity obtained in that country is annually increasing." "Little thinks the ball-room beauty, when the tapers are almost burnt out, that the wax by whose light her charms have been exalted was once hidden in the bells and cups of innumerable flowers, shedding perfume over the silent valleys of the Susquehanna, or nodding at their own reflected colours in the waters of the Potomac and Delaware."

The use of wax in making candles, ointments, &c. is well known. The housewives of this and other coun-

tries employ it to prevent bed-ticks from losing their feathers. They spread the ticking on a table and well rub its inner surface with a lump of wax. To spread it equally and cause it to enter into the tissue of the fabric, it is afterwards polished by a vigorous friction, with a ball of solid glass or the bottom of a bottle.

According to Buffon, the bees-wax of tropical climates is too soft for any but medicinal purposes.

There is a species of *wax*, which is generally regarded as *of vegetable origin*, and which is afforded by various trees, plants and fruits. The light down which silvers over the surface of prunes and other stone fruits, has been shown by M. Proust to be wax; the leaves and stem of the *Ceroxylon* also, afford it in considerable quantity, if bruised and boiled in water; but the trees which afford it in greatest abundance are the *Myrica cerifera angustifolia* or wax tree of Louisiana, and the *Myrica cerifera latifolia* of Pennsylvania, Carolina, and Virginia. The latter is now naturalized in France: it flourishes also in the dry lands of Prussia, and, from the productiveness of its berries, it seems surprising that its culture is not more general.

The mode in which this *myrtle wax* is obtained is as follows. Towards the end of autumn the natives gather the ripe berries, boil them in water, skim off the wax which rises, strain it from its impurities, and set it to drain, after which, they re-melt and form it into masses. Four pounds of berries yield about one pound of wax.

From the wax thus procured, they make soap and candles. The soap manufactured from it is said to be excellent, and to wash linen perfectly white; the candles afford a good light, without smoke or guttering; their

perfume is highly agreeable, not only during the time that they are burning, but for a considerable time afterwards.

Mr. Sparrman suspects that myrtle wax is deposited upon the berries by insects, and Du Halde has given an account of a white wax made by small insects, round the branches of a tree in China, in great quantity, which is there collected for medical and œconomical purposes. (Description of China, vol. i. page 230.) Myrtle-wax therefore may not be a vegetable product.

According to the experiments of M. Cadet and Dr. Bostock, this *myrtle wax differs in some respects from bees-wax*. First in colour, different specimens of it assuming different shades of yellowish green: secondly in smell; myrtle-wax, when fresh, emitting a fragrant balsamic odour. It has in part the tenacity without the unctuosity of bees-wax, and somewhat of the brittleness of resin. Its specific gravity is greater, insomuch that it sinks in water, whereas bees-wax floats upon it; and it is not so easily bleached to form white wax.

Analysis of Wax.

Carbon	81,79
Oxygen	5,54
Hydrogen	12,67

"The formation of resin and wax has been explained thus:—That when a volatile or a fixed oil is expelled out of plants, and has its surface exposed to the air, the first becomes a resin by losing hydrogen, the second a wax by absorbing oxygen."—Parkes's Chemical Catechism, p. 244, 11th edit.

CHAPTER XXVIII.

MEAD.

Prior to the introduction of agriculture into Britain, mead was the principal cordial beverage of its inhabitants: Matthias de Lobel, M.D., calls it Cambricus potus. In other northern nations also it was formerly in high estimation*. This must have proceeded, either from their unpampered simplicity of taste, from their lack of other cordials, or from their having a better method of making their mead than has been handed down to posterity; for certainly in the present day it is a liquor seldom made, and holding a very humble rank among our imperfect vinous productions. It however continued in favour long after the introduction of malt liquor, and the northern inhabitants of Europe drank it generally until very modern times; and even in this country, so late as the days of Dryden, it seems to have been better known than it is now, being sometimes used to soften or dilute strong wines.

> " T' allay the strength and hardness of the wine,
> Let with old Bacchus, new Metheglin join."
>
> Dryden.

To show how highly it was formerly esteemed in this country, I will give an extract from an ancient law of the principality of Wales, where " the praises of it, accompanied by the lyre, resounded through the spacious

* " Hydromel Borealibus, quibus vina desunt, pro vino est."—De Lobel.

halls of her princes." "There are three things in court which must be communicated to the king, before they are made known to any other person :—

"1st, Every sentence of the judge;
2nd, Every new song; and
3rd, Every cask of mead."

Mead-making appears to have been regarded by our forefathers as a high and important avocation; at the courts of the Princes of Wales, the mead-maker was the eleventh person in dignity, and took place of the physician. We read in the English History, that Ethelstan a subordinate king of Kent, in the tenth century, on paying a visit to his relation Ethelfleda felt very much delighted that there was no deficiency of mead. According to the custom at royal feasts, it was served up in cut horns and other vessels of various sizes. About the same period, it was customary to allow the monks a sextarium (about a pint) of mead, between six of them at dinner, and half the quantity at supper.

Queen Elizabeth was so fond of mead as to have it made every year; her recipe for it will be found at the end of this chapter.

Bruce tells us that the Abyssinians still use it as their common beverage: they ferment it with a small quantity of parched barley-meal, and take off its luscious taste by the addition of a few chips of Surdo wood. With the same intention the juice of the mountain-ash berry is fermented with it in some parts of Wales. Probably, says Mr. Knight, the barbarous inhabitants of Europe formerly acidulated *their* mead with it.

"Pocula læti
Fermento, atque acidis imitantur Vitea sorbis."

VIRGIL.

According to Feburier, though mead is much despised in France, when presented as mead, yet it is much used there, under fictitious names, such as wine of Rota, of Madeira, of Malvoisin (Malmsey), and of Spain.

It was probably the liquor called by Ossian, the joy and strength of shells, with which his heroes were so much delighted; the Caledonian drinking-vessels having consisted of large shells, which are still used by their posterity in some parts of the Highlands. Mention is sometimes made also of the Feast of Shells.

Mead was the ideal nectar of the Scandinavian nations, which they expected to quaff in heaven out of the skulls of their enemies; and, as may reasonably be supposed, the liquor which they exalted thus highly in their *imaginary celestial banquets*, was not forgotten at those which they *really* indulged in *upon earth*. Hence may be inferred the great attention which must have been paid to the culture of the bee in those days, or there could not have been an adequate supply of honey for the production of mead, to satisfy the demand of such thirsty tribes. In further confirmation of this attention, it may be observed that in France the ancient Barons drew a considerable revenue from a tax upon beehives; and they were among the articles of which a return was made at the doomsday survey.

The mythology of Scandinavia (the religion of our Gothic ancestors) was imparted by Sigge or Odin, a chieftain who migrated from Scythia with the whole of his tribe, and subdued either by arms or arts the northern parts of Europe. From him descended Alaric and Attila. In the singular paradise which Odin sketched for his followers, the principal pleasure was to be derived from war and carnage; after the daily enjoyment

of which, they were to sit down to a feast of boar's flesh and mead. The mead was to be handed to them in the skulls of their enemies, by virgins somewhat resembling the houri of the Mahometan paradise, and plentiful draughts were to be taken, until intoxication should crown their felicity. Hence the poet PENROSE thus commences his "Carousal of Odin."

"Fill the honey'd bev'rage high,
Fill the skulls, 'tis Odin's cry!
Heard ye not the powerful call,
Thundering through the vaulted hall?
Fill the meath and spread the board,
Vassals of the grisly lord!—
The feast begins, the skull goes round,
Laughter shouts—the shouts resound!"

Hence likewise, in an ode by Mr. STIRLING, we find the following illustration of the northern Elysium.

"Their banquet is the mighty chine
Exhaustless, the stupendous boar;
Virgins of immortal line
Present the goblet foaming o'er:
Of heroes' skulls the goblet made,
With figur'd deaths and snakes of gold inlaid."

Boar's flesh was considered by these tribes as the highest delicacy; the celestial boar was supposed to be daily renewed, and to afford an ample repast for the most numerous party: a quantity of mead also, sufficient for the intoxication of this paradisiacal community, was imagined to be daily supplied by a goat called Heidruna,

"Whose spacious horn would fill the bowl
That rais'd to rapture Odin's soul;

And ever drinking, ever dry—
Still the copious stream supply*." COTTLE.

I could not refrain from adducing these short historical and poetical evidences of the high estimation in which mead was held by our northern ancestors. I trust that I shall also stand excused for still further lengthening my preamble by entering upon *the general principles of wine-making.*

The grand desiderata in wine are strength, flavour, and pleasantness:—to accomplish the first, sugar must be converted by fermentation into alcohol; the second depends upon the article to be vinified, and upon the management of the process of vinification; flavour may likewise be produced artificially by different adjuncts: pleasantness will principally result from the same causes, but more especially from the liquor holding in solution a certain quantity of unconverted sugar.

The elements necessary to a due fermentation and to bring the process to a satisfactory issue, *are sugar, extractive matter, acid of tartar*, and *water*. These exist in the highest perfection and in the best relative proportions in *the grape:* hence the superiority of foreign wines. Whoever therefore expects to imitate, with much effect, those generous liquors, must supply, in the process, those ingredients in which the article sought to be converted into wine is deficient.

If the native juices of fruits be deficient in sugar, it will be impossible to convert them into a strong wine

* Considering the moderately intoxicating power of Mead, it may be presumed that no inconsiderable quantity was required at these jovial banquets, as it is calculated to contain only seven parts of alcohol in a hundred.

without a proper supply of that ingredient; and without a sufficiency of extractive matter, which is the natural ferment, a due fermentation could not be established; the wine would be sweet, but not potent; *sweet wines being the produce of an incomplete fermentation.* If the extractive matter were in excess, the liquor would have a tendency to the acetous fermentation, which might also be induced by a superabundant proportion of water.

The result of a complete fermentation is a dry wine; to produce which, the elements must all be nicely balanced, and the process conducted under favourable circumstances, with respect to temperature, tunning, stopping down, &c.

Two opposite practices prevail, in the manufacture of the same sort of wine; *some wine-makers boiling the juices before fermentation, others conducting the whole process without boiling:* the propriety or impropriety of these practices depends upon the quality of the juices to be vinified. Extractive matter is partially coagulable by heat; boiling therefore, by causing this matter to separate and to be deposited, tends to the production of a sweet wine. The extractive matter may also be precipitated by sulphuric acid gas, (burning in the cask a brimstone match as hereafter directed,) or by sulphuric acid itself, with which the soluble leaven forms an insoluble compound. Hence where the extractive matter is in excess, and where there is danger of fermentation going on too rapidly, boiling or sulphuring will be useful both to the wine and cider-maker, in checking or preventing fermentation. The superfluous extract thrown up in the course of fermentation as yeast, or deposited as lees, will, if remixed with the liquor, have the effect

of continuing the fermentation: hence the utility of racking and fining, where it is in excess; and of re-union, where it is deficient. *Artificial leaven or yeast*, which contains the extractive principle in great abundance, affords a supply to those juices which are deficient in it, and without which they will not ferment. *Natural leaven* (i. e. *extractive matter*) is soluble in cold water, artificial leaven is not: during fermentation, therefore, the latter is always thrown off: so also is the greater part of the former, if the process be well conducted.

Most of the fruits of this country abound in *malic acid*; those that possess only a moderate quantity of it, however, afford excellent wine with the addition of sugar only; still better wine may be obtained by the further addition of the acid of tartar. Where the malic acid prevails so abundantly as to make its neutralization desirable, Dr. McCulloch, (to whom I am indebted for much of the information contained in this chapter,) recommends coating the insides of the fermenting vats with a white wash of hot *caustic lime*. I have neutralized the malic acid, by putting into the cask, after the sensible fermentation has been completed, about a pound of *egg shells* to every sixty gallons of wine.

The acid of tartar increases the fermenting power of fluids: half-ripe fruits possess it in greatest abundance; hence the vivacity of champagne and green gooseberry wine. It is most conveniently used in the state of supertartrate of potash or common cream of tartar: the common rough tartar is in some respects preferable, as its admixture of yeast assists in perfecting the fermentation.

All vegetables contain more or less of extractive matter; those that possess little may be assisted in their fer-

mentation by that process being conducted in wooden vessels, wood supplying the extractive principle to the liquor; the same juices, therefore, which would ferment very well in wood, would scarcely ferment at all in glass or earthenware.

The extractive matter and the sugar are seldom completely destroyed in any wines; the existence of the former is evinced by the skinny matter frequently deposited upon the insides of the wine-bottles; the latter may be detected, by a nice palate, in the very driest of our wines; its predominance indicates an inferior wine.

From the preceding observations, my readers have probably anticipated my opinion of *honey in wine-making*. I regard it merely as *a substitute for sugar*; and to those who approve of its flavour I recommend the following *directions*, which I have successfully followed for several years, having my home-made wines enriched with a considerable portion of foreign flavour:—Dissolve an ounce of cream of tartar in five gallons of boiling water; pour the solution off clear upon twenty pounds of fine honey, boil them together, and remove the scum as it rises. Towards the end of the boiling add an ounce of fine hops; about ten minutes afterwards put the liquor into a tub to cool; when reduced to the temperature of 70° or 80° of Fahrenheit, according to the season, add a slice of bread toasted and smeared over with a very little yeast; the smaller the quantity the better, for *yeast invariably spoils the flavour of wines*, and where there is a sufficiency of extractive matter in the ingredients employed, it should never be introduced: if fermented in wooden vessels, none is required. The liquor should now stand in a warm room, and be stirred occasionally. As soon as it begins to carry a head it

should be tunned, and the cask filled up from time to time from the reserve, till the fermentation has nearly subsided. It should now be bunged down, leaving open a small peg-hole; in a few days this may also be closed, and in about twelve months the wine will be fit to bottle.

The ancients were accustomed to boil their mead for a considerable time, until the liquor would buoy up a fresh egg, allowing it to rise above the surface, about the size of a shilling, the criterion by which they judged that the process of boiling might be discontinued.

Many makers of both wine and cider have been unconsciously benefited from the acquisition of tartar by their liquor, it being a frequent practice to tun into an empty foreign wine-cask, whose incrusted sides have supplied their wine or their cider with a portion of that necessary ingredient for perfect vinification.

It is a practice with some to add spices to their mead during the fermentation, such as ginger, cloves, mace, rosemary, lemon-peel, &c. This is bad œconomy; a much smaller quantity will communicate the required flavour if the addition be made after the fermentation has ceased.

A common beverage is sometimes made, by simply washing the refuse honey-combs in water after extracting from them as much of the honey as will run, and then boiling it for a few minutes: this liquor will not require tartar or yeast: it should be tunned as soon as cool, bunged down in three or four days, and drank in a few weeks. In some parts of Wales the refuse-combs are brewed with malt, spices, &c., and the produce is called *Braggot*, a name derived from the old British words *brag* and *gots*, the former signifying *malt*, the latter *honey-comb*. [illegible] fer-

Simple hydromel is made either with honey which has become acid, or with honey and acidulated water: it is not fermented, but used extemporaneously as a summer beverage.

Feburier recommends one part of honey to be mixed with three parts of water, which he says will begin to ferment in about sixteen days, and throw off lees for six weeks or two months.

A knowledge of the principles of fermentation will enable the wine-maker to regulate its process. Thus, if a dry wine be desired, and fermentation be suspended, it may be renewed by a restoration of the separated gaven, or the addition of fresh; or by agitation, and a remixture of the lees. It is upon the latter principle, called "*feeding on the lees*," that some foreign wines are improved by long voyages; but this treatment, so *serviceable to Madeira and other Spanish wines*, and also to some of the French wines, *would destroy Burgundy*; the high aroma for which this wine is so much prized being obtained at the expense of some of its vinous attributes. If there be an excess of fermentation the scientific operator will regulate, check, or suspend it, by skimming, racking, fining. If skimming and racking do not succeed, recourse must be had to *fining*, which may be effected *by isinglass*, i. e. the proportion of about an ounce to 100 gallons. The isinglass must be beaten, for a few days, with a whisk in a small quantity of the wine, till completely attenuated. This solution must then be well stirred into the cask of wine, which in about a week will become fine, and fit for being racked off. This fining is accomplished by the union of the isinglass with that is called the tannin of the wine. Fining may also be effected by *stumming*, i. e. *by burning in a close vessel*,

containing a small part of the wine, a brimstone rag, at the rate of a dram of sulphur to thirty gallons; and when consumed, rolling the cask about for a quarter of an hour, that the wine may absorb as much as possible of the sulphuric acid gas. This being done, the cask is to be filled up with the remainder of the wine, and bunged down. In this process the sulphuric acid, or its oxygen, unites with the extractive matter or soluble leaven, which, being thereby rendered insoluble, is precipitated to the bottom, as I before observed. If wines be perfectly fermented, they do not require the addition of any brandy, as a sufficiency of spirit is generated during the process.

The best temperature for carrying on fermentation is about 54° Fahrenheit. Its perfection depends in some degree upon the volume of the liquor; the larger the quantity, the longer the fermentation will continue, and the stronger and pleasanter will be the wine. There are however exceptions to this rule. The peculiar excellence of champagne would be destroyed if its fermentation were conducted upon a large scale: it may be made successfully in a gallon measure. This wine is so managed by the makers as to ferment after bottling.

Dry wines and fine wines are much more durable than any others; and those that would perish in cask, *may be preserved many years by bottling.*

These hints will, I hope, enable the makers of home-made wines to conduct the process scientifically, and to secure generally a successful issue. Cookery books and good housewives abound in receipts for wine-making, which are very often fanciful and absurd, recommending the introduction of articles which, in their very natures, counteract the production of good wine. Hence we are sometimes presented with such miserable mawkish st fer-

as disgraces the name of wine, being only rendered tolerable by the brandy which has been added to it, and which in some degree covers the crudeness and insipidity of the compound, and moderates its hostility to the peace of our stomachs.

Ancient Testimonies in favour of Mead.

Mead of the finest quality was called Metheglin, a name derived from two Greek words, signifying vinum splendidum: it was the produce of finer honey than Mead, and contained a greater proportion of it to the quantity of water. Metheglin was to Mead what Vinum was to Lora; what prime cider fit for bottling is to common draught cider.

So much was Mead esteemed in Transylvania that Mercator speaks thus of it: "Qui etiam rerum peritis, Vinum Creticum ceu Malvaticum opinantibus facile imponat."

"Lautiorum tantum mensarum sit, et primates solum bibant," says Ulysses Aldrovandus.

"Mulsum est vinum utilissimum et stomacho convenientissimum," Lobel and Pictorius.

Mulsum is stated by Dr. Henderson to have been a mixture of wine and honey.

Age was considered as necessary to its excellence: "Vetus sit et ritè confectum," says Andreas Mathiolus.

Queen Elizabeth's Recipe for Mead.

Take of sweet-briar leaves and thyme each one bushel, rosemary half a bushel, bay-leaves one peck. Seethe these ingredients in a furnace full of water (containing probably not less than 120 gallons); boil for half an hour; pour the whole into a vat, and when cooled to a

proper temperature (about 75° Fahr.), strain. Add to every six gallons of the strained liquor, a gallon of fine honey, and work the mixture together for half an hour. Repeat the stirring occasionally for two days; then boil the liquor afresh, skim it till it becomes clear, and return it to the vat to cool: when reduced to a proper temperature (about 80°?) pour it into a vessel from which fresh ale or beer has just been emptied; work it for three days and tun.

When fit to be stopped down, tie up a bag of beaten cloves and mace (about half an ounce of each), and suspend it in the liquor from the bung-hole. When it has stood for half a year it will be fit for use.

THE

ANATOMY AND PHYSIOLOGY

OF

THE BEE.

PART II.

CHAPTER XXIX.

ANATOMY.

HAVING given in detail the instructions necessary for the domestic management of the bee, and treated of such parts of its physiology as that detail naturally suggested, I shall now proceed to give an account of the most important parts of its anatomical structure, and so much more of its physiology as may arise from a consideration of that structure, or be otherwise likely to interest my readers.

Some persons may possibly consider the anatomy of so small a creature as unimportant and uninteresting; but without understanding the anatomy of the bee, its physiology would be vague, uncertain, and conjectural; and it is physiological knowledge that has hitherto led, and must still lead, to a scientific and profitable management of this insect. The enlightened Boyle, when contemplating the various wonders of nature, has declared his astonishment to have been more excited by

the mite than by the elephant; and that his admiration dwelt not so much on the *clocks* as on the *watches of creation*. The finger of the Deity is as conspicuous in the minutest creature as in the great globe itself. Our astonishment is excited by the admirable adaptation of means to ends, as much in the formation of the one as in the structure of the other.

It is not my intention, however, to enter deeply into the anatomy of the bee, but merely to give a general account of those parts which are the most prominent and important; anything beyond this would, to the general reader, be tedious and uninteresting. Those who desire minute information may obtain it in various works, but in none more satisfactorily than in that of Messrs. Kirby and Spence.

The natural divisions of the Bee } are { The Head, The Trunk, The Abdomen.

The HEAD of the working bee is of a flattened triangular shape; those of the queen and drone are flat and somewhat rounded; in common with that of other creatures, the head is the inlet for nutrition and the principal seat of the organs of sensation. Of nutrition and sensation I shall speak in their appropriate places.

The TRUNK or THORAX, is the intermediate section of the body between the head and the abdomen: it approaches in figure to a sphere, consists of three segments, and is the seat of the organs of motion; it contains the muscles of the wings and legs, which proceed from it, and is the main prop, or as it were the key-stone, of the other two sections. The upper side is called *thorax* or the *chest*, the under side *pectus* or the *breast*.

The ABDOMEN is the third section of the body, posterior to the trunk; it is of an elongated oval form, and encompassed by scaly rings or segments of unequal breadth, diminishing in diameter as they recede from the breast. These rings, by sliding one over another, serve to shorten or lengthen the body. It is the seat of the organs of generation, and principally of those connected with respiration; and contains also the anus and the sting. The upper part is called *tergum*, or the *back*; the under side, *venter*, or the *belly*. These three divisions of the bee are connected together by very short thread-like ligaments.

THE HEAD.

This section of the bee comprises so many parts that are eminently calculated to call forth our admiration and excite our wonder as to entitle it to especial attention.

The MOUTH. No description of this portion of the bee's beautiful mechanism that I have hitherto met with has afforded me full satisfaction. That which is given by Mr. Kirby is, I think, the best that has hitherto been published; but even this is in some respects obscure, and is loaded with too many technicalities to be available to the general reader. For that which I am about to present to my readers I am in a great measure indebted to the friendly assistance which has been afforded me by one of the first entomologists of the day.

It is of course utterly impossible to give any anatomical definition, unless we occasionally employ technical terms, but it is highly important that in works of a popular character like the present such terms should be employed as rarely as possible, should be in themselves as clear and explanatory as the nature of the subject

will allow, and above all should be used with the strictest attention to precision, and each name wholly restricted to a single part.

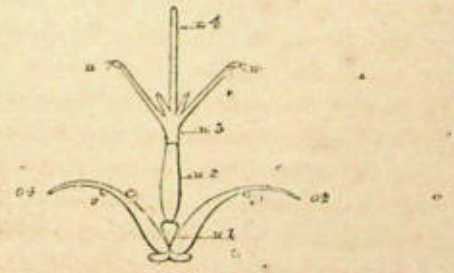
The mouths of all insects consist of the same parts, and these parts are essentially the same as in vertebrated animals, even in man himself; the parts are these, a *tongue*, *jaws*, *lips*, and a *throat* or *swallow*. There exists, however, this essential difference; that in insects the upper and lower jaws are each vertically divided into two, thus making a pair of upper and a pair of lower jaws, and each of these pairs of jaws has the power of moving and meeting horizontally, whereas in most other animals the jaws possess a vertical motion like our own. The mouth of insects may therefore be said to possess a tongue, a pair of upper and a pair of lower jaws, and an upper and lower lip. Fabricius, a very celebrated entomologist, was the first who applied a precise nomenclature to these parts; he called the tongue *lingua*, the upper jaws *mandibulæ*, the lower jaws *maxillæ*, the upper lip *labrum*, and the lower lip *labium*. There are moreover, in the mouths of all insects, four feelers or *palpi*, two of these attached to the lower lip are called labial feelers or *labipalpi*, and two attached to the lower jaws are called maxillary feelers or *maxipalpi*.

Writers subsequently to Fabricius, have suggested such multifarious alterations in this nomenclature, that it has been increased nearly a hundred-fold, and there is no part in the mouth of an insect but has a vast variety of appellations, each author contending for the honour of name-giving, which is thought by entomologists generally to be a very great *desideratum*: latterly, however, a new feeling, almost amounting to a rule, has prevailed, viz. the desire of returning to the earliest

nomenclature, and of adopting names in the order of priority; this view of the subject has been particularly enforced by Mr. Newman in the "Entomological Magazine and Grammar of Entomology": in these works this writer has unravelled the confused nomenclature of the various earlier authors, adopted names in their order of priority, and proposed no single name of his own invention, excepting for obscure parts which had previously escaped the notice of naturalists. Thus the Fabrician nomenclature has been restored almost entire.

In the different classes of insects, the mouth undergoes a great variety of modifications, but its form is now to be considered only in the bee.

