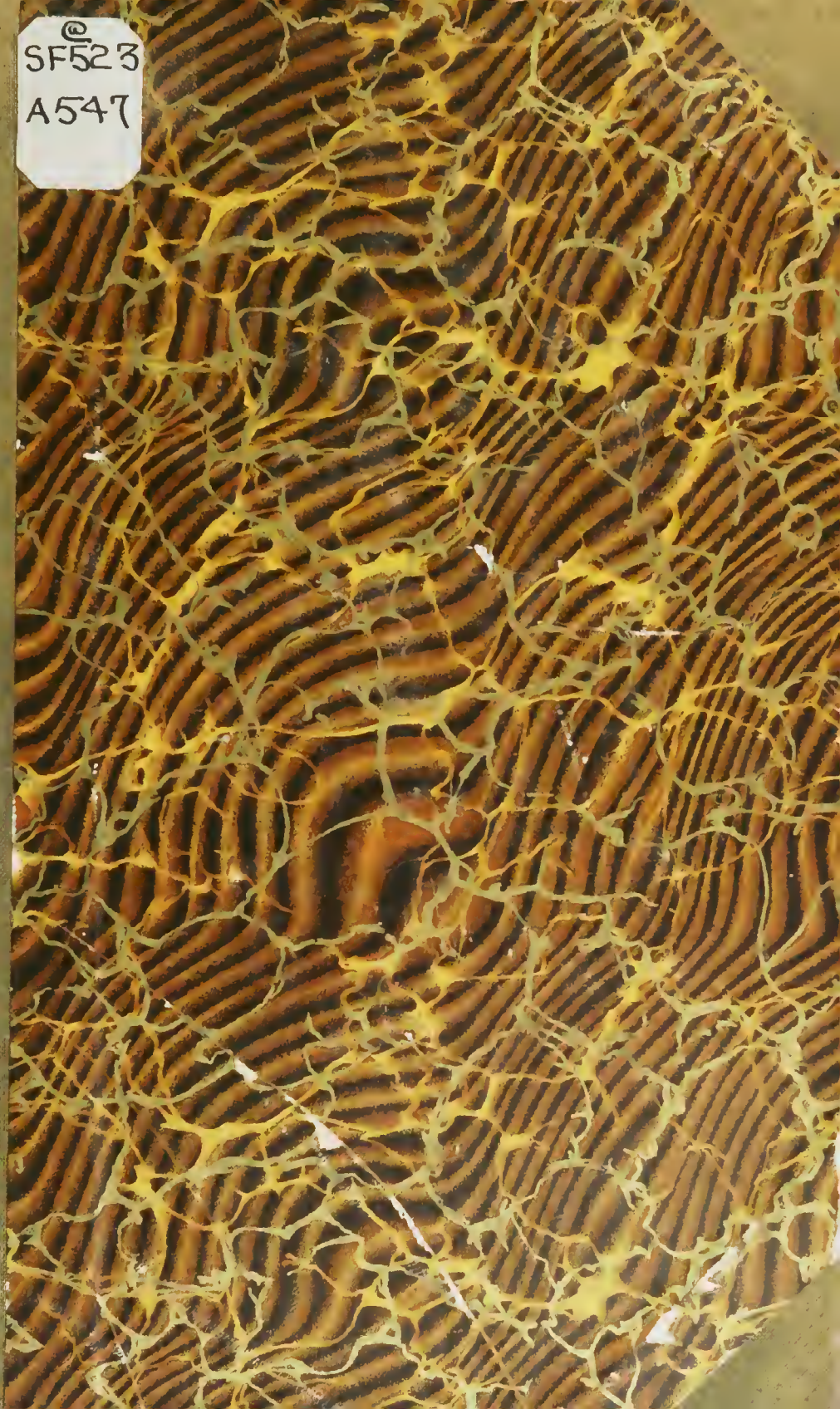

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THE NATURAL HISTORY OF THE BEE.

BY

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LECTURER IN BEE-KEEPING.

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NOTE.

I am indebted to the Proprietors of "The Bazaar, Exchange and Mart" for the facsimile illustrations originally prepared for their publication, entitled, "Cheshire's Bees and Bee-keeping."

J. A.

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INTRODUCTION.

THIS slight sketch is intended to be merely a simple introduction to the study of the bee and its ways. The earnest student is advised to refer to some larger work, such as "Bees and Bee-keeping," vol. i., by the late Frank R. Cheshire, or to "Langstroth on the Honey Bee," as revised and enlarged, first by the late Charles Dadant, and later by his son, Mr. C. P. Dadant. Members of the Scottish Bee-keepers' Association (Secretary, Rev. J. Beveridge, B.D., Gartmore, Stirling) may borrow these manuals from the excellent library of the Association, and this course is recommended in the first instance because the books are somewhat expensive. After perusing volumes borrowed from the library, the serious bee-keeper will decide which and how many of them must find a place in his own private collection.

Classification of the Honey Bee.

The bee is without the internal bony skeleton so characteristic of the higher animals, and is provided instead with a hard outer crust to which its muscles are attached. It is classed, therefore, among the Invertebrates or animals without a backbone. All invertebrate animals that possess jointed limbs are grouped together in the great Phylum of Arthropods, which is subdivided into Crustaceans (almost all aquatic),

Arachnids (spider-like creatures), and Insects. The Arthropods are predominantly active, and very successful in the struggle for existence. More than half of all the animals in the world are Arthropods, and the Insects alone are more numerous than all the other animals put