In order to enable the reader more thoroughly to understand the structure of this beautiful organ, the following wood-cut is given with references to its various parts.



The lower lip is the long part in the centre of the figure (marked *u* 1., *u* 2., *u*. 3., *u* 4.): it is divided into four parts; first, the *insertion*, a short heart-shaped piece (*u* 1.); secondly, the *labium* properly so called, a very conspicuous part, at least four times the length of

the preceding and nearly linear (*u* 2.); thirdly, the *palpiger* or feeler-bearer, a short piece (*u* 3.), from which arise the labial feelers or *labipalpi* (*û û*), one on each side; fourthly, the *ligula*, a long slender part, rough or somewhat serrated towards its extremity (*u* 4.); in all bees, not only the domestic but the wild kind, the *ligula* is trifid or divided into three lobes; occasionally we find these three lobes of equal length, but in the honey-bee the central lobe is by far the longest, and the lateral lobes appear like two minute scale-like appendages situated at its base, (*see the figure*): the lateral lobes have much puzzled those entomologists who do not found their descriptions on the principle of a uniform nomenclature, nor adopt the incontrovertible fact that there exists a uniformity of parts throughout the insect world; the celebrated Mr. Kirby called these little appendages *paraglossæ*. The *ligula* in the honey-bee has been so often denominated and described as the *tongue*, that it is very difficult entirely to eradicate the error; the tongue of a bee is situated within the mouth like our own, while the *ligula* is the very external extremity of the lower lip; the tongue is a very small and apparently insignificant part of the mouth, but with a lens of high power may be readily detected at the root of the *maxillæ*.

The last parts of the mouth to be considered are the *maxillæ* or lower jaws; these rise at the insertion of the lower lip one on each side. Each *maxilla* is by insect anatomists divided into four parts, but the divisions are not very distinct in the honey-bee, nor are they at all essential to the present object, that of making the structure of the bee's mouth perfectly intelligible. About half way along the exterior portion of each max-

la is situated the maxillary feeler or *maxipalpus* (*ó*), a diminutive and obscure part which may easily escape observation; the *maxipalpi* in the bee are considered rudimental only, but they are so situated as to be applied to the food in order to ascertain its quality; this office appears also to devolve in a great degree on the labial feelers, which the reader will recollect are particularly elongate and fully developed; they are furnished at their extremities with nervous papillæ, indicating some peculiar sense. The extremity of the maxilla is called the *lacinia* or blade (*a.4*).

The mandibles of the bee are strong, corneous, and sharp-pointed, and constitute the tools with which it performs its various labours; they meet over the other parts of the mouth, and are themselves partially covered in front by the upper lip; the lower lip and maxillæ are elongate, pliable and leathery, and probably serve to hold such materials as the mandibles have occasion to operate upon.

This compound and truly wonderful apparatus has frequently been considered but as a single part, and has been named the *tongue*, *trunk*, *proboscis*, &c., but a careful examination will convince the inquirer that it is composed of a variety of parts, and moreover, that these are the same parts which are found in the mouths of all insects.

Though this simplified description of a somewhat complex apparatus will, I trust, prove satisfactory so far as it extends, still there are some circumstances respecting it which in a popular view call for more particular attention.

The ligula and its appendages combine, as already stated, to form what has been usually called the Pro-

BOSCIS, which from the flexible power it possesses, compared with its dimensions, must be furnished with a very delicate muscular apparatus, by means of which it is capable of extending or contracting itself at pleasure, and with great rapidity. When in a state of inaction it is doubled up by means of a joint and lies in a very small compass; the first portion being brought within the lips, and the second part folded under the head and neck, protection being given to it by a double sheath, consisting of four strong scales. If it were constantly extended, it would be exposed to injury. When at work it is lengthened beyond its sheaths, and darts between the petals and stamina of those flowers which afford honey, moves about in every direction, probes them to the very bottom, sweeping their concave as well as their convex surfaces, and drains them of those treasured sweets, which without such an apparatus would be completely inaccessible. From this it will be evident that this compound piece of machinery in the bee is not used like the proboscis of other flies, not being tubular like theirs, but that it serves as a brush or besom to sweep, or as a tongue to lap*. Having collected the nectar of flowers in small drops, it deposits its collection upon the tongue, which is protruded for the purpose of receiving it, and having received it, withdrawn again, and this act of withdrawal propels the fluid into the pharynx.

The tongue of the bee is membranous and capable of inflation, thus forming a bag to receive the honey from the proboscis, preparatory to its conveyance through the pharynx.

The PHARYNX or swallow is situated at the root of

* The bee and all other insects that lap their food are called lambent insects.

the tongue, between the upper part of the proboscis and the sheath which covers it; it is a mere opening through which the honey passes from the tongue through the gullet to the honey-bag, and closed by a valve.

The Œsophagus or gullet, which commences at the termination of the pharynx, and receives the food from it, is long and slender, and traversing the neck and breast, dilates into the *honey-bag*, which receives the food after its passage through the gullet. This bag or first stomach, as it has been called, is in shape like a taper oil flask and as transparent as crystal; when full it is about the size of a very small pea. The honey which is conveyed to it is in part regurgitated; a part also is propelled onward to the second or proper stomach, there to be digested, animalized, and forwarded to the small intestines, from whence it is distributed, through appropriate vessels or tubes, to all parts of the body for its nutriment.

The true stomach appears to be merely a continuation of the honey-bag, and is separated from it by a very short tube; it is cylindrical, about the same diameter as the honey-bag, somewhat longer, and divided into circular rings, which are very muscular: they are both capable of contraction, and it is by this means that regurgitation is accomplished by the one, digestion and the conversion of sugar or honey into wax by the other. In bees caught on going out, early in the morning, Mr. Hunter found the reservoir for honey perfectly empty; but in those returning from the fields it was quite full, and *some* of its contents had passed into the stomach.

The Antennæ.—Of all the organs of insects, none appear to be of more importance than their antennæ:

in all the tribe they are planted either between or below the eyes; and no insect has more than two: in their general structure, they consist of a number of tubular joints, each having a separate motion, which gives them every variety of flexure. The antennæ of the male have one more joint than those of the female, the former having thirteen joints, the latter only twelve. They seem to enable the insects, by certain signs and gestures, to communicate to each other their mutual wants or discoveries. But I shall enter more fully into this subject when I come to speak of the various uses to which the antennæ are applied.

The Eyes, two in number, are of an oval shape and are placed in the sides of the head; they are compounds of an infinite number of hexagonal lenses, as clear as crystal, and are guarded by a horny tunicle or covering. This subject is, however, treated of in the next Chapter.

The Trunk or Thorax.

The trunk affords attachment to the organs of motion.

First, to the Wings, which transport the insect through the air; these consist of two *superior* and two *inferio.*: they are membranous, transparent, and of unequal size, and while in a state of repose are incumbent on each other, covering the abdomen. The Elytra or first pair of wings proceed from the mesothorax or second segment of the trunk, the second pair from the metathorax or third segment.

Bees and various other hymenopterous insects, and also those of the dipterous family, possess the power of flying in a more perfect degree than any class of animals besides, surpassing in this respect even the bird tribe.

the anterior margin of the under wings several small hooks, (eighteen or twenty,) are placed; these are capable of laying hold of the posterior margin of the upper wings, which is nicely folded down to receive them. By this means they are kept steady when flying*. The hooks are discoverable under a good magnifier.

Secondly, To the LEGS, by which the insect moves itself from place to place upon the earth. Of these there are *six in number*, each composed of several joints, and articulated like our arms, thus affording the power of various movements: the first pair proceed from the first segment of the trunk, (the prothorax or corslet,) the second pair from the mesothorax.

In the legs are three distinct divisions; namely, the thigh, the shank, and the foot. In the *four* hinder legs one joint forms a kind of *brush*, externally smooth and bare, but covered on the inside with stiff bristling hairs. By these the insect is enabled to brush off farina, both from the tips of the stamina of flowers and from the hairs of its own body. With the jaws and two fore-feet, the meal is rolled into small compact masses, which are conveyed, by the middle pair of legs, to the *spoon-shaped cavities* in the centre joint of the two hindmost feet. The exterior of these triangular cavities or baskets, as they have been called, is smooth and shining, the interior is covered and surrounded by strong close set hairs, to secure more firmly the precious burdens. (No such groove is to be found in the legs of either the queen-bee or drone.) *Each foot* terminates in *two hooks*, with their points opposite to each other, by means of which the bees suspend themselves from the roofs or sides of the hives or boxes, and hang from each other, when form-

* The two wings on each side being thus made to act as one.

ing those festoons, ropes, or curtains which are constantly observable prior to, and during, their formation of new combs. In these cases each bee, with its two fore-claws, takes hold of the two hinder legs of the one next above it, thus forming as it were a perfect grape-like cluster or living garland. This mode of suspension, so voluntarily adopted, must be agreeable to them; though the uppermost bees appear to bear the weight of all the rest. This weight is evidently much alleviated by being extensively divided, and Wildman supposed that the bees had a power of distending themselves with air, like fishes, by which they would acquire buoyancy. When the bees are thus intertwined with each other, they find no difficulty in extricating themselves from the congregated mass, but can at any time fly off from it, perch on it again, and make their way from the very centre of the cluster into the open air, without the smallest impediment.

From the middle of each hook proceeds a little thin membranous *appendix*, which is usually folded up; when unfolded, it enables the insects to sustain their bodies in opposition to the force of gravity, and thereby adhere to, and walk about freely and securely upon glass and other slippery substances, with their feet upwards. This peculiar mechanism of the feet of insects has been satisfactorily described by Sir Everard Home. Keller made a drawing of the fly's foot in a highly magnified state, showing the little cups or suckers that are alternately exhausted and filled with air, to enable the creature to move about in any direction, and upon the most polished surfaces, or to remain suspended in an inverted position for a great length of time, without the least exertion; for the adhesion of the suckers is in-

creased by the weight of the insect's body; hence, in general, when a fly takes rest, it prefers the ceiling to the floor. These little cups, pockets, or suckers may be seen distinctly, through a common magnifying glass, on inspecting the feet of an insect that is traversing the inside of a glass tumbler. The edges of this sucking apparatus are serrated, so as to fit them for the closest application to any kind of surface. The bees probably use this appendix likewise for taking up small bodies, the pollen for instance, which they thereby transmit to the hollows of their hinder legs.

The trunk also gives origin to a number of muscles, serving various purposes, which it would lead me too much into detail to enter upon here.

The Abdomen.

The abdomen, besides various other parts, contains in its anterior part two small bags, already mentioned at page 299; the *honey-bag* and the true stomach: it contains also the *venom-bag*, and the *anus*, which latter, in the female, comprehends the *ovipositor* and *sting*: in the male it contains the *organs of reproduction*, but no sting, and of course no ovipositor. For a particular account of these latter, *vide* Organs of Reproduction.

Organs of Sensation.

We have an abundance of presumptive evidence that bees are endowed with *sensation* and *perception*, and that the excitement of these faculties is communicated, through the medium of *nerves*, to a common *sensorium*, though the latter was denied to insects by Linnæus and other eminent naturalists. Fabricius has been regarded as the first who discovered a true brain in insects, al-

though it is well known that the researches of Roesel, Swammerdam and Lyonnet, had enabled them to detect and describe it many years before. The steps of these physiologists have been so successfully retraced by Cuvier as to place beyond dispute the existence of a brain in the head of insects. Common sensation, however, does not reside in the brain alone of insects, as in that of warm-blooded animals, but in the spinal marrow also; hence it is that bees, and many other insects, exhibit signs of sensation, after their heads have been severed from their bodies. Some insects exhibit these for a long time afterwards, the wasp for instance; Lyonnet informs us that he has seen motion in the body of a wasp three days after its division from the head; and I have known several instances of its inflicting wounds with its sting, at least four-and-twenty hours after the separation. The severed body will not only move but walk, and sometimes even fly, at first almost as actively without the head as with it. According to Linnæus, the *Hippobosca equina* or horse-fly, is capable of performing, in a still more extraordinary manner, some of the vital functions, after decapitation; it has been known not only to run about, *sed reverâ in coitu jungere.* The penetrating genius of Lord Bacon afforded him such illumination upon this subject, as to enable him to approach very near to, what is at this day regarded as a correct statement of the cause of this *protracted vitality* in mutilated insects. "They stirre," says he, "a good while after their heads are off, or that they be cut in pieces; which is caused also for that their vital spirits are more diffused throughout all their parts, and lesse confined to organs than in perfect creatures." We have a striking evidence of this vitality in the eel, when the

head is *injudiciously* severed from the body. "If," says Mr. Knight, "it be cut off, so that no part of the vertebræ remain attached to it, the animal appears to be conscious of existence, and I think I have seen it make such efforts afterwards to escape from a basket, as proved the foregoing position. But if when the head is severed, the vertebræ also be divided at the distance of half the diameter of its body from the head, all sensorial power, I am convinced, instantly ceases."

That insects have a real sensorium or brain would seem to be proved, by their having *memory*, and a *capacity to receive instruction*, and *acquire new habits*. Such functions, in higher animals, are regarded as functions of a cerebral system. That they are endowed with memory cannot well be doubted. Huber relates a remarkable instance of it in bees, which illustrates what will hereafter be said, on their having a method of communicating information to each other. "Honey," says he, "had been placed in a window in autumn, where the bees resorted to it in multitudes. It was removed, and the shutters closed during winter; but when opened again, on the return of spring, the bees came back, though no honey was there. Undoubtedly they remembered it, therefore an interval of several weeks did not obliterate the impression they had received." "But the most striking fact, evincing the memory of bees, has been communicated to me," says Mr. Kirby, "by my intelligent friend, Mr. W. Stickney, of Ridgemont, Holderness. About twenty years ago, a swarm from one of this gentleman's hives took possession of an opening beneath the tiles of his house, whence, after remaining a few hours, they were dislodged and hived. For many subsequent years, when the hives descended from this

stock were about to swarm, a considerable party of scouts were observed, for a few days before, to be reconnoitring about the old hole under the tiles; and Mr. Stickney is persuaded, that if suffered, they would have established themselves there. He is certain that for eight years successively the descendants of the very stock that first took possession of the hole frequented it as above stated, and *not* those of any other swarms; having constantly noticed them, and ascertained that they were bees from the original hive by powdering them, while about the tiles, with yellow ochre and watching their return. And even at the present time, there are still seen, every swarming season, about the tiles, bees, which Mr. Stickney has no doubt are descendants from the original stock." I have been witness to a similar circumstance, but cannot speak to its origin, as the annual visits to the tiles probably commenced before the family, now in possession of the premises, came to reside there (nine years ago). Since they did come, there has been no intermission, but the visits are not confined to the swarming season; and if there be any truth in the theory to be propounded hereafter, on the longevity of bees, we must suppose this to have been the case at Mr. Stickney's.

Some anecdotes of the spider prove that insects are capable of instruction. M. Pelisson, when he was confined in the Bastile, tamed a spider, and taught it to come for food at the sound of an instrument. *A manufacturer* also, in an apartment *at Paris*, fed 800 spiders, which became so tame, that whenever he entered it, which he usually did with a dish of flies, they immediately came down to receive their food. That insects are susceptible of a change of habits, or rather that they

may acquire civilized habits, if I may say so, is shown by the domestication of bees, and occasionally by that of ants and wasps. Huber's experiments with leaf-hives show the existence of this faculty in an eminent degree, for he assures us that it renders the bees quite tame and tractable.

Most physiologists, resting upon the evidence of analogy, agree in attributing *five senses* to insects: Dr Virey, as will be seen further on, ascribes to them *seven senses*; though there is a difference of opinion as to the organs by which those senses are conveyed. The *antennæ*, for instance, have been regarded by some as the organs of smell, by others as the organs of touch, and by a third class as the organs of hearing. With the substitution of taste for hearing, the same opinions have been maintained respecting the *palpi*; nor can the question even now be considered as settled. The prevailing opinion seems to be, that the antennæ are explorers or tasters, but that they are also applied to other uses; the effects produced by their excision indicate that they are organs of the highest importance. *Vide* Senses of Bees.

Messrs. Kirby and Spence notice the analogy borne by antennæ to the ears of vertebrate animals, such as their corresponding in number and standing out from the head. No other organ has been found which can be supposed to represent the ear*. And what I have said in another place, of their constituting a sixth sense, has received some countenance from the observations of those naturalists. "I conceive," says Mr. K., "that the antennæ, by a peculiar structure, may collect notices from the atmosphere, receive pulses or vibrations and

* Marcel de Serres thinks he has discovered an organ of hearing in most insects, but does not state its situation.

communicate them to the sensorium, which, (communications) though not precisely to be called hearing may answer the same purpose." Lehmann calls the function of the antennæ aëroscepsy. A very remarkable instance of the effect produced upon them by sound, is adduced by one of the authors just quoted. "A little moth was reposing upon my window; I made a quiet, not loud, but distinct noise: the nearest antennæ immediately moved towards me. I repeated the noise at least a dozen times, and it was followed every time by the same motion of that organ; till at length the insect, being alarmed, became agitated and violent in its motions. In this instance, it could not be *touch*; since the antenna was not applied to a surface, but directed towards the quarter from which the sound came, as if to listen."

That the antennæ should have been regarded as organs of smell is not surprising when the proceedings of the bees, on visiting flowers, are considered; their first act is to introduce one of the antennæ, but no further than the tip: this conduct would naturally enough convey the idea of looking or smelling for nectar; yet it does not at all militate against the opinion that the antennæ are transmitters of sound; the sense which they supply may, in these little creatures, be so very fine, as to enable them to hear the bursting of an anther, or the exudation of nectar. The continual motion of the antennæ of insects from side to side, when they walk, conveys the idea that it is thereby that they inform themselves of what is going on in their immediate vicinity. The importance of the antennæ may be inferred from their very complicated structure. Mr. Kirby has observed, that in one species of *Apis* which he examined, under a powerful magnifier, the ten last joints

of the antennæ appeared to be composed of innumerable hexagons, and from this similarity in their structure to the eyes, (*vide* Senses of Bees) he thought that they might serve a somewhat analogous purpose.

What I have said with respect to the senses of bees, in another place, will, I think, make it evident that these insects possess an organ of smell, but with respect to its situation naturalists differ. Easter, Lehmann, and Cuvier, consider the spiracles as the organs of smell, as well as of respiration: this opinion is founded upon the notion that, without the inspiration of air, there can be no smell; and that as insects are smaller than the food they live upon, it would be of no consequence to them where this sense was situated. Kirby and Spence, on the contrary, suppose that it resides in some organ near the mouth: in other parts of the animal creation certainly, that is its situation; and as there seems to be a necessary connection between smell and taste, analogy should lead us to argue in favour of that opinion; but though smell be usually accompanied by respiratory organs, they may not be essentially necessary to it; a bee may receive impressions from external objects, in a manner which we cannot comprehend. In confirmation of this opinion of Kirby and Spence, we have the experiments of Huber. It seems that no odour is so unpleasant to insects as that of oil of turpentine. M. Huber having presented this oil, on the point of a camel's hair pencil, successively to every part of the abdomen, trunk, and head, it excited no uneasiness in the bee: he then tried the eyes and antennæ, but with the same result; yet as soon as he pointed it a little above the insertion of the proboscis, near the cavity of the mouth, the bee receded, became agitated, clapped its wings, and would have

taken flight, had not the pencil been withdrawn. This experiment was repeated with the turpentine and other articles of penetrating odour, and with the same effect; but when the mouths of several bees were stopped with paste, no such consequences ensued; on the contrary, they traversed the impregnated pencils, without being at all annoyed by them, even honey did not attract them. All these circumstances tend to prove that the site of smelling is in or near the mouth.—This subject will be resumed in Chap. XXXII.

Organs of Respiration.

The respiration of bees is performed through several little orifices, called *stigmata, spiracles*, or *breathing pores*, situated in the sides of their bodies, behind their wings. Reaumur was of opinion that inspiration was performed through the spiracles, and expiration through the mouth; but Bonnet proved satisfactorily that neither inspiration nor expiration takes place through the mouth. The spiracles are connected with a system of air vessels called *trachee*, ramifying through every part of the frame, and serving the purpose of lungs. From the absence of lungs, Aristotle and the ancients in general thought that insects did not breathe. Pliny may perhaps be excepted, for he has observed that dipping bees in honey or oil deprives them of life;—this immersion stops up the mouth of the spiracles. Modern physiologists have, however, incontestably proved that they do breathe. "Life and flame," says Cuvier, "have this in common, that neither the one nor the other can subsist without air; all living beings, from man to the most minute vegetable, perish when they are utterly deprived of that fluid." Huber detected the existence of the

stigmata or breathing pores, by immersing different portions of a bee in water, and finally by total immersion, upon which he observed that bubbles of air attached themselves, for some time, to the orifices of the stigmata, which alternately appeared and receded, till their increased bulk enabled them to overcome the resistance of inspiration and rise to the surface. These respiratory organs escaped the observation of Swammerdam.

Air is equally necessary to insects in the egg state: Spallanzani found that their eggs could not be hatched in small close vessels, though all other circumstances were favourable to a development. The eggs of the hive-bee, whilst in the ovaries, have a net-work of air-vessels spread over their surfaces;—these were discovered by Swammerdam: from analogy, we may reasonably conclude, that such a provision obtains generally.

The closeness of a hive, and its having no direct current of air through it, may favour a belief that bees can exist in any atmosphere, however vitiated, and may seem also to confirm the opinion of the ancients, that they have no particular system of respiratory organs. But M. Huber and son have proved that they breathe, like other animals; that they are speedily deprived of life, if the process of respiration be arrested; so delicate indeed is their organization, that they detect the smallest deterioration in the atmosphere of their hives, and immediately adopt measures to restore, to this element, the degree of purity essential to respiration: from some eudiometrical experiments, it has been ascertained that the air of a well stocked hive is as pure as that by which it is surrounded. Still neither wax nor pollen favours the generation of oxygen gas, nor have bees the faculty of generating it; for when very closely shut up, they pe-

rish in a few hours. The writers just referred to, discovered that the bees, by uniting the two wings of each side, by means of the small marginal hooks with which they are provided, so as to make them present the largest possible surface to the air, were capable of striking it with considerable force, and that this force was increased by the wings forming a slight concavity. The wings, arranged in this manner, are put into a violent vibratory motion by the bees appointed to the office of ventilators, and produce what we call a draught of air. *Ventilation* is thus systematically accomplished. A certain portion of ventilating bees is stationed in files, at the entrance of the hive, with their heads turned inwards; another and a larger party, in files also, stands a considerable way in the interior, with their heads towards the entrance: thus both these parties co-operate, in producing a current of air in the same direction, and are so arranged as not to interrupt the passage of their fellow-citizens, moving in and out. As this hard duty has no intermission during the day, nor in hot weather during the night, and must necessarily occasion fatigue, one set of ventilators is considerately relieved in about twenty-five minutes, by another set of fresh bees. Under particular circumstances, the number of ventilating bees is considerably increased. "When the air," says Huber, "was not renewed in the manner desirable, we have seen all vibrating their wings at once, though this never occurs in the natural state, when the vibrations of a few are sufficient for ventilation." Although this fanning motion of the wings is so rapid as to render them almost indistinguishable, yet they may be observed to describe an arc of 90°. The sagacious bees remind me of a method which is sometimes adopted of renew-

ing the air of a room, called pumping; some person moves the door backward and forward so rapidly as to cause a thorough agitation of the confined air, and the introduction of a fresh unvitiated atmosphere. "When they are engaged in ventilation, the bees, by means of their feet and claws, fix themselves as firmly as possible to the place they stand upon. The first pair of legs is stretched out before; the second extended to the right and left; whilst the third, placed very near each other, are perpendicular to the abdomen, so as to give that part considerable elevation." That ventilation is carried on for the purpose of renewing the air of the hives, and not for lowering its temperature, is evident from its being continued to a certain extent, even during the depth of winter.

The vibratory motion of the bee's wings has been regarded, by some, as the principal cause of the *humming* noise heard, in every prosperous hive, during the busy season. This humming has likewise been attributed to the rushing of the air through their spiracles; so thought M. Chabrier, and, I believe, Mr. J. Hunter. Mr. H. assures us that bees can produce a sound independently of their wings; for if these be smeared over with honey so as to stick together, the bee still makes a noise, which is shrill and peevish. He found the same effect from holding the bee by the legs, with a pair of pincers, while the wings were perfectly still, and also by immersing the insect in water, though not till it was very much teased.

The whole body of a drone is in a state of vibration when it hums. Though deprived of its wings, it is capable of producing a sound exactly similar, and probably the same with its former hum, even when the legs are

cut off, the trunk retains its tremulous motion, and utters an audible noise. If immersed in water, many air-bubbles are disengaged from it: but though the mutilated insect be taken out alive, it is no longer sonorous. "This experiment, however incomplete," says a writer in the *Dictionnaire des Sciences Naturelles*, "tends at least to prove, that the humming of bees is not occasioned by a strong vibration of the internal part of the upper wings, but rather by a tremulous affection of the entire body; and perhaps even by the escape of a greater quantity of air through the stigmata or spiracles. This last would amount to a sort of voice." The humming noise with which a flower is always approached by the bee, ceases as soon as she has alighted upon it, though during the time that she is extracting its sweets she is in a constant vibratory motion.

Circulation.

The term circulation is not strictly applicable to the imperfect sanguineous system of insects, as the fluid which supplies their bodies with nutriment is not distributed to its several parts through the medium of a heart and vascular system. Lyonnet and Cuvier are both of opinion that insects have no heart, whereas all creatures that possess a circulation, properly so called, have a heart, lungs or gills, and a liver; but insects have only air-vessels and hepatic ducts. The chyle which is produced in their intestines, transpiring through the pores of the intestinal canal, passes into the general cavity of the body, where it is probably animalized, and made to answer the same purposes that blood does to creatures of a higher class, though when animalized it still retains its white colour. Although its distribution

is obscure, from its analogy to blood, we may conclude that it is a fluid which visits and nourishes every part of the insect's body; that from it secretions are made, and that, as in other creatures, it is fitted for these purposes by receiving oxygen from the air-vessels. Cuvier has observed that the blood of insects, "for want of a circulating system, not being able to seek the air, the air goes to seek the blood;" the air-vessels, as I have stated under the head of Respiration, are distributed to every part of the body.

Nutrition.

From what I have said under the head of Circulation, it will appear evident that the bodies of bees and other insects are supplied with nutriment in a very simple manner. Cuvier is of opinion that it is obtained by direct absorption or transudation, by imbibition as he calls it, through the pores of the intestinal canal, along which the blood or animalized chyle passes: and Lyonnet thinks that this imbibition is analogous to that which takes place from the earth by the roots of plants.

Secretion.

Everything connected with the subject of secretion seems to be obscure: it is evident, however, that secretions do take place; for silk, wax, and poison are all the results of that process. The first of these substances is only secreted by the bee when in its larva state. I must refer those who wish for information respecting silk, to those naturalists who have written on the silk-worm. The secretion of wax I shall treat of hereafter in a distinct chapter; and it will be better perhaps to speak of Poison, after describing the sting and its appurtenances.

There is one secretion, however, on which I will say a few words in this place, viz. Perspiration.

PERSPIRATION.

The *temperature of insects* not gregarious, is generally that of the medium they inhabit; but bees possess the power not only of preserving a higher temperature during the coldest months of winter, but of raising that temperature under particular circumstances. Dr. Darwin and Huber attempted to account for this, the former from the motion of their legs, the latter from the agitation of their wings;—but the experiments of Mr. Newport, referred to at page 202, clearly show that it is accomplished by the increased activity of their respiratory organs. Inch, a German, plunged a thermometer into a bee-hive in the winter, and saw the mercury stand 27 degrees higher than it did in the open air. Mr. Hunter found the *heat of a hive* vary from 73° to 84° of Fahrenheit; and Huber, who says that in a prosperous hive the thermometer in winter commonly stands at from 86° to 88°, and in summer between 95° and 97°, states that he has observed it on some occasions to rise suddenly from about 92° to above 104°. The former naturalist, about ten o'clock in the morning, in the middle of July, when the quicksilver in the thermometer in the open air ranged at 54°, found that on plunging it into a bee-hive, it rose in less than five minutes to 82°. At five the next morning it stood at 79°,—at nine it had risen to 83°,—at one to 84°; and at nine in the evening it had fallen to 78°. On the 30th of December, when the temperature of the air was 35°, that in the hive was 73°. From the experiments of that highly ingenious and patient observer, Mr. Newport, it

appears that these statements are calculated to mislead, and that the heat, shown on the thermometer, was produced by the agitation caused by its introduction, for whatever disturbs the bees invariably produces an accession of heat.

Bees also possess the power of counteracting or throwing off superabundant heat, by perspiration. Huber observed, that when crowded together in hot weather, they become much heated, and perspire so copiously, that those near the bottom seem perfectly drenched, and are, for a time, incapable of flying from the moisture on their wings.

Motion.

The *motions of insects* are performed through the medium of an appropriate apparatus of muscles, which move the head, trunk, abdomen, viscera, and limbs, as in other parts of the animal creation. The muscles of insects generally, possess very great power; we have evidence of this in the motion of the mandibles, and in the propulsion of the bee's sting. It is very strikingly evinced also in the flea; the former, it has been ascertained, can carry a load, forty or fifty times heavier than itself, and by the latter, the most surprising feats have been performed. Latreille gives an account of one that dragged a silver cannon twenty-four times its own weight, firing it off afterwards, without exhibiting any symptom of fear. An English workman, also, is said to have made an ivory coach, with six horses, a coachman on the seat with a dog between his legs, a postillion, four persons in the coach, and four lacqueys behind,—the whole of which was dragged by a single flea. A further evidence of the muscular power of the flea is

the extent of its leaps. This insect is provided with six articulated legs; the two hinder ones much exceed the others in size and length, and it is by their means, assisted by a springy membrane which may be brought to view under the microscope, that it is enabled to take those prodigious leaps that are so astonishing in creatures of such a diminutive size: its leaps have been found to equal a space of 200 times the length of its own body. This calculation, or a very similar one, was made by Socrates, who was much ridiculed for it by Aristophanes. The poet, however, did not confine his ridicule to this minuteness of calculation, but attacked likewise the character and precepts of that great philosopher; for the whole of which satire he has justly incurred the censure of posterity.

Organs of Reproduction.

These organs, in the drone, correspond in function and denomination with those of the higher classes of animals: their chief peculiarity consists in their size, in proportion to that of the insect, and in their being more under the belly than in other insects of this tribe;—they are larger than those of the humble-bee, and the two last scales of the back and belly are larger than those of the queen or workers.

The female organs consist principally of the ovaries, the oviducts, the sperm-reservoir, and the ovipositor. In the ovaries the eggs are generated, and remain till rendered fit by impregnation, and the other circumstances necessary for their maturation, to pass through the oviducts. According to Mr. Hunter, what are called ovaria are really ducts; the eggs therefore are not formed as in other families, in a cluster on the back,

but in those ducts, of which there are six on each side. When full of eggs, they form a kind of quadrangle; these six ducts uniting on each side into one duct; this latter enters a common duct to both sides, which may be called the *vagina* or *oviposite*. The common *oviduct* is the canal through which the eggs pass from the ovaries, as they are called, to the ovipositor. The *sperm-reservoir* is the organ which, according to Herold, receives the *impregnating sperm* of the drone, the *modus operandi* of which we are unacquainted with. In the hive-bee and in some other insects, the influence of this sperm continues so long a time, and through so many generations, as almost to exceed belief. (*Vide* page 33.) This led Dr. Haighton to entertain the opinion that actual contact betwixt the male sperm and the egg was not necessary, but that impregnation was effected by some unknown sympathetic influence. Messrs. Kirby and Spence have recourse to the old doctrine of an *aura seminalis* being all that is required to vivify the egg, and which they think may be retained for a long period. Upon this subject I have entered at some length in page 28 *et seq.* The *ovipositor* places the eggs in their appropriate situations, and is an instrument of most curious structure. It consists of a long tube, or rather of several tubes, retractile within each other, like the pieces of a telescope, and serves not only to convey the extruded eggs to the place of their destination, but acts also as a sheath for *the sting*, having a sharp point which makes the first impression when the creature intends to use its sting,—indeed it appears to be itself the sting. It has a slit near its extremity, through which the sting and poison are allowed to pass at the time of stinging. Some insects have occasion to bore a hole in wood, or other hard substances, to obtain a proper nidus for

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their eggs; the ovipositor is their operating instrument, and will either saw or bore a passage to the desired place. Thus it appears that this curiously complex apparatus, which in the bee is used both as a weapon of defence and offence, is a hollow horny tube or scabbard, inclosing two bearded darts, which can be thrust a short way beyond the sheath, though the whole appears, to the naked eye, like the solid point of the minutest needle.

This apparatus is moved by muscles which, though invisible to the eye, are yet strong enough to force the sting, to the depth of one twelfth of an inch, through the thick cuticle of a man's hand. It is articulated, by thirteen scales, to the lower end of the insect's body; and at its root are situated two glands or ducts, by which the poison is secreted: these glands uniting in one duct, eject the venomous liquid along the groove, formed by the junction of the two piercers. There are four barbs on the outside of each piercer: when the insect is prepared to sting, one of these piercers, having its point a little longer, or more in advance, than the other, first darts into the flesh, and being fixed by its foremost beard, the other strikes in also, and they alternately penetrate deeper and deeper, till they acquire a firm hold of the flesh with the barbed hooks, and then follows the sheath, entering and conveying the poison into the wound. The action of the sting, says Paley, affords an example of the union of *chemistry* and *mechanism*: of chemistry, in respect to the *venom*, which can produce such powerful effects; of mechanism, as the sting is a compound instrument. The machinery would have been comparatively useless had it not been for the chemical process, by which in the insect's body *honey* is converted into *poison*; and on the other hand,

the poison would have been ineffectual, without an instrument to wound, and a syringe to inject it.

In consequence of the barbed form of her sting; the bee can seldom disengage herself without leaving it behind her, together with the venom bag and its appurtenances, and even part of the bowels; Swammerdam knew an instance in which even the stomach was torn away with it; so that her life is usually sacrificed to her passion.

> "Illis ira modum supra est, læsæque venenum
> Morsibus inspirant, et spicula cæca relinquunt,
> Affixæ venis, animasque in vulnera ponunt." VIRGIL.

The sting of the queen-bee is longer and stouter than that of the working-bee, and bends a little under her belly. She is not eager to employ it; and from what has been said above, of the fatality which usually attends its use, conjecture has been busy as to the cause of her extreme caution in this respect. Dr. Evans observes, that it cannot arise from any selfish consideration, founded on an instinctive knowledge of the danger she thereby incurs; since the common bees, who run the same risk when they sting, are ready to attack upon the slightest provocation. "Is it owing," says he, "to a consciousness of the importance of her life to the community? or may we rather ascribe it to the dignified and generous forbearance so frequently exemplified in the lion or English mastiff?".

The reluctance of queens to eject their stings, led Pliny and others to doubt whether they possessed any. "Rex vel nullum habet aculeum, vel rasum ejus ei natura negavit."—PLINY. Their extreme caution in this respect, and the fatal consequences usually attending a

departure from it, gave birth to the following jeux d'esprit. In consequence of Pope Urban the Eighth being suspected of a stronger attachment to the French than to the Spaniards, a Frenchman, who had observed *three bees* quartered upon his arms, wrote this Latin verse:

"Gallis mella dabunt, Hispanis spicula figent."

To this a Spaniard is said to have subjoined,

"Spicula si figant, emorientur apes."

To close the series, and to show his universal paternal regard towards his flock, Pope Urban is made to add the following distich:

"Cunctis mella dabunt, et nullis spicula figent,
Spicula rex* etenim figere nescit apum."

This *caution of the queens* is never more conspicuously evinced than *in their combats with each other*, for it has been often observed that they instantly separate, if there be any danger of *mutual* destruction from the darting forth of their stings. Huber gives a striking instance of this. Two queens in one of his hives having left their cells at nearly the same instant, rushed together with great apparent fury. The antennæ of each were seized by the teeth of the other, and the head, breast, and belly of both were mutually opposed. Finding themselves however thus dangerously situated, and their curved extremities on the point of meeting, each disengaged herself and flew away; when the other bees, who had before receded, to make a clear arena for the combatants, drove them together again. This was done repeatedly, till at last the stronger queen, seizing the

* The ancients and also the naturalists of the middle ages supposed the sovereign of the bees to be a male.

other's wing, and curling her extremities under her belly, inflicted a mortal sting*.

I think this observation of Huber puts a negative upon Dr. Evans's last question, and to assent to his first would I apprehend raise her majesty too high in the scale of existence. I believe we must here, as in many other similar cases, acknowledge our ignorance, and refer the proceeding to instinct.

We have seen that where there is more than one native queen in a hive, there is always a combat between them, terminating in the death of all but one. Till within these very few years this statement has rested solely on the authority of foreign apiarians, and, with the exception of Mr. Golding, I know of no Englishman who has ever witnessed one of these combats. In his apiary it occurred between two artificial queens, in a unicomb hive. They both issued from their cells on the morning of the 25th July, 1833. One came forth in the usual way, the other was released by the workers, *through the side of the cell*. The elder soon began to pace the hive in quest of her competitor; two or three times they came within an inch of each other, and once the abdomen of the one actually traversed that of the other, without any apparent recognition, Mr. G. looking on with breathless anxiety. At length the elder princess, having a distinct view of the younger, made an immediate onset, clasped her round the back, and endeavoured to insert her sting. The junior having probably been set at liberty, by the workers, before she was perfectly matured, and being consequently inferior in

* But the war has no doubt been so fiercely waged sometimes as to prove mutually destructive; an instance of this came to the knowledge of Mr. Dunbar.

strength, offered but feeble resistance and was soon vanquished. The mortal wound having been inflicted the poor victim was left to her fate; she quickly sickened and retired to a distance; but soon rallied again and walked slowly about the hive; the victor, as if aware that she had placed her *hors de combat*, passing by her with the completest unconcern. On the following morning the workers had removed the wounded princess to the alighting board still alive; she was then placed under a glass and did not expire till mid-day, about twenty-four hours after she received her death-wound. I once preserved a wounded queen for about the same period; whence it may, I think, be inferred that queens when stung are not so violently affected as workers. I shall notice presently some cases of the *suddenly* destructive influence of the stings of the latter on each other which fell under my own observation; an instance equally destructive from a *royal wound* inflicted on a *worker* occurred to Mr. Golding; it was a case in which a queen and a worker, belonging to distinct families, were confined, by mistake, under the same glass.

It was the opinion of Schirach and Riem, that if a stranger queen were introduced where there was a native one, the former would be assailed by the workers, and by them stung to death. The experiments of Huber and Dunbar discountenance this opinion: Huber says that, in the whole course of his experience, he never knew more than one instance of a queen's being stung by a worker, and that was wholly unintentional. Feburier relates two instances, in which the stings of some workers seemed evidently directed to the destruction of a queen, but both were virgin queens, not belonging to

the hive in which they were assailed; they had probably issued from their own domiciles, in quest of the drones, and mistook a neighbour's entrance for their own.

But though the experiments to which I have just alluded, produced different results from what we were led to expect by Schirach and Riem, yet those of Huber did not correspond with those of Dunbar. The former introduced two stranger queens into hives containing native queens; of the latter one was fertile, the other a virgin,—the former were both fertile. Each of these introductions led to a single combat between the queens, and each terminated in the death of the stranger. The latter gentleman also, on two occasions, introduced stranger queens to the queens regnant, in his mirror hive; but in neither case were they stung to death, either by the queen or workers, but merely surrounded and confined by the latter, and by that confinement either suffocated or starved to death. Schirach and Riem had probably witnessed similar conduct on the part of the workers, and were no doubt led thereby to conjecture that they despatched the queens with their stings. In one of the instances that fell under Feburier's observation this was probably the case, as the queen died whilst thus surrounded. In the other she escaped and re-entered her own hive.

From what has been said of the fatal consequence to the bee itself, when it makes use of its sting for the annoyance of man and other animals, it might be supposed that the darting of the weapon by one bee into the body of another might cause the death of both; but this is not usually the case, otherwise there would be a great mortality amongst them, when the persecution of the

drones takes place. Huber contrived, as I have stated at page 46, to obtain a clear view of this scene of massacre, when the bees were seen to thrust their stings, so deeply, into the bodies of the drones, (generally between the segments of the abdomen,) as to be obliged to turn upon themselves, as upon a pivot, before they could extricate them; by so doing they succeeded, as it is said the queens do after their combats with each other. In similar contests between workers, which have proved mutually destructive, their death has been attributed to the victors being unable to extricate their stings from the wounds they have inflicted; this however is not uniformly the case, as I have had opportunities of noticing on several occasions, particularly in a family, the weakness of which, at the same time that it laid it open to attack, made it also desperate in its resistance, a concurrence of circumstances by no means uncommon. An assault having been made upon it, by some neighbouring bees, was repelled with so much vigour as to deter them from a repetition of it on that day; but on the day following, an assailant having had the temerity to enter, a violent struggle ensued, in single combat, which lasted for about two minutes, when the issue was suddenly fatal to both combatants. I immediately examined them, and found that neither had lost her sting, but in both this weapon, as well as the adjacent parts, were in a quivering state, and in one the sting was feebly ejected on pressure. About the same time and in the same family, I witnessed two similar combats, between a wasp and a bee, in which they grappled with each other so vigorously, that, after rolling over and over, locked in each other's hostile embrace, they fell to the ground, each as I believe mortally wounded; but I

could not be so sure, on either of these occasions, that I picked up the identical bee and wasp that were engaged, as I was in the case of the contending bees. Several other contests appeared to have occurred, producing a similar result, several bees and wasps lying dead, not only on the ground in front of the hive, but also on the floor-board within it: I examined them one by one, and found that all retained their stings. In these instances, therefore, the death of the insects must have been caused by the simultaneous injection of the poison by each, the effect of which seemed to be almost as suddenly destructive as a stroke of lightning.

In their mutual combats, however, they will sometimes, from the violence of their rage, cause the sting to enter so deeply, that, on attempting to withdraw it, it is torn away. Mr. Hunter saw an instance of this, in which, one bee having stung another in the mouth, the latter ran about with the sting and its appurtenances adherent in the wound. A similar case occurred to Mr. Golding; the bee which was the assailant could not disentangle herself, but dragged her victim after her.

By allowing the bee to draw out her sting gradually, when we ourselves are stung,—which if we had sufficient firmness and presence of mind to remain still, she would instinctively do, by bringing the beards close down to the sides of the darts,—the life of this insect might be preserved, and the pain in the wounded part be much lessened: but the excitement of both parties seldom admits of such forbearance. The wasp is not so liable to leave its sting behind as the bee, the beards of the former being rather shorter, and the insect stronger and more active.

The sooner the sting is extracted the less venom is

ejected, and consequently less inflammation induced, for the muscles of the venom bag retain sufficient life, after they have been torn from their attachments, to be capable, by means of their continued action, of compressing the poison, and perhaps the sting itself, still deeper into the flesh. On this account Swammerdam recommends the sting to be instantly severed from its appurtenances, with a pair of scissors, and then to be extracted with the point of a needle.

To alleviate the irritation, numberless *remedies* have been proposed, of the most opposite kind and uncertain effect; as oil, vinegar, bruised parsley, burnet, mallow, or the leaves of any succulent vegetable (renewed as soon as warm, and probably therefore operating by cold alone), honey, indigo dissolved in water, &c. &c. The *most effectual* remedy appears to be the *aq. ammon.* or *spirit of hartshorn*: nor is this surprising, when we consider that *the venom of the bee, or wasp, is evidently acid. If a humble-bee be irritated to sting paper tinged with litmus, or any other of the vegetable blues, the colour is changed by the acid of the venom to a bright red:* this acid appears not to differ from the acid (*bombic*) of silk-worms, or (*formic*) of ants. The acrimony of the latter many have experienced when inadvertently sitting down on an ant-hill. On this principle, a solution of any alkali, or even lime-water, might answer the same purpose; and soap would have the double advantage of neutralizing the acid and allaying the inflammation, by the oil which would be disengaged. Plunging the part stung into cold or warm water would afford the same relief as in burns, &c., and also dilute the acid acrimony. Volatile alkali in the forms recommended, though it does not always obviate tumefaction, will in

general quickly relieve the pain of a sting, and in cases of extensive stinging, its internal use may also be had recourse to with advantage. A phial of it should always be at hand near the apiary. Mr Dunbar assures me that he has found the juice of the common dock-leaf an effectual remedy for the sting of a bee or wasp.

Quietness is the surest protection against being stung. It has lately been affirmed, that a person is perfectly secure amidst myriads of bees, if he carefully keep his mouth shut, and breathe gently through the nostrils only, the human breath being, as it would appear, highly offensive to their delicate organs. (*Vid.* Senses of bees.) It is added that, with this precaution, hives may be turned up, and even part of the combs cut out, while the bees are at work, with perfect impunity.

Those who wish to view the sting of a wasp or bee through a microscope, may cut off the end of its tail, when by touching it with a needle or pin it will thrust out the darts and their sheath, which may be then snipt off with a pair of scissors and reserved for observation. If the insect be caught in a leather glove, and provoked to eject its sting, the same end will be answered; as the sting being detained by its barbs, will be left in the leather, from whence, when the creature is dead, (which in the case of a wasp will not be for many hours,) the whole apparatus may, with care, be extracted.

"Upon examining the edge of a very keen razor by the microscope, it appeared as broad as the back of a pretty thick knife, rough, uneven, and full of notches and furrows, and so far from anything like sharpness, that an instrument, as blunt as this seemed to be, would not serve even to cleave wood*." "An exceedingly

* Hook's Microcosm.

small needle being also examined, the point thereof appeared above a quarter of an inch in breadth; not round, nor flat, but irregular and unequal; and the surface, though extremely smooth and bright to the naked eye, seemed full of ruggedness, holes, and scratches. In short it resembled an iron bar out of a smith's forge.* But the sting of a bee viewed through the same instrument, showed everywhere a polish amazingly beautiful, without the least flaw, blemish, or inequality, and ended in a point too fine to be discovered; yet this is only the case or sheath of instruments still more exquisite.

The Poison of Bees.

The *poison of bees*, as also that of wasps, is a transparent fluid: applied to the tongue it imparts a sweet taste, which is succeeded by a hot acrid one. It gives a slight red tinge, as has been already hinted, to litmus paper, and hence the Abbé Fontana has concluded that an acid enters into its composition, but in very small proportion. The venom is so extremely active, that he conjectures a grain in weight would kill a pigeon in a few seconds. It is this fluid which causes the inflammation consequent upon being stung. A puncture from a needle that was charged with it, would produce precisely the same effects. These effects are very different in different persons; for whilst a single sting will produce alarming symptoms in one individual, another may receive numerous punctures without sustaining pain or inflammation in any considerable degree; sometimes without suffering either. The activity of the venom varies according to the season of the year, as

* Philosophical Transactions.

does also the irritability of the bees: a sting received in winter produces much less inconvenience than one inflicted in summer; the pain and inflammation are neither so intense nor of such long continuance. This may arise from there being a more copious secretion of venom in summer than in winter. During the former season, if a wasp inflict several successive wounds with its sting, the pain and inflammation become progressively less, at each consecutive puncture: after three or four punctures, it is rendered incapable of producing more inconvenience than the point of a sharp needle. This experiment cannot be so well tried with a bee, on account of her generally leaving her sting in the wound, whenever she has full power to insert it.

If a bee be provoked to dart its sting against glass, so as to eject its venom upon it, and the glass thus charged be placed upon a double microscope, oblong pointed crystals will become visible; these may be seen at first floating in the venom, and gradually shooting into crystals, as the fluid part evaporates.

The Anger of Bees.

I have already treated of the disposition of bees to use their stings, when irritated, either by direct interference with them, or by the approach of persons to whom they have an antipathy. The smart quick strokes of the wings, when they are angry and prepared to sting, give a sound very different from their usual buz. "Instead," says Mr. Hunter, "of that soft contented noise made by a bee coming home loaded on a fine evening, whenever she meditates an attack, with her sting, she makes a very different one." There is a

piercing shrillness in the sound, as the author and some of his friends have often experienced.

Messrs. Kirby and Spence, after quoting a passage from Mr. White's "Natural History," relative to the feigned attacks of some wild bees near Lewes in Sussex, which "with a sharp and hostile sound dash and strike round the heads and faces of intruders," make the following observations: "The hive-bee will sometimes have recourse to the same expedient when her hive is approached too near, and thus give you notice what you may expect, if you do not take her warning and retire. Humble-bees when disturbed, whether out of the nest or in it, assume some very grotesque, and at the same time threatening, attitudes. If you put your finger to one of them, she will either successively or simultaneously lift up the three legs of one side, turn herself upon her back, bend up her anus and show her sting, accompanied by a drop of poison. Sometimes she will even spurt out that liquor." The irascibility of hive-bees has been noticed in strong terms by Virgil; when once provoked, says he, they set no bounds to their anger, but

> "Deem life itself to vengeance well resign'd,
> Die on the wound, and leave their stings behind."

Fatal consequences, occurring from their wounds, are not often heard of, though such, I believe, have occasionally happened. A case of violent fever, produced by the injury they inflicted, is related by Messrs. Kirby and Spence, in which the person's recovery was for some time doubtful. Mungo Park also mentions, in his Travels, an instance of severe annoyance from them, and states that he lost several asses in Africa, owing to

their being attacked by bees. Mr. Talbot, in his "Five Years' Residence in the Canadas," states, that during the summer of 1820, the Rev. Ralph Leeming having sent a fine horse to grass, at a neighbouring farmer's, who kept about twenty stocks of bees, the animal got upon the lawn, where the hives were placed, and by accident overturned one of them, the bees of which attacked him with great virulence. The horse, rearing, and kicking from agony, overthrew another hive. Having thus doubled the number of his assailants, his sufferings throughout him to the ground, and in less than five minutes, from the commencement of the attack, the poor animal was literally stung to death.

There are other instances of this sort on record, which were attended by a like fatal result, though not quite so speedily. Two fell under the notice of Della Rocca, and several are mentioned by him as having occurred to M. Chabert and others, who attributed the death of the animals to impeded respiration, occasioned by the extreme agitation and flurry of their nervous systems, rather than to acute bodily suffering. This opinion is in accordance with that given by Mr. Lawrence in his Surgical Lectures delivered in 1830. "A case," says he, "was lately mentioned which excited considerable interest, of a gentleman in France, who was walking in his garden with his morning gown on and his breast open. A large bee-hive was upset, and he ran to put it right again; the bees fixed upon him, and stung him about the throat and chest: he immediately ran into the house, and the persons around him endeavoured to liberate him from the insects as soon as they could, but he said he felt himself sinking, and actually died in about ten minutes. The action of the heart became inter-

rupted, anxiety, agitation, and alarm arose, and he was carried off very speedily. Mr. Knight informed me that he knew an instance in which a peasant, who was stung by a number of hornets, lost his faculties, and though he lived for several years afterwards, remained in a state of idiotcy.

The anger of bees is not confined to man and other large animals; it is sometimes vented upon their own kind, not only in single combat, but in conflicts of organized masses. Cases of the former kind every observer must have noticed, and of the latter, several have been related by Reaumur, Thorley, Knight, and others. The engagement witnessed by Thorley lasted more than two days, and originated in a swarm's attempting to take possession of an already occupied hive. Remarkable battles of this kind have also been related by other writers. Whenever the angry excitation is diffused through a whole community, a great accession of heat is produced in the hive.

Notwithstanding bees are thus occasionally animated by a most vindictive spirit, against what they regard as a public enemy, they are not found to display any peculiar hostility in the revenge of a private injury, committed upon them at a distance from their homes. Bees, says Mr. Hunter, *never* sting but in the neighbourhood of their property, unless hurt; nor contend with each other for honey, unless it be placed within the boundary of their own right; but what they have collected, they defend. "Cum rari sint, nec sibi invicem, nec ullis aliis nocent; at verò apud suos alveos pugnant acerrimè." —*Aristotle.*

Mr. Knight has also observed that, though the most irritable of animals near home, he has seen them suffer

themselves to be patiently robbed of their loads by other bees, and that he has witnessed this in the same bee three times in succession. He says, likewise, that if the wasps in a nest have their communication cut off from those that are abroad, the latter, on their return, will not make any attack; but that if one escape from the interior it evinces a very different temper, and is ready to sacrifice its life to avenge the injury. This Mr. Knight discovered when a boy, and he has no doubt but that if a similar proceeding were adopted towards bees, they would observe the same conduct.

The Language of Bees.

All creatures, that live in society, seem to possess the power of communicating intelligence to one another. "Brutes," says Mr. Knight, "have language to express sentiments of love, of fear, and of anger; yet they seem unable to transmit any impression they have received from external objects. But the language of bees is more extensive; if not a language of ideas, it is something very similar." This faculty has been very remarkably illustrated by Peter Huber, in his Treatise on Ants, and the bee exhibits many strong evidences of it. P. H. has clearly shown that the communications of ants are made through the medium of their antennæ; and the elder Huber proved, very satisfactorily, that these organs serve the same purpose in bees.

Being desirous of ascertaining whether, when a queen was removed from a hive, (a circumstance which is generally communicated to the whole family within a few hours), they discovered their loss by means of smell, touch, or any unknown sense, he divided a hive into two

portions, by means of a grating which admitted a free circulation of air, but denied a passage to the bees, or even to their antennæ: the consequence was, that the bees contained in the half that had no queen, after they had recovered from the agitation, generally produced under such circumstances, set about building royal cells, just as they would have done if the queen had been entirely removed from the hive. He repeated this experiment with a grating, which allowed the transmission of the antennæ only. Here the effect was quite different; for the bees being able to assure themselves, by the frequent crossing of their antennæ with those of the queen, that she was still amongst them, everything remained in order; the brood were attended to, no interruption took place in any of their labours, nor were any royal cells commenced. From all these experiments, (and they were repeatedly tried), it seems evident that the antennæ of bees, as well as of ants, possess the faculty of receiving and conveying information. Bees receive some kinds of intelligence through the medium of certain sounds, as has been stated in another place. This faculty is very remarkable in the feathered tribe, their notes being so modulated as to convey from one individual its wants, feelings, and passions, to all the rest. Various instances of this communication are stated in White's Natural History of Selborne.

The antennæ, in addition to the uses already ascribed to them, may serve to *inform the bees of the state of the atmosphere, and enable them to discern the approach of a change in the weather.* The suddenness and rapidity of their flight, towards the apiary, often afford a hint to the observer of their proceedings, that a storm is at hand.

of which he received no intimation from any other quarter.

"Inque vicem speculantur aquas et nubila cœli."—VIRGIL.

"That the bees," says Dr. Evans, "can foresee bad weather, is a fact beyond denial; though we know not through the medium of what sense that faculty is exerted. We are often surprised to find, even with a promising appearance of the sky, their labours suddenly cease, and that those which are abroad hurry home in such crowds that the door is too small for their admission. But on strictly examining the heavens, we may discern some small and distant clouds, which, insensibly collecting, soon after descend in rain." The Doctor likewise says, that an observant friend of his, foretells with confidence that rain will fall in the course of a few hours, when he finds on a clear summer's morning that his garden is wholly deserted by his neighbour's bees. In this he enjoys an advantage over their real owner, the flowers near the apiary being crowded, as usual, by these wary foragers. "If," says Mr. Kirby, "they wander far from home, and do not return till late in the evening, it is a prognostic to be depended upon, that the following day will be fine; but if they remain near their habitations, and be seen frequently going and returning, although no indication of wet should be discoverable, clouds will soon arise, and rain come on. Ants also are observed to be excellently gifted in this respect; though they daily bring out their larvæ to the sun, they are never overtaken by sudden showers."

I have before stated, that in the course of a few hours the important intelligence of the loss or safety of a queen is known to a whole colony. It seems highly improbable

that in this time 20,000 bees should have assured themselves of the presence and safety of their queen, by applying their antennæ to her; such an attempt would create a state of complete confusion. Huber proved by a very decisive experiment, similar to those already related, that the queen is not distinguishable by her subjects, in consequence of any emanation from her person. There must then be some mode, to which I have given the name of language, by which those which have exchanged contact with their antennæ can communicat the tranquillizing intelligence to their companions. It seems impossible to explain, in any other way, the concurrence of so many wills to one end, or that sudden interruption and restitution of harmony which are often exhibited, in every community of bees. Mr. Knight thinks that bees are not only capable of communicating intelligence to the members of their own family, but that a friendly intercourse sometimes takes place between neighbouring colonies; in those cases, however, which he has related, after the intercourse had continued for a few days, it terminated in violent hostility.

Cases of reciprocal intercourse have been noticed by others, attended with a different result.

A very remarkable instance of visiting occurred to Mr. Golding in March 1832 The boxes, though at some distance from each other, were marked No. 4 and 5, and both families were vigorous, the former possessing an old queen, the latter a young one, but without any consanguinity. No. 4 appeared to commence the visiting, which in its progress became reciprocal, and was *amicable* throughout; No. 5 was shut up the first night, and continued so for about a week, during which time the bees of No. 4 gradually discontinued their attempts

to gain admission, and did not renew them for another week. The weather during this period proved cold; but on the 4th of April, a day or two previous to the setting in of fine weather, the visiting recommenced, was quite reciprocal, and so rapid as to communicate considerable heat to the glass windows of both boxes: the throng about No. 5 was so great as to obstruct the entrance, and cause the bees to cluster under the alighting board. It appeared very extraordinary that during this intercourse both families increased considerably in weight; on two of the early days in April, to the extent of a pound a day each, and on one day more than double that quantity; pollen was also carried in freely, particularly by No. 5. After the two or three first days, the visiting ardour gradually abated, and, at the end of a week, had ceased altogether. The natural inference from this proceeding, had it occurred in May or June, would have been, that one of the families had lost a queen; but that such could have been its object in the middle of March seems highly improbable; and a continued observation of both families, for several subsequent weeks, strengthens this improbability, for in both No. 4 and 5 the queens laid the usual complement of drone-eggs in May. If, therefore, either family had been in want of a queen, it could only have been supplied with an artificial one. To establish this point would have required an examination of the brood-combs in both boxes, to ascertain, in the first place, whether either of them contained an artificial cradle of royalty; and secondly, a scrutiny into the cells, to see whether the want of female eggs or larvæ, in one family, rendered it necessary for them to make application to a neighbour; but the deposition of drone-eggs, at the usual period, in both

hives, gives no countenance to the notion of a failure in either sovereignty. Moreover, had such been the fact, wherefore reciprocal visiting? Further experience and more extended observation are requisite, to afford a satisfactory knowledge of those proceedings; at present they are enveloped in obscurity. But from this case and another similar to it, which occurred to the same gentleman, and a third which is related by Feburier, it seems clear that, at any rate, some of the communications between different families of bees have other objects than those of hostility and spoliation. In the second of Mr. G.'s instances the visiting took place in May 1831, and was carried on with so much vigour that the visitors were in a state of activity considerably earlier than the other bees of his apiary, and it continued in an evening long after all around them were at rest. Here it was ascertained that each box contained a prolific queen.

Mr. Estlin's bees, referred to in Chapter 14, had their proceedings been noticed, would, I doubt not, have afforded an example of friendly communication.

Sleep of Bees.

It is reasonable to suppose that every part of animated nature needs occasional intervals of repose; and that this is the case with the bee seems evident, from the almost motionless quietude of the workers, which often occurs for fifteen or twenty minutes together, each bee inserting her head and thorax into a cell, where she might be supposed to be dead, were it not for the respiratory movements of the segments of her abdomen. The queen sometimes does the same in a drone cell, where she continues without motion a very long time, when "the workers form a circle round her, and gently brush the

uncovered parts of her abdomen. The drones, while reposing, do not enter the cells, but cluster between the combs, and sometimes remain without stirring a limb for eighteen or twenty hours." Huber says that he has seen the workers, even in the middle of the day, when apparently wearied with exertion, insert half their bodies into the empty cells, and remain there, as if taking a nap, for half an hour or longer; at night they regularly muster in a sleep-like silence.

"Molli reficit nox corpora somno."—VANIERE.

This state of repose, as Mr. Dunbar observes, may often be witnessed in those cells which are situated against the windows of a hive, where the glass forms one side of the cells. Here during the busy and fatiguing season of honey-gathering, the bees may be observed, lying at full length, their heads at the bottom, and every limb apparently in a state of relaxation, while their little bodies may be seen gently heaving by the process of respiration. It should seem, however, that at any rate queens can do without sleep for a considerable time, for Mr. Golding heard one pipe without five minutes' intermission for three days.

Longevity of Bees.

This is a subject upon which, I believe, no precise information has ever been presented to the public. "Cool courage and steady perseverance, crowned with unincumbered leisure," says Dr. Evans, "can alone expect to unlock this curious arcanum in natural history."

"Like leaves on trees the race 'of bees' is found,
Now green in youth, now withering on the ground;
Another race the spring 'or fall' supplies,
They droop successive and successive rise."

The several members of a hive have very different periods of existence. The general law among insects is, that both male and female shall perish soon after sexual union; in a few days or weeks at furthest, according to the time, probably, that the female occupies in maturing and depositing her eggs. By retarding sexual union, the lives of some insects may be very much prolonged,—even ephemeræ have been kept alive by this means for seven or eight days. Annual plants, if prevented from seeding, may be rendered biennial. The bee and some other insects are exempted from this forfeiture of life after sexual union, with the exception already alluded to in page 35.

The opinion of the ancients, respecting the term of the bee's life, was extremely vague and indefinite. The length of life allotted by *them*, to the *working bee*, was from *seven* to *ten* years: in later times, writers on bees have regarded it as not much exceeding *a year*; but the notions of both ancients and moderns, upon this subject, have been purely conjectural. Indeed it appears to be somewhat doubtful, whether the length of life which the former seem to have attributed to individual bees, was not meant to apply to the existence of each bee-community; though the language they make use of fully justifies the former construction, excepting in the case of Columella, who clearly regarded the ten years as applicable to the latter. The words of Virgil, who probably borrowed from Aristotle, are,

> "Ergo ipsas quamvis angusti terminus ævi
> Excipiat, neque enim plus septima ducitur æstas."

But the language of Columella applies to the existence of the community, and not to individual bees: "Durant-

que, si diligenter exculta sint, in annos decem, nec ullum examen hanc ætatem potest excedere, quamvis in demortuarum locum quotannis pullos substituent. Nam ferè decimo ab internitione anno, gens universa totius alvei consumitur."

Provided the hive be never changed, nor the combs renewed, it would not seem probable that any one family should have its existence prolonged beyond the period fixed by Columella, on account of the accumulation of silken pellicles, with which the breeding cells are successively lined, gradually rendering them unfit for use, particularly as they are still further diminished by the excrement of the larvæ, which is never cleaned out, but confined behind each lining: both together must soon render the cells unfit for use as brood cells. Mr. Hunter found three of these layers deposited in a single season, and counted upwards of twenty in the cells of an old comb, which, upon an average of three a year, would make the age correspond with the period fixed by some of the ancients; though this observation by no means proves that the hive upon which it was made, or any other, might not have had a much more protracted existence. Mr. Espinasse tells us, that he once took a hive which had stood fourteen years, having found that it had become weak: it had nevertheless sent off a swarm the year previous. Della Rocca says, that he has known hives in Syria continue in a flourishing state from forty to fifty years, though but rarely. Butler speaks of a colony having occupied the same domicile for *one hundred and ten years*. The spot chosen was over the study of Ludovicus Vives in Oxford, who was appointed Professor of Rhetoric in that University, through the influence of Cardinal Wolsey. He took

up his residence in Corpus Christi* College, where he was welcomed by a swarm of bees which settled under the leads of his study. These bees and their posterity, which were always known by the name of Vives's bees, kept possession from 1520 till 1630, in which year a decay of the leads caused them to be disturbed, when they were found to have stored an almost incredible mass of honey†.

"Particular attention from bees was formerly considered to be indicative of eloquence, in the persons who were the objects of it, and Plato, Menander, Pindar, Lucan, and Ambrosius, have been adduced as evidences of the truth of this opinion. Ludovicus Vives has been cited as a further evidence: he was called by the University the mellifluous Doctor. Butler thus closes his history of the occurrence: "How sweetly did all things then concord; when in this neat museum, newly consecrated to the Muses, the Muses' sweetest favourite was thus honoured by the Muses' birds!" "Apes cum causâ Musarum dicuntur volucres." VARRO.

A question may arise, whether, in these instances of long-continued occupancy, there might not have been departures from legitimate ownership; whether for example, in the case of Vives in particular, the bees in possession in 1630 were in a regular line of descent from those which settled under the leads in 1520. These lat-

* It is somewhat remarkable that this college is called in the statutes, by its founder, "the College of Bees," and Erasmus inscribed an epistle to its first president thus: "Johanni Claymundo Collegii Apum Præsidi."

† Mr. Knight attributes these prodigious storings of honey, several of which have come to his knowledge, to the superior protection afforded by human habitations; an argument in favour of inclosed bee-houses.

ter and their posterity might have been long defunct, as well as several generations of other bees that might have been induced to take possession of such a commodious and well-furnished residence. Besides, it has been stated, by persons whose words may be fully credited, that bees, so situated, are now and then joined by neighbouring swarms. The longest period during which I ever found any family to flourish was seven years; on the eighth the hive became wholly depopulated, the inmates having apparently died a natural death.

To common observers it might appear, that the lives of the bees were coeval with the foundation of the colony, presuming upon all the young bees leaving the parent stock in swarms. But I have already stated that all swarms consist of a mixture of young and old bees; the difference between them is very distinguishable, those of the present year being brown, plump, and clothed with light hairs; whilst the old ones have red hairs, notched and ragged wings, and are pale and somewhat shrunk in their bodies.

The cases which I have related, and others of a similar kind, have led to the erroneous opinion that bees are a long-lived race. But this, as Dr. Evans has observed, is just as wise, as if a stranger, contemplating a populous city, and personally unacquainted with its inhabitants, should on paying it a second visit many years afterwards, and finding it equally populous, imagine that it was peopled by the same individuals, not one of whom might be then alive. "Such strangers are we to the honied hive, where, however quickly its generations may have passed away, the same face is presented to the beholder."

"The race and realm from age to age remain,
And time but lengthens with new links the chain."

SOTHEBY'S GEORGICS.

The usual term of the male's existence is two or three months only; I say the usual term, for his life is always cut off by violence, when no peculiar circumstances arise to render his existence any longer useful. Such circumstances having arisen, he may be kept alive somewhat longer.

An intelligent writer in the Westminster Review, when criticising my disquisition upon the length of the bee's life, in the former edition of this work, expressed his regret that we possessed no positive evidence which could throw light upon it. This gentleman's observations induced me to direct my attention more closely to the subject, first theoretically, then practically; and I shall now proceed to give the result of my inductive reasoning as well as of my actual observation.

A good family of bees being known to consist of from 12,000 to 20,000, and a fertile queen to breed that number at least every year, which, under favourable circumstances, is usually thrown off by swarming, it appeared to follow, as a matter of course, that if swarming were prevented by affording hive room to the bees, the number during the breeding season would often be more than doubled, and that if their lives were only extended even to the shortest period hitherto assigned them, they would remain in a crowded state till the following spring. But repeated experience has clearly shown, that the population of families which have been thus accommodated with room, if examined in the following winter, do not consist of more than 3000 or 4000. After receiving a

great increase, in the ensuing spring, they again suffer a similar reduction, before the succeeding winter; and this regular alternation, of increase and decrease, will go on for years, keeping a family, that has been duly supplied with hive-room, at about the same average amount at each respective period of the year. This reduction to the smaller number, above stated, every successive winter, can only be produced by the old bees dying, and leaving the business of the family to be conducted by young ones; and it affords, I think, conclusive evidence that the *working-bee's* life is regularly cut off in *less than a year.*

The period at which the queen-bee deposits her greatest number of eggs is the spring, and it has been emphatically called *the great laying.* I think the facts above stated amply justify the opinion that all the bees, brought into existence by this laying, die before winter, and are succeeded by those born, at intervals, during summer and autumn, and in mild weather, during part of the winter also. The proportion of eggs deposited by the queen at these latter layings, when compared with the great laying in spring, accounts satisfactorily, upon the theory above stated, for the great disparity in the populousness of a family of bees at different periods of the year. This view of the matter renders it more than probable, therefore, that *the life of the working-bee does not exceed six or seven months.* In order to illustrate my theory I will give below a summary, which, though not pretending to minute precision, may possess sufficient for the purpose.

Bees constituting a family in February	3,000	
Spring-bred bees	17,000	
Summer and autumn ditto	6,000	
	26,000	
Removed by death between February and December		23,000
Thus bringing the family down to the February number		3,000

Thus far I was conducted by theory, a theory which I propounded to my apiarian friends several years ago, and which they all regarded as being invulnerable. I have recently had an opportunity of confirming its *general* correctness, by the result of some experiments, the particulars of which I will now detail.

On the 13th of June, 1835, I introduced a prime swarm to my mirror-hive, the early proceedings of which bore so close a resemblance to those which occurred to Mr. Dunbar, as reported in the Edinburgh Philosophical Magazine, as well as in page 24 of this work, that I need not detail them here. On the 1st of July, when the queen was in the midst of her laying of drone-eggs, and when the hive was well stored with honey as well as with worker-eggs and brood in all stages, I removed her majesty from the family. Though I watched assiduously from early morn till late at night, for several days no agitation was perceptible. Still I concluded that the bees were aware of the loss they had sustained, as on the second day I perceived the foundation of four royal cells, which were closely attended to by the workers. The general business of the family went on with

as much alacrity as usual; pollen was duly carried in, honey-cells were stored and sealed over, brood-cells cleared out and replenished with honey, and, in short, not the slightest evidence was afforded of the absence of the queen. The usual period for enlarging and sealing up the royal cells passed away, but they never proceeded beyond the state of acorn-cups. There was, however, no remission in the attention paid to them by the workers. In a few days the young workers began to issue from their cells, and on the 13th of July I perceived the first issue of drones. From this period both were to be seen emerging daily; the latter continued to come forth till the 25th. This state of affairs somewhat perplexed me, and, as was natural, gave birth to theorizing. Some might have said it was a case of instinct at fault; to me it appeared to be an instance of one instinct overpowering another. I have stated that on the second day, after the queen's removal, I perceived the rudiments of royal cells; I question much whether I might not have seen them at the time of removal had I more narrowly inspected the combs; and if so, I think the cause of failure may be inferred; for, being formed during her majesty's occupancy of the hive, the bees would naturally expect her to make the usual deposits in them, and the constant attention which they paid to these cells, by popping in their heads, gives countenance to the opinion. That such was the expectation of the bees receives still further countenance from the situation of these royal cradles: they were constructed upon the edges of the combs, as the *natural* cradles of royalty always are; not formed by the breaking down of worker-cells, as is the case when *artificial* cradles are constructed. The *natural* cradles of royalty are for the most

part situated on the edges of the *worker*-combs, but now and then also upon the margins of the *drone*-combs. This latter circumstance was remarked by Swammerdam, and an instance of the kind once fell under my own notice.

Admitting the view I have taken of the proceedings of my bees to be a sound one, it would seem not improbable, considering the populousness of the stock and the warmth of the weather, that had I removed the queen a day or two earlier, or a day later, one or more royal cradles would have been perfected; as in the first case there would, most likely, have been a formation of *artificial* ones, and a consequent raising of *artificial* queens; in the latter case there *might* have been a tenanting of the *natural* cells of royalty, and a maturation of natural queens. In both these respects I was disappointed; no queen was raised; and though no substitute for the old one was presented to the family, there was no abatement of their watchfulness, nor any relaxation of their diligence.

The circumstances, under which this family of bees was placed, appeared to offer a favourable opportunity for ascertaining the age to which the life of the working-bee, as well as that of the drone, might extend: I knew that all the young workers were born within three weeks after the removal of the queen, and all the drones within twenty-four days of that time. I carefully watched the proceedings of the family during the remainder of the year, but, till the close of autumn, nothing different was noticeable in their proceedings from what would have taken place if a queen had been with them, excepting that there was no massacre of the drones, nor any deposition of fresh ova: both the store- and the brood-cells were richly furnished with honey. The hive was situ-

ated in an upper apartment of my dwelling-house, well protected from cold; the quicksilver in Fahrenheit's thermometer, which hung over them, seldom ranging below 45°, and never lower than 43°. The drones began to decline in number towards the end of October, and by the middle of November not a single drone remained. Soon after *their* extinction there was a gradual but manifest diminution of the working-bees: they continued decreasing till the 30th of December, when only thirteen remained alive: these were quite active on the morning of that day, but before night ten of them had expired; the other three, when I retired to rest about eleven o'clock, were moving briskly about upon the comb; but when I rose next morning (31st) they also had closed their career.

Apprehending that when the family became very much reduced, that so small a number of bees would be unable to maintain a due degree of heat, I not only surrounded the hive with a thick coating of wool, but kept a fire in the apartment night and day, which preserved a regular temperature of between 50° and 60° Fahrenheit.

From the particulars above detailed, it will, I think, appear pretty evident that the average *life of the drone* is about *four months*, whilst that of the *working-bee* is extended to about *six months*. It will also appear that their lives are cut off rather suddenly.

On the extinction of the family I took from the hive nearly twelve pounds of fine liquid honey.

The result of this experiment, as respects the length of the working-bee's life, confirms the opinion which I had previously formed; it was still further confirmed by a repetition of the experiment in 1837. In the latter

instance the swarm was not introduced to the hive till the 22nd of June, nine days later than that of 1835, and the relative time, at which the inmates died, was in very close accordance with the respective periods at which the swarms issued; the drones of the latter were not extinct till the 21st of November, nor the workers till the 8th of January following. In common with the rest of my bees, this family, though much reduced in number, was gaily taking the air on the 25th and 28th of December, two remarkably fine warm days, and when extinct they left behind them nearly as large a store of honey as the family of 1835. I could adduce one or two more cases in point, but shall confine myself to an experiment of Reaumur. He marked five hundred bees in April with red varnish, and saw them alive a month afterwards; but in the succeeding November not one of them could be distinguished. This circumstance standing alone, cannot be regarded as conclusive; for in the first place the red varnish might have peeled off, prior to his last observation; and in the next place, it is possible that none of the marked bees might have been spring-bred; but taken in conjunction with the facts detailed as having been noticed by myself, illustrating as they do the theory which precedes them, I think it may be received as strongly confirmatory of the opinion that the working-bee's life is much shorter than has usually been supposed, as it seems highly probable that at least *some* of the bees marked by Reaumur, if not all, were the produce of the spring-laying; and whether or not the varnish and the bees had disappeared together, no doubt he observed in November a very manifest diminution in the populousness of the family.

It now only remains that I should advert to the lon-

gevity of the queen-bee, and upon this point the evidence which we possess is sufficiently ample to justify a tolerably decisive statement. The experiments of Huber, Della Rocca, Dunbar, and Golding have clearly proved that her majesty sees several generations of workers pass away before she quits the stage herself. Huber, though he only speaks positively of her life being extended to two years, was of opinion, I believe, that it might reach to four or five; and the three other naturalists, by marking their queens, were enabled to trace them, from hive to hive, through a period of nearly four years; a coincidence in point of time which speaks strongly in favour of the diligence and accuracy with which their observations were made, at the same time that it justifies the opinion of Huber. Della Rocca's queen had accidentally lost a leg in being hived, the others were distinguishable by having had one of their antennæ clipped, neither of which bereavements prevented the fulfilment of every royal function.

CHAPTER XXX.

SENSES OF BEES.

In considering the phænomena of insect sensation, little advantage can be derived from analogy; the physiology of the senses of bees, and other insects, is therefore but imperfectly understood. Still they must have credit for the *possession* of senses, however differently modified from those of man. Some of their senses may open avenues to knowledge, with which he must ever remain unacquainted. Arts which he is obliged to attain by long labour and great diligence, they seem to derive from nature, through the medium no doubt of organs so exquisitely fine, as to elude not only his search, but even his conception.

Of all the senses of bees, none appears to be so acute as that of SMELL. It is this which, in all probability, enables them to distinguish, not only individuals of their own species, but one human being from another; and also to discover honey-dews and honey-bearing flowers, at a very considerable distance.

"Per auras
Mellis apes, quamvis longè, ducuntur odore."

The "quamvis *longè*" of Lucretius has been so extended by some as to render the use even of "quamvis *longissimè*" hardly strong enough. The most extraordinary extension of the kind of which I have ever heard, is that of the botanist M. Michaux the younger, who having travelled to Florida, was actually told by the natives to be-

lieve that *nearly all their bees had emigrated to Cuba*, (25 French leagues,) *attracted by the odour of the orange and citron blossoms*, so abundant in this island! That bees may fly from one island of the Archipelago to another, is quite within the bounds of credibility; but with respect to their astonishing flight from Florida to Cuba, the Floridans must surely have been hoaxing the botanist, and, as Mr. Dunbar observes, "If he could be so simple as to believe them, I think he was a very fit subject for hoaxing." The real facts, I believe, are these. On the cession of the Floridas to England in 1763, many of the inhabitants emigrated to Cuba, and together with the rest of their moveables, transported their hives along with them; instead therefore of the fragrance of the orange blossoms being wafted to the bees, the bees were wafted to the orange blossoms.

An experiment, made by Huber, clearly demonstrates that bees do possess the faculty of smell. Honey being of all odorous substances the most attractive to them, he placed vessels of it in boxes perforated with very small holes, to allow the odorous effluvia to escape, but not of sufficient size to permit a sight of the honey, when the bees came directly to the boxes. He also tried this experiment with the addition of small card valves, which the bees, after examining the boxes all round, contrived to raise up, that they might get at the honey. Mr. Hunter states, that he has seen great commotion produced in a recent swarm in wet weather, when he supposes the bees to have been hungry, by placing honey on the floor of the hive. It was a glass hive, which afforded him a good opportunity of observing their proceedings, and he says, that all of them appeared to be upon the scent: even those that were weak and

hardly able to crawl, threw out the proboscis as far as possible, to get at the honey: this, he thinks, must have arisen from their smelling, and not from their seeing it.

The acuteness and delicacy of this sense may tend to cause that neatness which they observe in themselves and in their habitations, and should therefore induce a carefulness, on the part of their proprietor, that they be annoyed by no offensive odours. Their notorious frequenting of stable drains and other depositories of urine, might seem to render such carefulness futile; but to this subject I have adverted in a former chapter, and have since had the pleasure of seeing my opinion confirmed by that of Messrs. Kirby and Spence.

Bees appear to have an antipathy to particular individuals. Their aversion, in all probability, arises from the persons disliked having some peculiar odour about them, which though not unpleasant to man, may be so to bees. Whatever the odour, it seems to be transmitted by the breath: Huber was of this opinion. Speaking of the impunity with which his assistant, Francis Burneus, performed his various operations upon bees, he observes, that "the gentleness of his motions, and the habit of repressing his respiration, could alone preserve him from the wrath of such formidable insects."

The different reception which persons experience, on approaching the domicile of bees, is attributed by some apiarians to the different degrees of confidence manifested in the approach; they are of opinion, that if visitors could avoid the exhibition of all apprehension, they would not be attacked. My own experience has long convinced me of the erroneousness of this opinion, and an anecdote related to me by the son of Monsieur De Hofer, Conseiller d'Etat du Grand Duc de Baden,

strengthens my dissent from it. Mons. De Hofer had for years been a proprietor and an admirer of bees, and almost rivalled Wildman in the power he possessed of approaching them with impunity: he would at any time search for the queen, and taking hold of her gently place her upon his hand. But having been unfortunately attacked with a violent fever, and long confined by it, on his recovery he attempted to resume his favourite amusement among the bees, returning to them with all that confidence and pleasure which he had felt on former occasions; when to his great surprise and disappointment, he discovered that he was no longer in possession of their favour, and that instead of being received by them as an old friend, he was treated as a trespasser; nor was he ever able, after this period, to perform any operation upon them, or to approach within their precincts, without exciting their anger. Here then it is pretty evident that some change had taken place in the Counsellor's secretions, in consequence of the fever, which, though not noticeable by his friends, was offensive to the olfactory nerves of the bees.

M. Feburier concurs with me in opinion on this subject, and says he has observed that red and black-haired persons are most liable to attack. He also mentions a mastiff dog, to which his bees had a particular dislike, insomuch that they would follow him into the house, and render closed doors and windows necessary to his protection. I have two neighbours, brothers, both men of as firm nerves as any I know, not given to flinch even upon *great* occasions, much less from the sting of a bee; but whilst the one can station himself close to the hive's mouth, hive the bees, or inspect their interior, at any time, as with perfect security, the other, during the gather-

ing season, can rarely even enter the garden with impunity. The obnoxious brother, whose persecution began at a very early age, admits that it has for a long time engendered a feeling of timidity, owing to the suffering that a sting occasions him. The hair and complexion of both brothers is dark, but the favourite is the darker of the two.

The extreme sensitiveness of smell in bees is evinced by their promptitude in resenting an injury, inflicted on any of their community. In hiving, or performing any other operation upon them, great caution should therefore be observed, lest any of them be trodden upon or crushed to death. It may be thought that this promptitude to resent the injury I have here mentioned, may not proceed from the acuteness of their smell, but from an effect produced upon some other organ of sense. I infer that it proceeds from the former, on account of their being so quickly roused to anger from a state of tranquillity, by having a fresh envenomed sting and its appendages presented before the entrance of their dwelling. This experiment, of presenting fresh poison to the bees, was tried by Huber in such a variety of ways, as to prove beyond all doubt that it was the penetrating odour of the poison only, and not the manner of presenting it, that affected them; for when the poison had coagulated, the same mode of presentation produced no sensible effect.

Butterflies and moths are supposed to be directed by this sense to the discovery of their mates. If the female of the eggar moth (*Phalæna quercus*) be inclosed in a box, and placed in the neighbourhood of the males, they are attracted to the spot in such numbers as to show clearly that they are sensible of her presence. We

have analogous instances of the existence of this faculty in other insects. The flesh-fly (*Musca vomitoria*) occasionally deposits its eggs on plants of the stapelia genus, no doubt from their odour resembling that of putrefying flesh. This may be regarded by some as an evidence of mistaken instinct; but from what will be stated in the following chapter, I think that my readers will consider this to be erroneous, and that it should rather be regarded as affording presumptive evidence of mistaken judgment. Instinct would direct the creature to deposit its eggs where the larvæ when hatched would be furnished with the means of subsistence, instead of thus exposing them to perish. At all events, it affords tolerably good evidence of the existence of an organ of smell in the insect.

The sense of TOUCH in bees, that is, their *active* or *exploring touch*, seems to be very acute. To the nicety of this sense has been attributed their power of commencing and carrying on their various works in the interior of the hive, where, of course, they can have no assistance from light. The recognition of their queen evinces the existence of some such sense; for the experiments related at page 338, indicate that her presence is not ascertained either by the organs of sight, hearing, or smell.

The ANTENNÆ have generally been considered as their organs of touch; and indeed, in popular language, they are usually called feelers or horns; they have likewise assigned to them the office of wiping and cleaning the eyes. The antennæ, however, are not regarded as feelers by our leading entomologists: at present, their uses are not clearly defined. Some have regarded them as organs of smell; others as organs of hearing; a third

party have conceived that they perform some function of which man has no definite idea,—supplying the insect with a sixth sense, an intermediate faculty, according to Messrs. Kirby and Spence, between hearing and touch, rendering it sensible of the slightest movement of the circumambient air. Dr. Evans designates the antennæ as their sight-supplying sense.

> "The same keen horns, within the dark abode,
> Trace, for the sightless throng, a ready road,
> While all the mazy threads of touch convey,
> Shot inward to the mind, a semblant day."—Evans.

The antennæ, of which there are only a single pair, proceed from the anterior part of the head before the eyes.

The Palpi are generally considered as the true feelers; which, as well from their texture, as from the manner in which insects apply them to their food, before they begin to eat it, seems probable: Cuvier and Lehmann were of this opinion. The palpi are attached to the under jaws and lips, and are four in number. In some respects they bear analogy to the antennæ; but the latter, being more articulated, have an extended power of motion. Some insects with small antennæ are observed to have very large palpi, which gives reason to suppose, that although their offices may be different, they are intended to assist each other. Both the palpi and antennæ are in continual motion; the former are incessantly applied to the surfaces on which the insects advance when walking, as if to feel their way; and the latter constantly examine every body with which they come in contact. The antennæ, however, are doubtless the more important organs of the two; for the palpi,

when removed, have not been found to occasion much apparent inconvenience; whilst from the experiments of Huber and others, it appears that the excision of the antennæ deprives the insect of the perfect exercise of its functions. It seems immediately to lose its instincts, and to become dull and listless. The amputation of one antenna produces no effect; but if both be cut off near the root, the bee no longer possesses the power of guiding itself; it cannot direct its tongue with precision, to receive food from its companions, nor take any share in the operations of the family; but exhibits perfect indifference and keeps near the entrance, apparently attracted by the light; when that is withdrawn, it soon leaves the hive, to return no more. "Their departure," says Huber, "must be ascribed to the loss of that sense which is employed to guide them in the dark."

That bees possess a fine sense of TASTE, may be readily conceived, from the delicious food which they collect, and from their having a preference for those flowers that afford the best honey. Hence the superiority of the honey of Narbonne, Hymettus, Hybla, and Pontus. Huber regards taste as the least perfect of the senses of bees; but the reasons he gives for this opinion are unsatisfactory. Indeed, the tongue of the bee is an organ so considerably developed, as to afford very strong evidence of its power of discrimination in the selection of food. Cuvier considers it to be one of the primary functions of its organization.

There is tolerably good presumptive evidence that bees have a quick sense of HEARING, from their being so sensibly affected by different sounds. Their joyful them on recovering a lost queen, as well as on other oc-

casions, and also the voice of the queen when piping, would lead us to infer their possession of this sense. Huber was of opinion that if bees do possess the sense of hearing, it is differently modified from the same sense among beings of a higher order, and for reasons which he does not well define, he designates it as a sense analogous to hearing; a something acting in concert with, and in aid of the antennæ. The consequences which ensue upon the production of certain sounds, either by themselves or others, show that the vibrations of the air make an impression upon some sense. They are evidently capable of being acted upon by the human voice. I know an old dame, a very fearless operator, who on an exhibition of displeasure on the part of her bees, suppresses it at once, by suddenly saying, "Ah! would you dare!" One of Mr. Knight's servants also, under similar circumstances, quells their anger by exclaiming, "Get along, you little fools!" The words of course must be unimportant; it is no doubt the loudness and energy with which they are pronounced that operates upon the bees. Aristotle was doubtful whether insects possessed this sense, "Quanquam incertum est an audiant." Linnæus and Bonnet were of opinion that they did not; but for the reasons already stated, I think these naturalists were mistaken. There are other evidences, equally strong, to show that some insects possess this faculty. One grasshopper will chirp in response to another, and the female be attracted by the voice of the male. Brunelli shut up a male in a box, and allowed the female her liberty: as soon as the male chirped she flew to him immediately. A bee on the window within a bee-house will make a responsive buz to its fellow-

citizens on the outside. For further evidence of the existence of this faculty in insects, see Chap. 29. (Organs of Sensation.)

The EYE-SIGHT of bees, notwithstanding the wonderful mechanism of their eyes, seems less perfect than their other senses: on some occasions it scarcely serves them to distinguish the entrance of their hives, when they come home loaded with provision. Butler and Wildman say that they have observed them go up and down, seeking the door of the hive, as if they were in the dark, and I have frequently seen them after alighting, rise again, in order to find the entrance. Wildman thought they saw better when flying than when on foot. I believe, however, that this opinion of Wildman will not, upon examination, be found quite correct. The mere act of flying does not enable them to see objects better; but when on the wing, they are at a greater distance from these objects, the eyes of these insects being so constructed as to enable them to see best at a moderate distance. Therefore, as Dr. Evans has justly remarked, "the poet's disdainful allusion to a

> Fly whose feeble ray scarce spreads
> An inch around,

should here be exactly reversed."

Dr. Derham, in his Physico-theology, has observed, when speaking of the eye of the bee and other insects, that "the cornea and optic nerves, being always at one and the same distance, are fitted only to see distantial objects, but not such as are very nigh." This visual orb, this seemingly simple speck, though really complicated piece of mechanism, says Derham, "will be found, upon examination, to form a curious

lattice-work of several thousand hexagonal lenses, each having a separate optic nerve ministering to it, and therefore to be considered as a distinct eye*. M. Leewenhoeck, having properly prepared and placed an eye of this kind betwixt his microscope and a church steeple (299 feet high, and 750 distant), saw plainly the steeple inverted, through every different lens, though each lens was not larger than a needle's point. Yet, doubtless the insect perceives but a single object, and that in an upright position. The hemispheric arrangement of these lenses enables the bee to see accurately in every direction, and without any interval of time or trouble."

> "Not huge Behemoth, not the whale's vast form
> That spouts a torrent, and that breathes a storm,
> Transcends in organs apt this puny fly.
> Her fine-strung feelers, and her glanceful eye,
> Set with ten thousand lenses."—EVANS.

The eyes of all insects are immoveable, and have neither iris, nor pupil, nor eyelids to cover them: but these apparent defects are amply made up to them in a variety of ways; in the case before us, by the complex structure of the organs, (thus giving a separate eye for each separate object of vision,) and by the hardness of their coats, which cover and secure them from injury.

Reaumur performed an experiment similar to that which I have just related of Leewenhoeck, and with a like result. Hooke computed the lenses in the eye of a horse-fly to amount to nearly 7000. Leewenhoeck found more than 12,000 in that of a dragon-fly; and 17,325 have been counted in the eye of a butterfly.

* The multitude of hexagonal lenses which compose the eye of a bee, make it appear, when viewed through a microscope, exactly like honey-comb.

The lenses are most numerous in the beetle, and so small as not to be easily discoverable under a pocket microscope, except the eye be turned white by long keeping.

The peculiar construction of the bee's eye, for seeing objects best at a moderate distance, will account for the circumstance noticed by Wildman, and also for the following observation of Dr. Evans. "We frequently observe bees flying straight homewards through the trackless air, as if in full view of the hive, then running their heads against it, and seeming to *feel* their way to the door with their antennæ, as if totally blind." Sir C. S. Mackenzie remarked the imperfect vision of bees, and how very much puzzled they are to find the entrances to their hives, if the relative position of those entrances be altered, or the hives be removed two or three yards from the place where they have usually stood. In cases of removal, the bees do not during the first day fly to a distance, nor till they have visited and recognised neighbouring objects. Mr. Rogers, in his "Pleasures of Memory," has noticed this defective vision in the bee. Having spoken of her excursive flights to a distance, and referred to her bending her course homewards again, he observes,

> "That eye so finely wrought
> Beyond the search of sense, the soar of thought,
> Now vainly asks the scenes she left behind;
> Its orb so full, its vision so confined!"

And he concludes that it is by the aid of memory that she retraces her passage back to the hive, by recognising the scents of the various flowers which she has passed or visited on her outward journey,—

> "The varied scents that charm'd her as she flew."

But this idea is more poetical than accurate, for every observer of the proceedings of bees, must have noticed, that on their return home from considerable distances, their course is as direct as the flight of an arrow, and almost as rapid.

With respect to the actual rapidity of the bee's flight, Feburier calculates it to be at the rate of above 12 miles an hour, but this must be considerably below the mark. Coach-passengers must often have observed that bees, in their progress through the air, made more than twice the speed at which they themselves were travelling, when going at the rate of ten miles an hour. Mr. Dunbar is of opinion that they more than treble Feburier's rate; at present, however, it is a moot point, and I must leave its decision to the observation of some future rail-road traveller.

In consequence of this peculiarity of insect vision, many of those bees that return homewards, after dusk in the evening, are obliged to lie abroad all night. The same peculiarity, added to the acuteness of their smell, has given birth to various contrivances for inducing bees of different hives to mingle peaceably together, as mentioned at page 190.

From the experiments of Swammerdam, Reaumur, Hooke and others, it seems that bees and other insects, particularly those of the hymenopterous order, possess organs of vision, besides those which are properly called their eyes. These organs, known by the name of STEMMATA, are three smooth lucid hemispherical dots, placed in a triangular position upon the vertex or top of the head, and having a silvery lustre, as if intended to reflect the light which falls upon them. The two reticular eyes of one of these insects having been covered

with fluid pitch, (the stemmata being left open,) when placed under a glass, the insect ran up and down, but without striking against the sides of the glass. In a similar experiment upon a dragon-fly (*Libellula*), the insect flew away, but in its flight struck against walls and other objects, seeming able merely to distinguish the presence or absence of light. The stemmata in another insect being covered, and the reticular eyes left open, seemed to cause no impediment to its usual proceedings; it appeared to see as well as before. But when both the stemmata and the eyes were covered, the insect seemed to be totally deprived of sight; it walked slowly under the glass, and when allowed its liberty, made no attempt whatever to fly. These experiments being tried upon bees by Reaumur, they remained immoveable, appearing uncertain where to direct their flight: when the compound eyes only were covered, they ascended vertically in the air as far as the eye could trace them, seeming to follow that direction which the aid of the stemmata enabled them to take. These stemmata may, from their situation, assist the insect in performing its various operations in the interior of the hive; may, as Reaumur has observed, answer to them the purpose of microscopes.

I cannot conclude this chapter on the Senses of Bees without noticing the theory of that eminent physiologist Dr. Virey. He has given it as his opinion, that there are seven senses, which he thus divides. Four physical, namely, Touch, Taste, Smell, and Love; three intellectual, namely, Hearing, Sight, and Thought. (*N. Dict. d'Hist. Nat.*) Whether Love and Thought should be added to my enumeration of the senses of bees I shall not now inquire: if they may be, this work will supply

abundant evidence of both, if we comprehend the whole community of bees; for though physical love appears not to constitute any part of the pleasure of the working bee, (except from some accidental cause, which has been already explained,) there is presumptive proof of its possessing thought or intellect; and although it may not be easy to adduce testimony in favour of the queen's or the drone's possessing thought, they both satisfactorily evince a susceptibility of physical love.

CHAPTER XXXI.

INSTINCTS OF BEES.

All creatures, of whatever size, that live together in large communities, have long been observed to display more knowledge and ingenuity than those that do not congregate: this superiority is also supposed to distinguish those which possess the most exquisite sense of touch, and whose occupations require a continued exertion of their powers. The insect tribe strongly confirm the truth of these remarks.

Solitary insects may exhibit a single trait of superiority, either in the catching of their prey, as the spider does; or in the securing of a well-protected habitation, as is instanced by the carpenter bee, the mason bee, and some other lone and non-associating insects; but the history of those which unite in societies unfolds more of insect energy and talent. In large communities a combination of exertions is requisite, to procure supplies for the general weal; an intercourse of mutual intelligence is kept up; labour is regularly divided; the sphere of action is extended; and in cases of emergency, there is an unusual manifestation of insect power and intelligence. Instances of all these faculties are eminently conspicuous in the honey-bee;—some of them I have before noticed, and shall now advert to a few more.

The mental powers of bees, if I may be allowed to use the term, have been included by some writers under

the general name of Instinct; others, considering the whole of their proceedings to be fraught with intelligence, have regarded them as evidences of a reasoning power. *All* the phænomena of insect life cannot, I presume, be explained without giving them credit for both.

> "Deem not, vain mortal, that reserved for thee
> Hangs all the ripening fruit on reason's tree;
> Ev'n these, the tiniest tenants of thy care,
> Claim of that reason their apportion'd share:
> Witness yon slaughter'd snail, within their door,
> Tomb'd like the first bold Greek on Ilion's shore."
>
> EVANS.

Huber, speaking of the humble-bee, has observed that its instinct is still more *refined* than that of the honey-bee. As an instance of this, he states that the former, when unable to penetrate a flower through its natural cavity, makes an aperture at the base of the corolla, or even of the calyx, and insinuates its proboscis into the reservoir of honey, through the opening it has made. This proceeding, instead of being a refinement of instinct, may, I think, be regarded as affording evidence of a reasoning faculty; for after experiencing its inability to reach the bottom of the long flower-tube by the ordinary channel, that preliminary step is abandoned, and all the insect's future abstractions of honey from it are accomplished through an artificial opening.

A snail having crept into one of M. Reaumur's hives early in the morning, after crawling about for some time, adhered by means of its own slime to one of the glass panes, where, but for the bees, it would probably have remained, till either a moist air or its own spume had loosened the adhesion. The bees having discovered

the snail, immediately surrounded it, and formed a border of propolis round the verge of its shell, which was, at last, so securely fixed to the glass, as to become immoveable, either by the moisture of the air from without, or by the snail's secretion from within,

"Nor aught avails that in his torpid veins,
Year after year, life's loitering spark remains*;
For ever closed the impenetrable door,
He sinks on death's cold arm to rise no more."
EVANS.

The same occurrence was once witnessed in Mr. Golding's apiary.

Maraldi has related a somewhat similar instance. He states that a houseless snail or slug, as it is called, had entered one of his hives; and that the bees, as soon as they observed it, pierced it with their stings, till it expired beneath their repeated strokes; after which, being unable to dislodge it, they covered it all over with an impervious coat of propolis.

"For, soon in fearless ire, their wonder lost,
Spring fiercely from the comb th' indignant host,
Lay the pierced monster breathless on the ground,
And clap, in joy, their victor pinions round.
While all in vain concurrent numbers strive,
To heave the slime-girt giant from the hive,—
Sure not alone by force instinctive sway'd,
But blest with reason's soul-directing aid,
Alike in man or bee, they haste to pour,
Thick hardening as it falls, the flaky shower;
Embalm'd in shroud of glue the mummy lies,
No worms invade, no foul miasmas rise." EVANS.

* In the Annual Register for 1775 some very extraordinary instances are related of the protraction of life in snails. After they had lain in a cabinet above fifteen years, immersing them in water caused them to revive and crawl out of their shells.

In these cases who can withhold his admiration of the ingenuity and judgment of the bees? *In the first case*, a troublesome creature gained admission into the hive, which, from its unwieldiness, they could not remove, and which, from the impenetrability of its shell, they could not destroy: here then their only resource was to deprive it of locomotion, and to obviate putrefaction; both which objects they accomplished most skilfully and securely,—and, as is usual with these sagacious creatures, at the least possible expense of labour and materials. They applied their cement, where alone it was required, namely, round the verge of the shell. *In the latter case*, to obviate the evil of putrescence, by the total exclusion of air, they were obliged to be more lavish in the use of their embalming material, and to form with it so complete an incrustation or case over the "slime-girt giant," as to guard them from the consequences, which the atmosphere invariably produces, upon all animal substances that are exposed to its action, after life has become extinct. May it not be asked, What means more effectual could human wisdom have devised, under similar circumstances? Indeed, many of the proceedings of bees and other associated insects seem traceable to a reasoning power; for they exhibit an adaptation of means to ends, and vary them to suit particular emergencies;—the judicious performance of actions with a view to some proposed end, is the criterion by which we judge of rationality.

On the other hand, the difficulty of ascribing *some* of their actions to any other principle than that which is known by the name of *Instinct*, has led to a classification of *the whole* of their proceedings under *that* head.

INSTINCT is a faculty the exercise of which implies

an exquisitely fine mechanism of some of the senses. It appears to operate independently of all anticipation of consequences; the avenues to knowledge seem to be less circuitous in other animals than in man; neither experience nor inductive reasoning are so essential to the perfection of their operations, and they have been thought to possess, what many an indolent human being has wished to find,—a royal road to knowledge.

"If in the Insect, Reason's twilight ray
Sheds on the darkling mind a doubtful day,
Plain is the steady light her *Instincts* yield,
To point the road o'er life's unvaried field;
If few those Instincts, to the destined goal,
With surer course, their straiten'd currents roll."

EVANS.

One writer, and that a very ingenious one, has endeavoured to resolve *all* instincts into reason, and has boldly hazarded the following conjecture. "If we were better acquainted with the histories of those insects that are formed into societies,—as the bees, wasps and ants, —we should find that their arts and improvements are not so similar and uniform as they now appear to us, but that they arose in the same manner (from experience and tradition) as the arts of our own species; though their reasoning is from few ideas, is busied about fewer objects, and is exerted with less energy *."

Since the Doctor wrote this passage, much light has been thrown upon those very subjects on which he laments our defective knowledge: but whilst it strengthens what I have said as to the possession of reason by insects, it confirms my observations respecting their instinctive powers.

* Darwin.

The erroneousness of the Doctor's opinion, and the predominance of instinct are seen in the movements made by the lower animals, during their infancy, of those parts designed to be employed offensively by them at maturity. The pupa of a wasp, for instance, if released from its nymphine covering, will eject its sting, upon being touched, after the manner of a full-fledged wasp. Parallel instances are mentioned by Mr. White, in his "Natural History of Selborne," respecting young vipers; and chickens, very soon after they emerge from the shell, can distinguish between a fly and a wasp; for whilst they seize the former with little twitterings of complacency, the latter is rejected with notes expressive of disapprobation. A still more striking instance of this early exhibition of an instinctive faculty occurred to Sir James Hall. While raising chickens by artificial heat, he saw one of them pounce upon a spider which was passing near to it, at the very moment it was extricating itself from its shell.

There are facts recorded, in Huber's *researches respecting ants*, which exhibit in some at least of those insects, *(the Amazons,)* a power of acquiring habits and characters which cannot well be regarded as merely instinctive. The Amazons take advantage of an improvement in their condition, and avail themselves of that strength, which sometimes accrues to them, in consequence of a large accession to their numbers. To relieve themselves from labour, they enslave, by a *coup de main*, a feeble colony of ants of another species, and transporting it to their own domicile, impose upon the captives the task of collecting provision, rearing the young, repairing the formicary, &c. &c. The Amazons become a complete aristocracy, and like ladies and gen-

tlemen, have servants to wait upon them, which latter are called emphatically by Naturalists, the HELOTS of the community.

I shall not attempt to determine the point where Intellect begins to dawn, nor to assign the boundary where instinct assumes the characteristics of reason. For it is nowhere more difficult to discriminate between the regular operation of implanted motives, and the result of acquired knowledge and habits, than in studying the phænomena presented by the bee. For the present therefore I must be allowed to regard the provinces of reason and instinct as undefinable; indeed it seems highly probable that our limited faculties may never enable us to acquire a knowledge of them. Still the facts which I have related, and those which I shall proceed to detail, afford such apparently strong evidences of a reasoning faculty, that without introducing that faculty as their source, it would be impossible to explain the phænomena of insect life or of animal life in general. Dr. Darwin, in his *Zoonomia*, relates an anecdote of apparent ratiocination in a *wasp*, which had caught a fly nearly as large as itself. Kneeling down, the Doctor saw the wasp dissever the head and tail from the trunk of the fly, and attempt to soar with the latter; but finding when about two feet from the ground that the wings of the fly carried too much sail, and caused its prize and itself to be whirled about, by a little breeze that had arisen, it dropped upon the ground with its prey, and deliberately sawed off with its mandibles, first one wing and then the other: having thus removed these impediments to its progress, the wasp flew away with its booty, and experienced no further molestation from the wind.

Some of the proceedings of bees in glass hives cannot

be referred to their instinctive faculties,—glass being a substance which would never be presented to them in their natural state. "Having frequently observed," says Dr. Evans, "on the inside of my glass hives, prior to the formation of cells, a number of gluey spots ranged at regular distances, I supposed them at first to be intended as a kind of land-marks, pointing out the divisions of the future streets, &c. On re-examination, however, I found them evidently used as so many foot-stools on the slippery glass, each bee resting on one of these with its middle pair of legs, while the fore-claws were hooked with the hind ones of the next above; thus forming a *living* ladder, by which the workers were enabled to reach the top, and pursue their favourite plan of commencing their combs there."

A very striking illustration of the reasoning power of bees occurred to my friend the late Mr. Walond. Inspecting his bee-boxes at the end of October 1817, he perceived that a centre comb, burthened with honey, had separated from its attachments, and was leaning against another comb, so as to prevent the passage of the bees between them. This accident excited great activity in the colony, but its nature could not be ascertained at the time. At the end of a week, the weather being cold and the bees clustered together, Mr. W. observed, through the window of the box, that they had constructed two horizontal pillars betwixt the combs alluded to, and had removed so much of the honey and wax from the top of each as to allow the passage of a bee: in about ten days more there was an uninterrupted thoroughfare; the detached comb at its upper part had been secured, by a strong barrier, and fastened to the window with the spare wax. This being accomplished,

the bees removed the horizontal pillars first constructed, as being of no further use "During this laborious process," says Mr. W., "the glass window in the box was as warm as I had felt it during any part of the summer, and the bees were as active within the box," thus affording presumptive evidence in support of the opinion advanced at page 125.

M. P. Huber of Lausanne, in his *Observations on Humble-bees*, published in the sixth volume of the Linnæan Transactions, has given a curious detail of some experiments in which the bees conducted themselves somewhat similarly to those of Mr. Walond. Having inclosed twelve humble-bees in a bell-glass upon a table, he gave them a part of their cones or chrysalids, containing about ten silken cocoons, and freeing the latter as much as possible from wax, he fed the bees for some days with pollen only. The cells containing the cones being very unequal, the mass was so unsteady as extremely to disquiet the bees. Their affection for their young led them to mount upon the cocoons, to impart warmth to the inclosed larvæ: they could not do this without causing the comb to totter or lean on one side, and having no wax for fastening the work to the table, they had recourse to the following ingenious expedient. Two or three bees got upon the comb, and descending to the lower edge of it, with their heads downwards, hung from it by the hooks of their hind feet, and clung to the table by those of the second pair, which are very long; thus did they keep this piece of cell-work steady by their own muscular strength. When fatigued by this constrained and irksome position, they were relieved by their comrades; even the queen assisted. Having kept the bees in this state till nearly the end of

the third day, and shown them to several persons, Huber introduced some honey, to enable them to form wax: they soon constructed pillars, extending from the most projecting parts of the cell-work to the table, and thus kept it in a firm position. The wax, however, getting gradually dry, the pillars gave way; when the poor insects adopted their former straining expedient for steadying the comb, and continued, perseveringly, to sustain it in this manner, till Huber took pity on them and glued the cake of comb firmly to the table. "Could the most intelligent architect have more judiciously propped a tottering edifice, till adequate supports could be applied?

"The resources of bees, when attacked by the *Sphinx Atropos*, or *Death's head hawk-moth*, are much in point. In this case, according to Huber, they construct small archways and various other ingenious barricadoes, with a mixture of wax and propolis, so as just to allow the egress and ingress of one or two workers, and effectually to exclude their marauding enemy. The bees do not, as if guided by mere instinct, commence their fortifications on the first attack of the Sphinx, nor until they have been robbed of nearly their whole stock of honey. This is a case in which the insect is taught by experience, and which admits in all its particulars of a direct comparison with human reason and human contrivance. Moreover, on the cessation of danger, and when honey-flowers were abundant, the colony prosperous and swarms prepared to issue, these sagacious engineers demolished the fortifications, in order that their proceedings might no longer be impeded by an obstructed portal. A colony that had been thus attacked in 1804, and was tardy in its defensive operations, having, as Huber conceived,

derived instruction from the past, constructed fresh ramparts speedily, on the reappearance of the Sphinx in 1807, and thus guarded itself from impending danger.

This statement of Huber has received confirmation from a somewhat similar proceeding in the apiary of Mr. Golding. On examining a family of bees, in August 1837, he found the entrance, which was originally of the usual dimensions, very much contracted and exhibiting the following appearance:



In this state I saw it, when visiting Mr. Golding in the spring of the present year. The materials of the curtain above shown, appeared to be a compound of wax and propolis, about the 16th of an inch in thickness, and it was appended to the inner edge of the hive entrance. What danger it was meant to guard against is unknown, as the year 1837 did not abound with wasps, the chief enemy of bees in this country. It affords decisive evidence, however, that bees do occasionally contract their portals to meet particular emergencies.

From what has been said in page 350, it seems probable that the lives of the working bees do not extend beyond six or seven months; and if the facts and the reasoning there advanced be considered as decisive, it will appear evident that the information of the colony of 1807, above referred to, must have been traditional, or else derived from a queen which had reigned over them from 1804. On the subject of traditional information, see Memory of Bees. It is further remarkable,

as a confirmation of this process of ratiocination and reflection, that if the apiarian apply proper guards before the entrances to the hives, when the Sphinx makes its appearance, the bees, finding that they are anticipated, devise no measures of security.

I shall adduce another instance in support of my position that insects are endowed with reason, and that they mutually communicate and receive information. "A German artist of strict veracity, states, that in his journey through Italy, he was an eye-witness to the following occurrence. He observed a species of *Scarabæus* busily engaged in making, for the reception of its egg, a pellet of dung, which, when finished, the insect rolled to the summit of a hillock, and repeatedly suffered it to tumble down the slope, apparently for the purpose of consolidating the pellet by the adhesion of earth to it in its rotating motion. During this process, the pellet unluckily fell into a hole, out of which the beetle was unable to extricate it. After several ineffectual attempts, the insect went to an adjoining heap of dung, and soon returned with three companions. All four applied their united strength to the pellet, and at length succeeded in pushing it out, when the three assistant beetles left the spot, and returned to their own quarters*."

Mr. Hunter speaks rather sarcastically upon the subject of reason being one of the attributes of insects. "Reason," says he, "has been ascribed to bees; they have been supposed to be legislators, and even mathematicians; and though there is some show of reason for these suppositions, there is much more of imagination." To show how far the excursive fancy of apiarians had sometimes carried them, Mr. H. selected a very unfor-

* Kirby and Spence, vol. ii. p. 519. 5th edition.

tunate instance, namely, the assertion, as he calls it, that workers' eggs may be converted into queens,—a fact which has since been established, by a series of the most satisfactory experiments. Dr. Virey, in his *Nouvelle Dictionnaire d'Histoire Naturelle*, denies that insects possess any portion of intellect, and attributes all their operations to mere instinct, which he considers as the result of pure mechanism, depending upon the construction of their nervous systems, in the same manner as the tune, played upon a barrel organ, is dependent on the notes which the cylinder successively presents to its keys. Des Cartes, and others before him held a similar opinion, considering insects as being simply susceptible of external impressions, and through the medium of that susceptibility stimulated to act. Buffon also attempted to explain the phænomena of insect life by the simple laws of mechanism, conceding to the insects at the same time a power of distinguishing and choosing between pleasure and pain. Some have even ventured to assert that the general exactness of the cell-work of bees is a proof of their stupidity, and that "the wonders of the honey'd reign," no more bespeak the agency of mind or intellect, than the configuration of salts into their respective crystals.

> "Shall then proud sophists arrogant and vain,
> Spurn all the wonders of the honey'd reign,
> And bid alike one mindless influence own
> The social bee, and crystallizing stone?
> Each link they trace in animation's round,
> Dashes their poison'd chalice to the ground."—EVANS.

If this theory respecting insects were just, it should elucidate all the phænomena which it undertakes to explain, otherwise it is injurious to science. Examination

will prove it to be a mere hypothetical opinion, ingenious, and at first sight plausible, but completely unsatisfactory. This theory is the natural consequence of denying to insects any portion of intellect, and its erroneousness is shown by their capability of instruction.

Sir Joseph Banks's *spider*, that, on being crippled, changed from a sedentary web-weaver to a hunter *, is a case in point, as is also the well-known fact that birds build their nests differently, where climate and other circumstances require a variation. A *dog* may be restrained from obeying its instincts, by the intimidating recollection of a beating which it had formerly received: in this case the intellect of the creature *counteracts its instincts*.

M. Reimar has denied that the lower animals possess *memory*, properly so called; and has given it as his opinion, that they are only influenced by past events, in consequence of having present objects before them,—never by reflection or knowledge of the past, as being past; but that, with them, a former impression may be renewed, without being recollected; that it is thus rendered present to the imagination, but has no place in the memory. For arguments and instances in support of their being endowed with memory, see Chap. 29. (Organs of Sensation.)

The possession of the organs of sense implies the possession of some portion of intellect, for without intellect those organs would seem incapable of being employed

* The account of this spider was sent to Dr. Leach by Sir Joseph Banks. An interesting history of it is given in the Linnæan Transactions, vol. ii. p. 393. It had lost five of its legs, which were afterwards reproduced, but the new legs were shorter than those for which they were substituted.

to the greatest advantage. "There is this difference," says Mr. Spence, "between intellect in man, and the rest of the animal creation. Their intellect teaches them to follow the lead of their senses, and to make such use of the external world as their appetites or instincts incline them to,—and *this is their wisdom:* while the intellect of man, being associated with an immortal principle, and connected with a world above that which his senses reveal to him, can, by aid derived from Heaven, control those senses, and render them obedient to the governing power of his nature; and *this is his wisdom.*" A distinction has been made, and very properly, between wisdom and knowledge. The former alone can be possessed by the lower animals, man can possess both. The distinction between them has been very accurately marked by Cowper, though in making it he has confined himself to man only.

> "Knowledge and wisdom, far from being one,
> Have oftimes no connection. Knowledge dwells
> In heads replete with thoughts of other men,
> Wisdom in minds attentive to their own."

It will, I think, be evident to my readers, from the general tenour of this chapter, that though I make a distinction between the instinct and the reason of bees, I do not confound their reason with the reason of man. But to obviate all possibility of misconception, I will at once define my meaning, when I use the terms insect reason and instinct.

By *reason*, I mean the power of making deductions from previous experience or observation, and thereby of adapting means to ends. *Instinct* I regard as a disposition and power to perform certain actions in the same uniform manner, depending upon nice mechanism and having no reference either to observation or expe-

rience; operating on the means, without anticipation of the end, incited by no hope, controlled by no foreboding. Those who have attended to this subject, will be aware that *insect reason*, as above defined, is more restricted in its functions than *the reason of man*; to which is superadded the power of distinguishing between the true and the false, and, according to some metaphysicians, between right and wrong. Reason, in man, has a regular growth and a slow progression; all the arts he practises evince skill and dexterity, proportioned to the pains which have been taken in acquiring them. In the lower links of creation, but little of this gradual improvement is observable; their powers carry them almost directly to their object: They are perfect, as Bacon says, in all their members and organs from the very beginning.

"Far different Man, to higher fates assign'd,
Unfolds with tardier step his Proteus mind,
With numerous Instincts fraught, that lose their force
Like shallow streams, divided in their course;
Long weak, and helpless, on the fostering breast,
In fond dependence leans the infant guest,
Till reason ripens what young impulse taught,
And builds, on sense, the lofty pile of thought;
From earth, sea, air, the quick perceptions rise,
And swell the mental fabric to the skies."—Evans.

"Both Instinct and Reason," says Dr. Evans, "appear to lose their intensity, in proportion as their rays diverge from their proper focus; and as they are less frequently aroused to action. A domesticated fowl is furnished with the same apparatus as her wild sisters on the waste, for rendering her feathers impenetrable to water; yet, living principally under cover, she secretes much less of the oily fluid, destined for that purpose, and makes, when accidentally wet, a most ridiculous appearance. The force of instinctive propensities, when

directed to one object, and uninfluenced by reason, is strongly exemplified in *the idiot bee-eater of Selborne*, mentioned by Mr. White, in his *History of Selborne*. The collected powers of reason, when concentred in a single focus, is no less finely instanced in the immortal Newton."

To those readers who have not seen Mr. White's account of the bee-eater, the following abstract of it may prove acceptable.

The boy was a resident in Selborne, about the year 1750. He took great notice of bees from his childhood, and at length used to eat them. In summer, his few faculties were devoted to the pursuit of them, through fields and gardens. During winter, his father's chimney corner was his favourite haunt, where he dozed away his time, in an almost torpid state. Practice made him so expert, that he could seize honey-bees, humble-bees, or wasps with his naked hands, disarm them of their stings, and suck their honey-bags, with perfect impunity. Sometimes he would store the bees in bottles, and even in his shirt bosom. He was the terror of the surrounding bee-keepers, whose gardens he would enter by stealth, and rapping on the outsides of their hives, catch the bees as they came out to see what was the matter. If in this way he could not obtain a sufficient number to supply his wants, so passionately fond was he of honey, that he would sometimes overturn the hives to get at it. He was accustomed to hover about the tubs of the mead-makers, to beg a draught of bee-wine, as he called it. As he ran about the fields he made a humming noise with his lips, resembling that of bees. The lad was lean in his person, and of a cadaverous, unhealthy aspect: he died before he reached the age of maturity.

CHAPTER XXXII.

ON THE ARCHITECTURE OF BEES.

"Quel abîme aux yeux du sage qu'une ruche d'abeilles! Quel sagesse profonde se cache dans cet abîme! Quel philosophe osera le sonder!"—BONNET.

THE combs of a bee-hive comprise a congeries of hexagonal cells, formed by the bees, as receptacles for honey or for embryo bees. A honey-comb is allowed to be one of the most striking achievements of insect industry, and an admirable specimen of insect architecture. It has attracted the admiration of the contemplative philosopher in all ages, and awakened speculation not only in the naturalist, but also in the mathematician: so regular, so perfect, is the structure of the cells, that it satisfies every condition of a refined problem in geometry. Still a review of their proceedings will lead to the conclusion, as Huber has observed, that "the geometrical relations, which apparently embellish the productions of bees, are rather the necessary result of their mode of proceeding, than the principle by which their labour is guided." We must therefore conclude, that the bees, although they act geometrically, understand neither the rules nor the principles of the arts which they practise so skilfully, and that the geometry is not in the bee, but in the great Geometrician who made the bee, and made all things in number, weight and measure*. The hexagonal form of the cells in a honey-

* Reid.

comb has been regarded, and is indeed now generally acknowledged, by philosophers, to be the result of the mechanical laws which influence the pressure of cylinders composed of soft materials. The nests of solitary bees, and the *royal* cells in a bee-hive, are uniformly circular; and the cells in the pith of wood, which are hexagonal in the central parts, are circular towards the circumference, where there is diminished pressure: hence it is inferred that the hexagonal form is produced by the general reaction of the solid parts on each other.

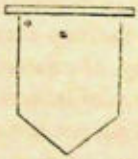
Before the time of Huber, no naturalist had seen the commencement of the comb, nor traced the several steps of its progress. After many attempts, he at length succeeded in attaining the desired object, by preventing the bees from forming their usual impenetrable curtain, by suspending themselves from the top of the hive; in short, he obliged them to build upwards, and was thereby enabled, by means of a glass window, to watch every variation and progressive step in the construction of comb.

Each comb in a hive is composed of two ranges of cells backed against each other: these cells, looking at them as a whole, may be said to *have one common base*, though no one cell is opposed directly to another. This base or partition between the double row of cells is so disposed as to form a pyramidal cavity at the bottom of each, as will be explained presently. *The mouths of the cells*, thus ranged on each side of a comb, *open into two parallel streets* (there being a continued series of combs in every well-filled hive). These streets are sufficiently contracted to avoid waste of room and to preserve a proper warmth, yet *wide enough to allow the passage of two bees back to back*. The usual distance of one comb

from another is somewhat more than the third of an inch. Apertures through different parts of the combs are reserved to form near roads, for crossing from street to street, whereby much time is saved to the bees.

> "These in firm phalanx ply their twinkling feet,
> Stretch out the ductile mass, and form the street,
> With many a cross-way path and postern gate,
> That shorten to their range the spreading state."—EVANS.

The bees, as has been already observed, *build their cells of an hexagonal form, having six equal sides*, with the exception of the first or uppermost row, the shape of which is an irregular pentagon, the roof of the hive forming one of the members of the pentagon, thus:



"There are only three possible figures of the cells," says Dr. Reid, "which can make them all equal and similar, without any useless interstices. These are the equilateral triangle, the square and the regular hexagon. It is well known to mathematicians that there is not a fourth way possible, in which a plane may be cut into little spaces that shall be equal, similar, and regular, without leaving any interstices." Of these three geometrical figures, the hexagon most completely unites the prime requisites for insect architecture. The truth of this proposition was perceived by Pappus, an eminent Greek philosopher and mathematician, who lived at Alexandria in the reign of Theodosius the Great, and

its adoption by bees in the construction of honey-comb was noticed by that ancient geometrician. These requisites are;

First, Œconomy of materials. There are no useless partitions in a honey-comb, each of the six lateral panels of one cell forms also one of the panels of an adjoining cell; and of the three rhombs which form the pyramidal base of a cell, each contributes one-third towards the formation of the bases of three opposing cells, the bottom or centre of every cell resting against the point of union of three panels that are at the back of it.

Secondly, Œconomy of room; no interstices being left between adjoining cells.

Thirdly, The greatest possible capacity or internal space, consistent with the two former desiderata.

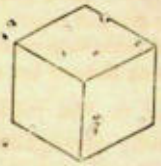
Fourthly, Œconomy of materials and œconomy of room produce œconomy of labour. And in addition to these advantages, the cells are constructed in the strongest manner possible, considering the quantity of materials employed. Both the sides and bases are so exquisitely thin, that it has been calculated that three or four placed on each other are not thicker than a leaf of common writing-paper; each cell, separately weak, is strengthened by its coincidence with other cells, and *the entrance is fortified with an additional ledge, or border of wax*, to prevent its bursting from the struggles of the bee-nymph, or from the ingress and egress of the labourers. This entrance border is *at least three times as thick as the sides of the cell*, and thicker at the angles than elsewhere, which prevents the mouth of the cell from being regularly hexagonal, though the interior is perfectly so.

"On books deep poring, ye pale sons of toil,
Who waste in studious trance the midnight oil,
Say, can ye emulate with all your rules,
Drawn or from Grecian or from Gothic schools,
This artless frame? Instinct her simple guide,
A heaven-taught Insect baffles all your pride.
Not all yon marshal'd orbs, that ride so high,
Proclaim more loud a present Deity,
Than the nice symmetry of these small cells,
Where on each angle genuine science dwells,
And joys to mark, through wide creation's reign,
How close the lessening links of her continued chain." EVANS.

I have just adverted to the ingenuity of the bees in thickening, and thereby strengthening the mouths of the cells. *Additional strength is also supposed to be derived from the bees covering the whole surface of the combs, but more particularly the edges of the cells, with a peculiar kind of varnish,* which they collect for the purpose. At first the combs are delicately white, semi-transparent, and exceedingly fragile, smooth but unpolished: in a short time their surfaces become stronger, and assume more or less of a yellow tint. The deepening of the colour of honey-combs has been supposed, by some, to be the effect of age; and in part it may be: but there are other causes also which do not seem to admit of explanation. The varnish with which they are coated will not account for it, else why do some combs from their commencement assume a darker colour? This, Mr. Golding assures me, is sometimes the case where dark-coloured pieces of comb are used for guide combs, as also when royal cells are attached to old combs; those appended to new ones are always white. This varnish strongly resembles propolis, appearing to differ from it only in containing the colouring material which imparts to wax its yellow hue. The source of this colouring

matter has not been discovered; it is insoluble in alcohol; but the manufacture of white wax shows that it is destructible by light.—But to return to the construction of the cell-work.

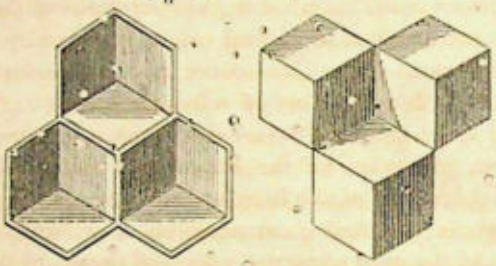
The pyramidal basis of a cell is formed by the junction of three rhomboidal or lozenge-shaped portions of wax; thus,



the apex of the pyramid being situated where the three obtuse angles of the lozenges meet. To the exterior edges and angles are attached the six panels or sides of each cell. The apex of each pyramidal bottom, on one side of a comb, forms the angles of the bases of three cells on the opposite side, the three lozenges respectively concurring in the formation of the bases of the same cells. This will I hope explain what is meant by *each cell, separately weak, being strengthened by coincidence with others.* The bottom of each cell rests upon three partitions of opposite cells, from which it receives a great accession of strength.

As it is desirable that the reader should thoroughly comprehend this subject, I will restate it in other words.—The partition, which separates the two opposing rows of cells, and which occupies, of course, the middle distance between their two surfaces, is not a plane but a collection of rhombs, there being three at the bottom of each cell: the three together form in shape a flattened pyramid, the basis of which is turned towards the mouth

of the cell; each cell is in form therefore an hexagonal prism, terminated by a flattened trihedral pyramid, the three sides of which pyramid are rhombs, that meet at the apex by their obtuse angles. The plates underneath, represent the opposite surfaces of the pyramidal bases of adjoining cells, and will, I trust, enable the reader to understand the foregoing description.



The union of the lozenges in one point, in addition to the support which it is the means of affording to the three partitions between opposing cells, is also admirably adapted to receive the little egg and to concentrate the heat necessary for its incubation.

Each obtuse angle of the lozenges or rhombs forms an angle of about 110°, and each acute one, an angle of about 70°. M. Maraldi found by mensuration that the angles of these rhombs which compose the base of a cell, amounted to 109° 28′ and 70° 32′; and the famous mathematician Koenig, pupil of the celebrated Bernouilli, having been employed for that purpose by M. Reaumur, (who presumed that the angles were adapted for the purpose of saving material), has clearly shown, by the method of infinitesimals, that the quantity of these angles, using the least possible wax, in a cell of the same capacity, should contain 109° 26′ and 70° 34′. This was

confirmed by the celebrated Mr. McLaurin, who very justly observes, that the bees do truly construct their cells of the best figure, and with nearly mathematical precision. What an astonishing coincidence is this! Several profound mathematicians occupy themselves in solving an intricate problem, and after the exercise of considerable ingenuity and deep thought, they find their conclusions made manifest in the operations of the bee!

The construction of several combs is generally going on at the same time. No sooner is the foundation of one laid, with a few rows of cells attached to it, than a second and a third are founded on each side, parallel to the first, and so on, (if the season give encouragement to the operations of the bees,) till the hive is filled with their works; the first constructed comb or combs being always in the most advanced state, and therefore the first to be completed.

We are informed by Huber that *the design of every comb is sketched out, and the first rudiments laid, by one single bee*; that this founder-bee forms a block, out of a rough mass of wax, drawn partly from its own resources, but principally from those of other bees, which furnish materials, in quick succession, from the receptacles under their bellies, taking out the plates of wax with their hind feet, and carrying them to their mouths with their fore feet, where the wax is moistened and masticated, till it becomes soft and ductile.

> Thus, "filter'd through yon flutterer's folded mail,
> Clings the cool'd wax, and hardens to a scale.
> Swift, at the well-known call, the ready train
> (For not a buz boon Nature breathes in vain,)
> Spring to each falling flake, and bear along
> Their glossy burdens to the builder throng."—Evans.

The founder-bees, as Huber calls them, (one of whom

lays, as it were, the first stone of each successive edifice,) place them at such distances from each other as to determine the relative position of the combs, and their degrees of approximation; these foundations serving as guides for the ulterior labours of the other wax-working bees, who sculpture the cells, and give them the advantage of the margin and angles already formed.

The expedients resorted to by that ingenious naturalist, Huber, unfolded the whole process. He was enabled to bring each bee so completely under view that she might be seen to extract with her hind feet one of the plates of wax from under the scales where they were lodged, and carrying it to the mouth, in a vertical position, turn it round; so that every part of its border was made to pass, in succession, under the cutting edge of the jaws: it was thus soon divided into very small fragments; and a frothy liquor was poured upon it from the tongue, so as to form a perfectly plastic mass. This liquor gave the wax a whiteness and opacity which it did not possess originally, and at the same time rendered it tenacious and ductile. These materials, thus blended, having been accumulated in the hollow of the teeth, issued forth like a very narrow ribbon. The tongue, during this process, assumed the most varied shapes and executed the most complicated operations, and after drawing out the whole substance of the ribbon in one direction, drew it forth a second time in an opposite one. The issuing of this masticated mass from the mouth was, no doubt, what misled Reaumur, and caused him to regard wax as nothing more than digested pollen.

The scales of wax thus prepared by the bees, are applied by them to the roof or bottom of the hive, as the

case may be; and thus a block is raised of a semi-lenticular shape, thick at top and tapering towards the edges. When of sufficient size, a cell is sculptured on one side of it, by the wax-working bees, who relieve one another in succession, sometimes to the number of twenty, before the cell is completely fashioned. At the back and on each side of this first cell, two others are sketched out and excavated. By this proceeding the foundations of two cells are laid, the line betwixt them corresponding with the centre of the opposite cell. As the comb extends, the first excavations are rendered deeper and broader; and when a pyramidal base is finished, the bees build up walls from its edges, so as to complete, what may be called, the prismatic part of the cell. Every succeeding row of cells is formed by precisely similar steps, until there is sufficient scope for the simultaneous employment of many workers.

"These, with sharp sickle, or with sharper tooth,
Pare each excrescence, and each angle smooth,
Till now, in finish'd pride, two radiant rows
Of snow-white cells one mutual base disclose.
Six shining panels gird each polish'd round,
The door's fine rim, with waxen fillet bound,
While walls so thin, with sister walls combined,
Weak in themselves, a sure dependence find."

EVANS.

The pyramidal bases and lateral plates are successively formed, with surprising rapidity: the latter are lengthened as the comb proceeds, for the original semi-lenticular form is preserved till towards the last, when if the hive or box be filled, the sides of all the cells receive such additions as give them equal depth.

The cells intended for the drones are considerably larger, and more substantial, than those for the working

lays, as it were, the first stone of each successive edifice,) place them at such distances from each other as to determine the relative position of the combs, and their degrees of approximation; these foundations serving as guides for the ulterior labours of the other wax-working bees, who sculpture the cells, and give them the advantage of the margin and angles already formed.

The expedients resorted to by that ingenious naturalist, Huber, unfolded the whole process. He was enabled to bring each bee so completely under view that she might be seen to extract with her hind feet one of the plates of wax from under the scales where they were lodged, and carrying it to the mouth, in a vertical position, turn it round; so that every part of its border was made to pass, in succession, under the cutting edge of the jaws: it was thus soon divided into very small fragments; and a frothy liquor was poured upon it from the tongue, so as to form a perfectly plastic mass. This liquor gave the wax a whiteness and opacity which it did not possess originally, and at the same time rendered it tenacious and ductile. These materials, thus blended, having been accumulated in the hollow of the teeth, issued forth like a very narrow ribbon. The tongue, during this process, assumed the most varied shapes and executed the most complicated operations, and after drawing out the whole substance of the ribbon in one direction, drew it forth a second time in an opposite one. The issuing of this masticated mass from the mouth was, no doubt, what misled Reaumur, and caused him to regard wax as nothing more than digested pollen.

The scales of wax thus prepared by the bees, are applied by them to the roof or bottom of the hive, as the

case may be; and thus a block is raised of a semi-lenticular shape, thick at top and tapering towards the edges. When of sufficient size, a cell is sculptured on one side of it, by the wax-working bees, who relieve one another in succession, sometimes to the number of twenty, before the cell is completely fashioned. At the back and on each side of this first cell, two others are sketched out and excavated. By this proceeding the foundations of two cells are laid, the line betwixt them corresponding with the centre of the opposite cell. As the comb extends, the first excavations are rendered deeper and broader; and when a pyramidal base is finished, the bees build up walls from its edges, so as to complete, what may be called, the prismatic part of the cell. Every succeeding row of cells is formed by precisely similar steps, until there is sufficient scope for the simultaneous employment of many workers.

> "These, with sharp sickle, or with sharper tooth,
> Pare each excrescence, and each angle smooth,
> Till now, in finish'd pride, two radiant rows
> Of snow-white cells one mutual base disclose.
> Six shining panels gird each polish'd round,
> The door's fine rim, with waxen fillet bound,
> While walls so thin, with sister walls combined,
> Weak in themselves, a sure dependence find."
>
> EVANS.

The pyramidal bases and lateral plates are successively formed, with surprising rapidity: the latter are lengthened as the comb proceeds, for the original semi-lenticular form is preserved till towards the last, when if the hive or box be filled, the sides of all the cells receive such additions as give them equal depth.

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bees, and, being in general later formed, usually appear near the bottom of the combs or portions of combs. Last of all are built the *royal cells*, the cradles of the infant queens: of these there are usually three or four, and sometimes ten or twelve, in a hive, attached to the edges of the comb, particularly to such combs as do not adhere to the sides of the hives. When the number exceeds three or four, the whole are seldom perfected. Mr. Hunter says that he has seen as many as thirteen royal cells in a hive: Swammerdam mentions thirty: the greatest number I ever knew to be fully completed was eighteen; it occurred in the apiary of a cottager in Kent. Such is the genuine loyalty of bees, that the wax which they employ with so much geometric œconomy, in the construction of hexagonal cells, is profusely expended on the mansions of the royal bee-nymph, one of these exceeding in weight a hundred of the former. They are not interwoven with them, but suspended perpendicularly, their sides being nearly parallel to the mouths of the hexagonal cells.

"No more with wary thriftiness imprest,
They grace with lavish pomp their royal guest,
Nor heed the wasted wax, nor rifted cell,
To bid, with fretted round, the imperial palace swell."

EVANS.

The form of these royal cells is an oblong spheroid, tapering gradually downwards, and having the exterior full of small indentations, somewhat resembling the *rustic* work of stone buildings. These cells are in depth about an inch, in diameter about the third of an inch, and smoothly polished within. The mouth of the cell, which is always at its bottom, remains open till the

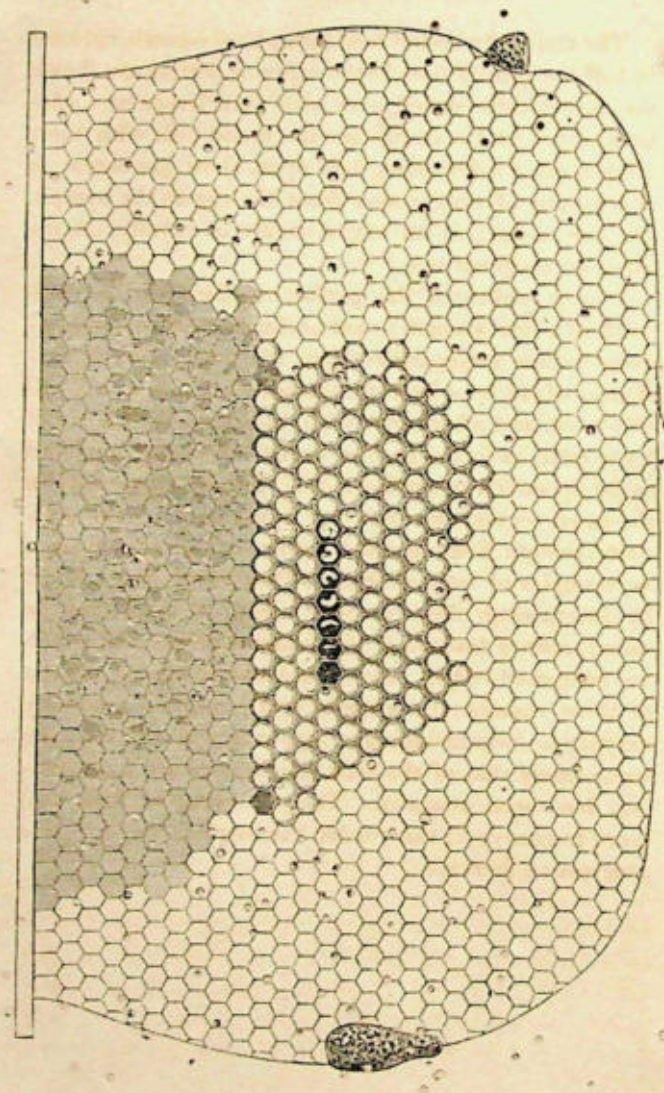
maggot is ready for transformation, and is then closed like the rest, but with a thicker cover.

Soon after the emergence of a ripened queen, the lodge which she inhabited is generally destroyed, and in the case of artificial-cradles, which are always formed on the central parts of the brood combs, its place is often supplied by a range of common cells. Its site in this range may always be traced, by that part of the comb being thicker than the rest, and forming a kind of knot; the upper portions of the natural cells generally remain like inverted acorn-cups, suspended by their short peduncles.

"Yet no fond dupes to slavish zeal resign'd,
They link with industry the loyal mind.
Flown is each vagrant chief? They raze the dome,
That bent oppressive o'er the fetter'd comb,
And on its knotted base fresh garners raise,
Where toil secure her well-earn'd treasure lays."

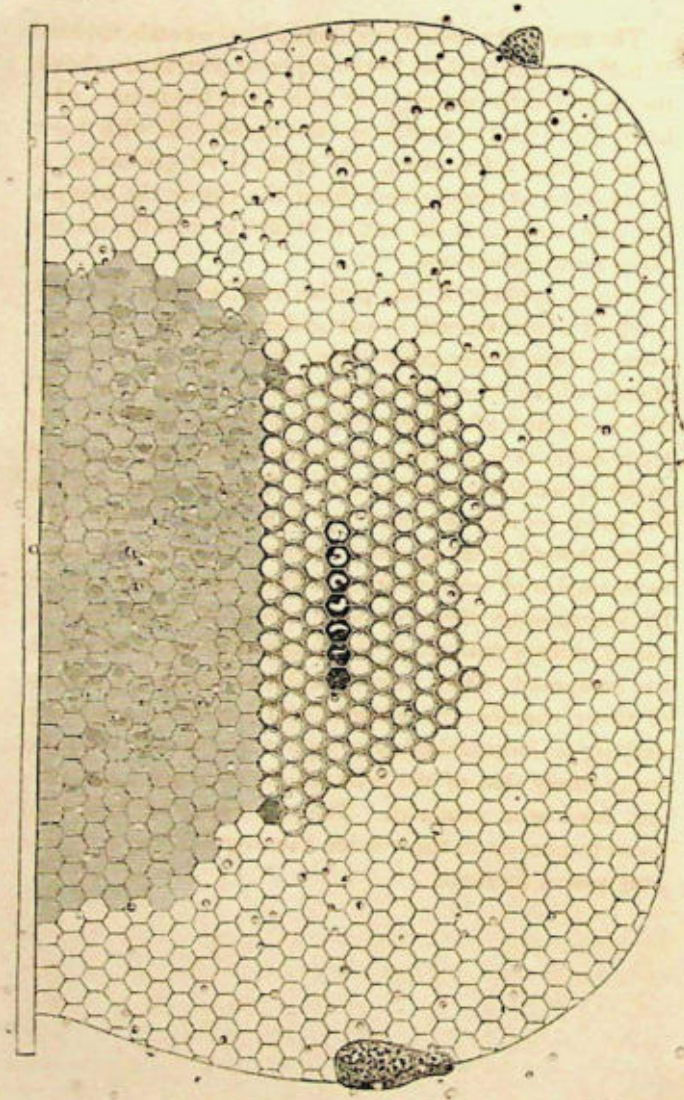
EVANS.

In this mutilated state only, and not in the breeding season, could Mr. Hunter have seen this cradle of royalty; for he describes it as the half of an oval, too wide and shallow to receive its supposed tenant.



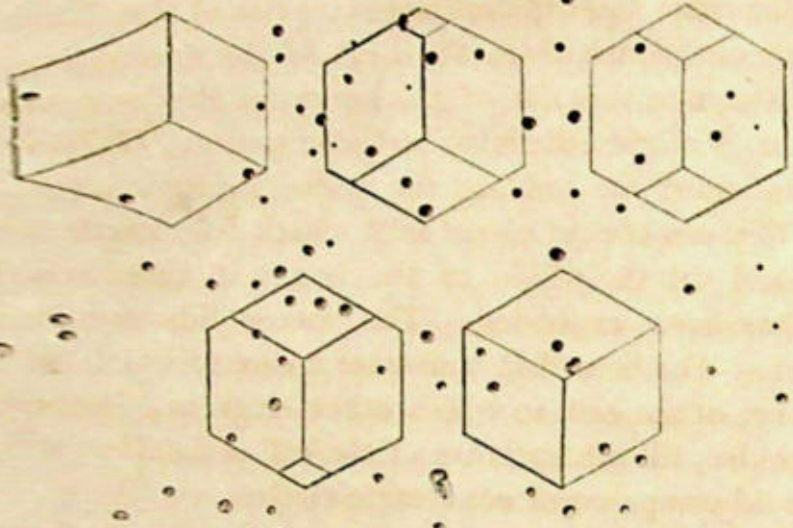
The annexed wood-cut exhibits a honey-comb, reduced to half the natural size. In the superior portion are shown the honey-cells sealed over with their irregular undulating lids: in the centre are the brood-cells with their convex lids: a few being left open, show the larvæ in every state of progression from the egg to the nymph. On one margin is an entire cradle of royalty, on the other an incipient one.

I have spoken of the perfect regularity in the cell-work of a honey-comb;—particular circumstances, however, induce a departure from this exactness; for instance, where bees have commenced a comb with small cell-work, and afterwards wish to attach to it a set of large cells, as in the case of drone-cells being required to be appended to worker-cells. These deviations from the usual regularity renew our admiration of bee ingenuity, though Reaumur and Bonnet have regarded them as examples of imperfection. They effect their object by interposing three or four series of, what may be called, *cells of transition*, the bottoms or bases of which are composed of two rhombs and two hexagons, instead of three rhombs; the rhombs and hexagons gradually varying in form and relative proportion, till the requisite size, namely that of the cells which they are approaching, has been attained. The following outlines will serve to convey to the reader the regular steps in this progressive increase.



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The same gradation is observed when returning to smaller cells. Every apparent regularity is therefore determined by a sufficient motive, and forms no impeachment of the sagacity of the bee.

The common breeding-cells of drones or workers are, frequently, (after being cleaned,) made the depositories of honey; but the cells are never made so clean, as to preserve the honey undeteriorated. The finest honey is stored in new cells, constructed for the purpose of receiving it, their configuration resembling precisely the common breeding-cells: these *honey-cells vary in depth and diameter, their capacity being regulated by the productiveness of the sources from which the bees are collecting, and by the season of the year:* the cells formed rather late in the summer vary in their dimensions from those that are formed earlier; being intended for honey only, they are larger and deeper; still, however, their diameter, with the exception of the cells of transition, is uniformly that of drone or that of worker-cells, but the texture of their walls is thinner, and they have more dip

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The brood-cells, when their tenants have attained a certain age, are also covered with waxen lids, like the honey-cells; the lids differ a little, the latter being somewhat concave, the former convex. *The depth of the brood cells* of drones and working bees is about half an inch; the former being somewhat more, the latter rather less; *their diameter* is more exact, that of the drone-cells being $3\frac{1}{3}$ lines*, that of the workers $2\frac{5}{3}$ lines. These, says Reaumur, are the invariable dimensions of all the cells that ever were, or ever will be made.

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CHAPTER XXXIII.

AN INQUIRY INTO THE SOURCE AND NATURE OF BEES-WAX.

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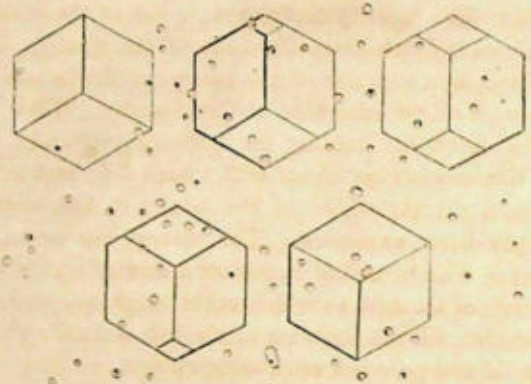
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Fourthly, That fresh colonies carry in very little, if any, of this matter, for some days after swarming, though combs are formed within that period. I noticed this fact in my first colony: the swarm issued from the parent hive on the 18th of May;—five days of rainy weather succeeded: during this period the bees were prevented from flying abroad; I fed them nightly with sugared ale, and before the return of fine weather a considerable quantity of comb was formed. Now excepting such materials as the bees might have brought with them from the parent hive, in this case, the sugared ale alone must have been the source of the wax. Huish has remarked that unless bees have access to water, and also to sugar or honey, no comb can be formed. Again, it may be observed, that upon the storifying plan, when fresh works are commenced in the duplets or triplets, if the farina were the basis of the combs, an increased quantity should be carried in. On the contrary, though I have watched the bees very minutely on these occasions, I scarcely ever witnessed the introduction of farina; and in such rare instances as I did observe it, it might fairly be regarded as food for the young larvæ of the bees contained in the full box or boxes.

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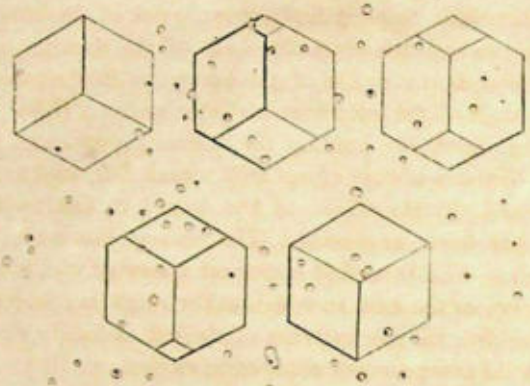
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From meal-tipp'd anthers steal the lacquer'd crown,
And brush from rind or leaf the silvery dow;
Nay, oft, when threaten'd storms or drizzling rain,
Close in their walls, th' impatient hosts detain,

E'en from the yellow board's nectareous rill,
Their tubes secerning ean a stream distil;
Clear and untinctured as the fountain wave,
That glides, slow trickling, thro' the creviced cave.
But, as that weiling wave, around the stone,
In rings concentric, wreathes its sparry zone,
So filter'd thro' yon flutterer's folded mail,
Clings the cool'd WAX, and hardens to a scale."—EVANS.

The observations of Mr. John Hunter tended to confirm this view of the matter; still more so, those of M. Huber and son. In order to determine the point with greater precision, Huber instituted many experiments. On the 24th of May he lodged a recent swarm in a straw hive, leaving at its disposal only a sufficiency of honey and water for its consumption, and preventing it from going beyond the precincts of a room, so closed as to admit only a renewal of the air*. At the end of five days as many cakes of beautifully white, though very fragile wax, were suspended from the roof: the honey had totally disappeared. Still, however, as there was a possibility that the thighs and stomachs of the bees might have conveyed pollen from the parent hive, he withdrew these five combs, and replaced the bees in the hive with a fresh supply of honey and water; they renewed their toil with unabated industry, and soon fabricated new combs: these last were taken from them; when the patient and indefatigable insects commenced a third structure of cells. Five times in succession were their works thus completed and removed, although during the whole of this period they were fed merely with honey and water, and could not possibly have had access to farina.

* To prevent the bees from being impatient, it was found necessary to conduct the experiment in a cool place, as well as to exclude the light.

These experiments, so uniform in their results, give indubitable validity to the fact,—that honey, through the organic intervention of bees, may be converted into wax. A contrary experiment was made, by abundantly supplying a hive with fruit and pollen only: but during eight days' confinement the bees produced no wax whatever, nor exhibited any plates under their abdominal rings; no combs were formed, nor was an atom of farina touched,—a clear proof that farina supplies neither wax nor sustenance to adult bees. The improbability of this indeed is evinced by its abundance in hives whose tenants have died of famine. And as to its being the constituent of wax, Reaumur calculated that a well-stocked hive might collect at least 100 pounds of pollen in a season, whereas the weight of wax fabricated in the same time would not exceed two pounds.

Experiments have proved the excellence of sugar as a substitute for honey, and in some instances its superiority, for the formation of wax. It might otherwise have been supposed that bees might form comb from some particles of wax accidentally present in the honey, and that these afforded the pabulum for this secretion. To prove therefore that the saccharine principle alone enabled the bees to produce wax, being still confined, they were supplied with a syrup made with Canary-sugar and water, and at the same time comparative experiments were made in another hive, where the bees were fed on honey and water. The syrup-fed bees produced wax sooner and more abundantly than the honey-fed bees. Another fact was also incontrovertibly elicited; namely, that in the old hives the honey is warehoused, and that in the new ones it is consumed and transmuted into wax.

The experiments of Huber have been confirmed by those of M. Blondelu, of Noyzu, who addressed a memoir upon this subject to the Society of Agriculture at Paris, in May 1812. Huish has critically examined these experiments of Huber, but without being convinced by them; for having observed pollen on the thighs of bees when swarming, and upon dissection, in their stomachs also, he considers that pollen, elaborated in the second stomach of the bee, "contains in itself the principle of wax." Were this the case what a store of pollen must the bees have reserved, in Huber's experiments, wherein they formed five successive sets of comb, without access to fresh pollen! The pollen or bee-bread, which Huish discovered on the thighs and in the stomach of some of his bees, was most likely imported by such of them as being on the return home at the time their companions were swarming, joined the throng with that freight which was intended for larva-food in the hive. With this pollen (or ambrosia, as it has been called), after conversion into a sort of whitish jelly by the action of the bee's stomach, where it is probably mixed with honey, and then regurgitated, the young brood, immediately upon their exclusion from the ova state and until their change into nymphs, are fed by the nursing-bees several times a day. The opinion that pollen is the prime constituent of wax was held by Buffon, and remains uncontradicted in an edition of his works so late as 1821. Arthur Dobbs, Esq., in the Philosophical Transactions for 1752, instead of considering wax as digested pollen discharged from the stomach of the bee, regards it as being emitted *per anum*; and as he speaks of its discharge in husks or shells, doubtless he saw it in that form, which it is

now known to assume when moulded upon the body of the bee. Indeed he says that he has had swarming bees alight upon his hand, and drop warm wax upon it. Its being secreted only by the under side of the belly might easily deceive, and lead him to regard it as alvine excrement. That minute and accurate observer Butler, though evidently not aware of the secretory process by which wax is generated, noticed that in fresh swarms, the bees came in without any pollen upon their thighs, and therefore supposed the mouth to be the vehicle for conveying it. "When they gather abundance of this stuff," (pollen) "they have never the more wax; when they make most wax, they gather none of this." Butler even remarked that old stocks gather much pollen, and fresh ones little; because the stocks have larva to feed, whilst the swarms have none.

I will here subjoin some more proofs of the non-identity of wax and pollen. So long ago as 1768, the LUSATIAN SOCIETY (called *Société des Abeilles*, founded at little Bautzen, a village in Upper Lusatia, under the auspices of the Elector of Saxony,) knew that wax was not discharged from the mouths of bees, but was secreted in thin scales among their abdominal rings or segments. About 1774, Mr. Thorley caught a bee just entering its hive, and found, among the plaits of its belly, no less than six pieces or scales of solid wax, perfectly white and transparent, and he oftentimes saw wax in the same situation. Mr Duchet, in his *Culture des Abeilles*, quoted by Wildman in 1778, declares that wax is formed of honey; and relates in proof of it, that he has seen a broken comb of an overset hive, which was repaired during bad weather, when the bees could not acquire any other material. This statement of Duchet

corresponds with my own observation, as stated in page 403, but is not so conclusive. In Duchet's instance there might have been other materials in the hive besides honey; whereas in my case the bees had access to no materials whatever, excepting the sugared ale and the honey which they had conveyed from the parent hive, the swarm having been just hived. Butler and Wildman state their having seen pieces of wax, like fish-scales, on the hive floor of fresh swarmed colonies, part of which, at least, they both thought must have been formed upon the body of the bee; for though some flakes might have fallen from the combs then constructing, there were many pieces among them which were concave on one side and convex on the other, as if moulded on the insect's belly. Flakes were likewise seen, hanging loose, between the abdominal scales of the bees. In 1792, Mr. John Hunter, apparently unacquainted with antecedent conjectures, detected the genuine reservoir of wax under the bee's belly. He considered wax as an external secretion of oil, formed and moulded between the abdominal scales of the insect. Dr. Evans confirms the testimony of Wildman and Hunter. "One or more bees," he remarks, "may be often seen before the door of the hive, supporting themselves by their two fore feet, fluttering their wings, and agitating the hind parts of their bodies. They are then evidently moulding the wax between their abdominal scales, the motion of the wings serving to preserve their balance, and as a signal for their companions within to come and carry off the falling flakes, to the formation of which he was an eye-witness."

To complete the evidence however, to me so irresistible, in favour of the wax-secreting faculty of the

bee's body, I observe finally, that in 1793, M. Huber's observations led him to the same conclusion as Mr. Hunter's, relative to the nature of the laminæ under the abdominal scales: but Huber slumbered not there; he prosecuted the inquiry more successfully than any preceding naturalist, and at length demonstrated the secreting organs which had eluded the scrutiny of Swammerdam, Hunter, and other acute anatomists. He found that these laminæ were contained in distinct receptacles, on each side of the middle process of the scales; he examined, with great care, the form and structure of these secreting cavities, which are peculiar to working bees. Each working bee has eight of these organs, sacklets or small compartments. Their general shape is an irregular pentagon, and the plates of wax, being moulded in them, exhibit accordingly the same form. A perforation of their lining membrane on the side next to the abdomen, started a jet of transparent fluid, which congealed on cooling; in this state it resembled wax, and became again fluid on the application of heat. Comparative experiments were made with the substance contained in the pouches and with the wax of fresh combs: a great similarity between these two substances was discerned; the latter appeared somewhat more compound, having probably received some additional ingredient, while employed as the material for building. The secreting function of the membrane on the inner surface of these cavities, was further evinced, by a more minute examination of its structure, which exhibited a number of folds, forming an hexagonal net-work, analogous to the inner coat of the second stomach of ruminating quadrupeds. Huber does not appear to have known the observations either of Duchet or of Wild-

man on this subject, although they were made long prior to Mr. Hunter's; for he quotes only from the latter.

"Whenever combs are wanted, bees fill their crops with honey, and retaining it in them, hang together in a cluster from the top of the hive, and remain apparently, in a state of profound inactivity, about twenty-four hours. During this time, the wax is secreted, and may be seen in laminæ, under the abdominal scales, whence it is removed by the hind legs of the bee, and transferred to the fore legs; from them it is taken by the jaws, and after being masticated as described in Chap. xxxii. page 387, the fabrication of comb commences. In swarms it may, and sometimes does, commence immediately after hiving, thus affording evidence of preparation, and consequently of intention to swarm.

"To see the wax-pockets in the hive bee, you must press the abdomen, so as to cause its distention; you will then find, on each of the four intermediate ventral segments, separated by the carina or elevated central part, two trapeziform whitish pockets, of a soft membranaceous texture: on these the laminæ of wax are formed, in different states, more or less perceptible*." Eight scales are thus produced at once, a pair under each ring, except the first and last, which are constituted differently from the rest. The size of the scales varies with the diameter of the rings, on which they are moulded; the largest being beneath the third, the smallest under the fifth ring.

"Non labor omnibus idam," says Vaniere. Messrs. Huber and son have affirmed that the office of collecting

* Kirby and Spence.

honey, for the elaboration of wax, is filled by a particular description of bees or labourers, to which they have given the name of *wax-workers*. These bees are susceptible of an increase in size, as is evident from the state of their stomachs, when quite full of honey. Dissection has shown that their stomachs are more capacious than those of the bees that are differently occupied. Bees not possessed of this expanding stomach, gather no more honey than is necessary to supply the immediate wants of themselves and their companions, with whom they readily share it: they seem formed for retirement, and are called *nursing-bees*, their duty being to rear the young, and attend to the internal œconomy of the hive. The task of storing with provisions devolves upon the wax-workers, who, when not occupied in the construction of comb, disgorge their honey into those cells which are intended for its reception. By marking the bees, it was found that they never encroached upon each other's employment: this strict adjustment of duty is the more remarkable, since the power of producing wax is common both to the nursing- and wax-working bees, a small quantity of wax having been actually found in the receptacles of the nursing-bees. The difference between these bees had probably been observed both by Aristotle and Pliny; the former speaks of "optimum genus apum, quæ breves, variæ et in rotunditatem compactiles; secundæ quæ longæ et vespis similes;" and Pliny uses similar language. That such difference actually exists, is confirmed by the observations of Mr. Newport on humble-bees; he witnessed their mode of raising the temperature of their domicile some hours before the perfect maturation of the brood, and found there was a successive change of nurses, as

soon as the heat of those in attendance became lowered by perspiration.

In the foregoing experiments for ascertaining the sources of wax, the bees had borne their confinement without evincing the least impatience; but on another occasion, when shut up with a brood of eggs and larvæ, and without pollen, though honey was copiously supplied, they manifested uneasiness and rage at their imprisonment. Fearing the consequence of this state of tumult being prolonged, Huber allowed them to escape in the evening, when too late to collect provisions; the bees soon returned home. At the end of five days, during which this experiment was tried, the hive was examined:—the larvæ had perished, and the jelly that surrounded them on their introduction into the hive had disappeared. The same bees were then supplied with fresh brood, together with some comb containing pollen: very different indeed was their behaviour with this outfit; they eagerly seized the pollen and conveyed it to the young; order and prosperity were re-established in the colony; the larvæ underwent the usual transformations; royal cells were completed and closed with wax, and the bees showed no desire to quit their habitation. These experiments afford indisputable evidence of the origin of wax and the destination of pollen. Butler observed that there was a great increase in the members of the hive, after pollen was carried in, which he supposed rendered the queen prolific.

Though the wax of honey and brood-comb is an original secretion from the body of the bee, wax is also considered by some as a vegetable substance existing abundantly in nature. According to Proust, it forms the silvery down on the leaves, flowers and fruit of many

plants, and resides likewise in the feculæ of others. Dr. Darwin, in his *Phytologia*, supposes that wax is secreted to glaze over the fecundating dust of the anthers, and prevent its premature explosion from excessive moisture: to an unseasonable dispersion of anther-dust he ascribes the failure of orchard and corn crops in summers of extreme humidity. The wax-tree of Louisiana* (*Myrica cerifera*) contains immense quantities of wax. In this respect there appears an identity betwixt animal and vegetable secretion, which may be viewed as indicative of simplicity in the structure of the bee: a still simpler organization exists in the aphis, which extracts the saccharine juices from the leaves and bark of trees, and expels them again nearly unchanged†.

* *Vide* Part I. Chap. 27. † *Vide* Part I. Chap. 5.

CHAPTER XXXIV.

POLLEN.

Pollen and *Farina*, in the language of Botanists, are terms applied to the powdery particles discharged by the anthers of flowers in warm, dry weather, and which hang about the stamina. The colour, as well as the structure of pollen, varies in different plants. Its use, in fecundating the germens of flowers, is well known: the services of bees, towards that end, will be noticed in a separate chapter. The sixth volume of the Linnæan Transactions contains an interesting paper upon this substance, by Mr. Luke Howard. So likewise does the 18th No. of the Edinburgh Journal of Science, from the pen of Mr. Robert Brown.

Pollen has a capsular structure, varying its shape in different flowers, insomuch as to be a popular object for the microscope. According to the description of Miss Kent, each grain consists commonly of a membranous bag, which contains a meal still finer, so fine, that its granules do not exceed the 10,000dth part of an inch in some plants, the geranium for instance. These internal particles are said to have been first discovered by Mr. Needham. When the bag containing them comes to maturity, it bursts on the application of moisture: this bursting is naturally effected by the honey-like exudation of the stigma; but if extraneous moisture accomplish it prematurely, the pollen is rendered useless for the purpose of fructification. Whenever moistened, the bag explodes with great force, and discharges a subtile va-

pour or essence, which, when released by the peculiar moisture of the stigma, performs effectually its final purpose.

This substance, as I have stated in the last chapter, was once erroneously supposed to be the prime constituent of wax; but the experiments of Hunter and Haber have proved that wax is a secretion from the bodies of wax-working bees*, and that the principal purpose for which they collect pollen is to nourish the embryo-bees (it has been called the ambrosia of the hive). Huber was the first who suggested this idea, and it well accords with what we observe among other parts of the animal kingdom;—birds, for instance, feed their young with different food from what they take themselves. Mr. Hunter examined the stomachs of the maggot-bees, and found farina in all, but not a particle of honey in any of them. Huber considers the pollen as undergoing a peculiar elaboration in the stomachs of the nursing-bees, to be fitted for the nutriment of the larvæ.

"In spring," says Dr. Evans, "which may be called the bee's first *carrying* season, scarcely one of the labourers is seen returning to the hive, without a little ball or pellet of farina, on each of its hinder legs. These balls are invariably of the same colour as the anther-dust of the flowers then in bloom, the different tints of yellow, as pale, greenish or deep orange, being most prevalent." The bees may frequently be observed to roll their bodies on the flower, and then, brushing off the pollen which adheres to them, with their feet, form it into two masses, which they dispose of in the usual way. In very dry weather, when probably the particles

Vide Chap. XXXIII.

of pollen cannot be made to cohere, I have often seen them return home so completely enveloped by it, as to give them the appearance of a different species of bee. The anther-dust, thus collected, is conveyed to the interior of the hive, and there brushed off by the collector of her companions. Reaumur and others have observed, that *bees prefer the morning for collecting this substance*, most probably that the dew may assist them in the moulding of their little balls. "I have seen them abroad," says Reaumur, "gathering farina at the earliest dawn;" they continue thus occupied till about ten o'clock.

> "Brash'd from each anther's crown, the mealy gold,
> With morning dew, the light fang'd artists mould,
> Fill with the foodful load their hollow'd thigh,
> And to their nurslings bear the rich supply."—EVANS.

This is their practice during the warmer months; but in April and May, and at the settlement of a recent swarm, they carry pollen throughout the day; but even in these instances, the collection is made in places most likely to furnish the requisite moisture for moulding the pellets, namely, in shady and sometimes in very distant places.

When a bee has completed her loading, she returns to the hive; *part* of her cargo *is instantly devoured* by the nursing-bees, to be regurgitated for the use of the larvæ, and *another part is stored* in cells for future exigencies *in the following manner*. The bee, while seeking a fit cell for her freight, makes a noise with her wings, as if to summon her fellow-citizens round her; she then fixes her two middle and her two hind legs upon the edge of the cell which she has selected, and curving her body, seizes the farina with her fore legs,

and makes it drop into the cell: thus freed from her burthen, she is fully prepared to collect again. Another bee immediately packs the pollen, and kneads and works it down into the bottom of the cell, probably mixing a little honey with it, judging from the moist state in which she leaves it; an air-tight coating of varnish finishes this storing of pollen.

The bee stores pollen in worker-cells only. I am not aware of this fact having ever been publicly stated before: I am indebted for a knowledge of it to the attentive observation of Mr. Humphrey. This discrimination of the bee may arise from an instinctive knowledge that pollen may be best preserved when stored in small quantities.

The quantity of this substance collected is immense; Swammerdam calculated that a single family would gather from thirty to sixty pounds in a season.

From the uniform colour of each collection, it is reasonable to suppose that *the bee never visits more than one species of flower on the same journey*; this was the opinion of Aristotle, and the generality of modern observers have confirmed it. Reaumur, however supposed that the bee ranged from flowers of one species to those of another indiscriminately. Mr. Arthur Dobbs, in the Philosophical Transactions for 1752, states that he has repeatedly followed bees when collecting pollen; and that whatever flowers they first alighted upon decided their choice for that excursion, all other species being passed over unregarded: Butler had previously asserted the same thing. Here we see the operation of a discriminating instinct, which in the first place leads the insect to make an aggregation of homogeneous particles, which of course form the closest cohesion; and

in the next place prevents the multiplication of hybrid plants. This remark was made by Sprengel, who has confirmed the observations of Dobbs, Butler, and others. The bees, which Réaumur observed to visit flowers of different species, might have been in quest of honey as well as of pollen.

CHAPTER XXXV.

PROPOLIS.

Besides the honey and pollen which are gathered by bees, they collect a resinous substance, that is very tenacious, semitransparent, and which gives out a balsamic odour, somewhat resembling that of storax. In the mass, it is of a reddish brown colour; when broken, its colour approaches that of wax. Dissolved in spirit of wine or oil of turpentine, it imparts, as varnish, a golden colour to silver, tin, and other white polished metals. Being supposed to possess medicinal virtue, it was formerly kept in the shop of the apothecary. According to Vauquelin, propolis consists of one part of wax and four of pure resin; in which respect, and in its yielding the same acid, (the *benzoic*,) it resembles balsam Peru. It also contains some aromatic principles.

With propolis, bees attach the combs to the roof and sides of their dwelling, stop crevices, fasten the hives or boxes to the floors and roof, strengthen the weak places of their domicile, and varnish the cell-work of their combs. The chapter on Instincts details the modes in which bees employ it for their protection against intruders into their hives. From its being used for the firm attachment of combs to the roofs of hives, it must be the first matter collected by a recent swarm. The term Propolis is derived from the Greek, and signifies 'before the city,' bees having been observed to make use of it, in strengthening the outworks of their city.

Reaumur was unable to discover its vegetable source. It is generally supposed to be gathered from the resinous exudations of the poplar, alder, birch, and willow; according to Riem, from pines and other trees of the fir tribe; though some authors have alleged that bees can produce it where no such trees are near them, and that turpentine and other resins have been disregarded when laid before them. A recent experiment of Huber has solved this question: he planted in spring some branches of the wild poplar, before the leaves were developed, and placed them in pots near his apiary: the bees alighting on them separated the folds of the largest buds with their forceps, extracted the varnish in threads, and loaded with it, first one thigh and then the other; for they convey it like pollen, transferring it by the first pair of legs to the second, by which it is lodged in the hollow of the third. Huber examined the chemical properties of this varnish, and identified it with the propolis which fastens the comb to the hives.

With respect to the absence of fir-trees, &c. in the neighbourhood of the hives, it is to be recollected, in the first place, that *bees will fly about three miles* (some say five,) for what they may want: Huber *thinks that the radius of the circle they traverse does not exceed half a league*, yet says that the question is undecided: in the second place, that a balsamic and tenacious secretion is found upon the buds of several plants and trees, which are often crowded with these insects; such for instance as the tacamahac, horse-chestnut, and hollyhock. Dr. Evans says that he has been an eye-witness of their collecting the balsamic varnish which coats the young blossom buds of the hollyhock, and has seen them rest at least ten minutes on the same bud, moulding the bal-

sam with their fore-feet and transferring it to the hinder legs, as above stated. When finally moulded, the pellets of propolis are of a lenticular form.

"With merry hum the Willow's copse they scale,
The Fir's dark pyramid, or Poplar pale,
Scoop from the Alder's leaf its oozy flood,
Or strip the Chestnut's resin-coated bud,
Skim the light tear that tips Narcissus' ray,
Or round the Hollyhock's hoar fragrance play.
Soon temper'd to their will through eve's low beam,
And link'd in airy bands the viscous stream,
They waft their nut-brown loads exulting home,
That form a fret-work for the future comb,
Caulk every chink where rushing winds may roar,
And seal their circling ramparts to the floor."—EVANS.

As to the bees refusing resinous substances, when presented to them, as substitutes for propolis, Mr. Knight has assured us, in the Philosophical Transactions, that this is not the fact, as he had seen them carry off a composition of wax and turpentine, which had been laid over the decorticated parts of his trees.

The bees blend this substance with wax in different proportions, as occasion may require. Among the ancients it bore different names, according to the quantity of wax it contained. Virgil made this distinction, though Mr. Martin conceives that his "*Narcissi lacrymæ. cera,*" [cum quâ]—"spiramenta tenuia linunt,"—and *gluten*, all mean the same thing: this is probably a mistake. It seems much more likely that Virgil should mean *commosis* (or *metys*), *pissoceron* and *propolis*, the three names by which Pliny says that the varieties of propolis were distinguished in his time.

I have before alluded to the fortification of the weak places of hives with propolis. M. Reaumur, whose hives

consisted of wooden frames and panes of glass, wishing to put this talent of the bees to the test, carelessly fastened the glass of a hive with paper and paste, before putting in a swarm; the bees soon discovered the weakness of his paste-work, and indignantly gnawing to pieces this feeble fence, secured the glass with their own cement.

I have already observed, that *the sage bee* chooses the morning for collecting pollen, on account of the dew's enabling her to compress it better; but, as moisture would render propolis less coherent, she *gathers this substance when the day is somewhat advanced*, and when the warmth of the sun has imparted to it softness and pliancy. These qualities are however soon lost, after it has been detached from the secreting surfaces, and exposed to the oxygenizing power of the air. So rapid is this hardening process, that the bees which store it oftentimes find some difficulty in tearing it with their jaws from the thighs of its collectors.

On the last page but one I have noted that Huber says the extent of a bee's flight in quest of food is undecided, but that it probably does not exceed half a league. Upon this Mr. Dunbar observes, "If Huber meant half a German league, as he probably did, then, according to his calculation, a bee will fly two miles from its home. I am rather disposed to question the accuracy of this calculation. That the insect can and does fly thus far on some occasions, I do not doubt; but in her ordinary excursions during the honey season, I believe *one* English mile will be found to be the extent of her flight. I am led to this conclusion by the circumstance that my own apiary is within a mile and a half of an extensive moor, and that during the finest

weather in September, when the heath is in full bloom, few of my hives send any forager in that direction." Huber himself must have been aware of the usual extent of the bee's flight not exceeding two miles; for whilst he resided at Cour, near Lausanne, and afterwards when he lived at Vivai, his bees suffered so from scanty pasturage, that he could only preserve them by feeding, although those that were located two miles off him were in each case storing their hives abundantly.

CHAPTER XXXVI.

IMPORTANCE OF BEES TO THE FRUCTIFICATION OF FLOWERS.

Honey is regarded by modern naturalists as of no other use to plants but to allure insects, which, by visiting the nectaries of their flowers to procure it, become instrumental to their fertilization, either by scattering the dust of the stamens upon the stigmata of the same flower, or by carrying it from those which produce only male blossoms to those that bear female ones, and thereby rendering the latter fertile.

No class of insects renders so much service in this way as *bees*; they *have* however *been accused of injuring vegetables*, in three ways: 1st, by purloining for their combs the wax which defends the prolific dust of the anthers from rain; 2ndly, by carrying off the dust itself, as food for their young larvæ; and 3rdly, by devouring the honey of the nectaries, intended to nourish the vegetable organs of fructification*.

In defence of his insect protégées, Dr. Evans has observed,—

"First, That the proportion of wax collected from the anthers is probably very trifling, it being so readily and abundantly obtainable from honey.

"Secondly, That for any depredations committed on the farina, they amply compensate, by their inadvertent yet providential conveyance of it, on their limbs and

* Darwin's *Phytologia*.

corselets, to the female organs of monoecious or dioecious plants, whose impregnation must otherwise have depended on the uncertain winds. This is exemplified in the practice of our gardeners, who in early spring, before they dare expose their hotbeds to the open air, and consequently to the access of insects, insure the fertility of the cucumbers and melons, by shaking a male blossom over each female flower. For the same purpose, and with the same success, a gentleman in Shropshire substitutes a male blossom, in place of the female one, at the top of his embryo cucumber, which instantly adheres, and falls off in due time*.

"To the same kind intrusion of insects we owe the numberless new sorts of esculents and endless varieties of flowers in the parterre:

> 'Where Beauty plays
> Her idle freaks; from family diffused
> To family, as flies the father dust
> The varied colours run.' THOMSON.

"Thirdly, That in a great many instances, the honey-cups are completely beyond the reach of the fructifying organs, and cannot possibly be subservient to their use. Hence Sir J. E. Smith *believed the honey to be intended, by its scent, to allure these venial panders to the flowers*, and thereby shows how highly he estimated their value to vegetation. See his Introduction to Botany. In the same work, the author observes that Sprengel has ingeniously demonstrated, in some hundreds of instances, how the corolla serves as an attraction to insects, indi-

* When bees do not take spontaneously to the blossoms of the cucumber, melon, &c., they may be tempted to fertilize them, by applying honey to the male and female bloom.

cating by various marks, sometimes perhaps by its scent, where they may find honey, and accommodating them with a convenient resting-place or shelter while they extract it. This elegant and ingenious theory receives confirmation from almost every flower we examine. Proud man is disposed to think that

'Full many a flower is born to blush unseen,'

because he has not deigned to explore it; but we find that even the beauties of the most sequestered wilderness are not made in vain. They have myriads of admirers, attracted by their charms, and rewarded by their treasures, which would be as useless as the gold of a miser, to the plant itself, were they not the means of bringing insects about it."

Thus the bee, by settling upon and collecting honey from a thousand different flowers, is thereby assisting the great purpose of vegetable reproduction, at the same time that the loads she carries home enable her to construct receptacles for the reproduction of her own race.

"Flower after flower she sips,
And sucks their honied fragrance, nor beclims
Their brightness, nor appears to spoil their stores;
For all she lights on seems to grow more fair."

"For the due fertilization of the common *Barberry*, it is necessary that its irritable stamens should be brought into contact with the pistil, by the application of some stimulus to the base of the filament; but this would never take place were not insects attracted, by the melliferous glands of the flower, to insinuate themselves amongst the filaments, and thus, while seeking their own food, unknowingly to fulfil the intentions of Nature in another

department*." *In some cases the agency of the hive-bee is inadequate to produce the required end; in these the humble-bee is the operator:* these alone, as Sprengel has observed, are strong enough, for instance, to force their way beneath the style-flag of the *Iris Xiphium*, which in consequence is often barren. *Other insects* besides bees *are instrumental in producing the same ends*; indeed they are necessary instruments: and hence, according to the same naturalist, in some places, where the particular insect required is not to be met with, no fruit is formed upon the plant which is usually visited by it, where it is indigenous; for he supposes that *some plants have particular insects appropriated to them.* The American *Aristolochia Sipho*, though it flowers plentifully, never forms fruit in our gardens, probably for the reason just assigned. The *Date Palm.* affords a striking instance of the necessity of extraneous intervention to perfect fructification; male and female flowers are borne on separate trees, and unless the two sorts be in the neighbourhood of each other, the fruit has no kernel, and is not proper for food. There was a tree of this kind, bearing female flowers, at Berlin, for the fructification of which, a

* This process may be strikingly exemplified, by exciting artificially the basis of the filaments, in the flower just mentioned. In the beginning of June, when the barberry usually blossoms, the six stamens are sheltered by the concave form of the flower, and spread moderately, so long as they are unmolested; but if one of them be stimulated *at its root*, by means of a long stout bristle or horse-hair, it will bend forward, and strike its anther full of pollen, upon the top of the pistil; after which it will retire gradually, yet perceptibly, to its former position. This action may be produced again and again in the same stamen, or in all six successively. In performing this experiment, care should be taken to apply the stimulating point without shaking the flower.

branch, with male flowers upon it, was once sent by post from Leipsic (20 German miles), and being suspended over some of the pistils, the tree afterwards yielded fruit and seed in abundance. Professor Willdenow has stated a very curious circumstance concerning the *Aristolochia Clematitis*. He observes that the stamens and pistils of the flower are inclosed in its globular base, the anthers being under the stigma, which thereby requires the intervention of an insect to convey the pollen to it. The *Tipula pennicornis* accomplishes this object; it enters the flower by its tubular part, which is thickly lined with inflected hairs, so as readily to admit the fly, but totally to prevent its release, till by the fading of the corolla the hairs have fallen flat against its sides. Hence the insect, in struggling to effect its escape brushes off the pollen and applies it to the stigma, thereby accomplishing the fertilization of the flower.

"Si quid novisti rectius istis,
Candidus imperti; si non, his utere mecum."—Hor.

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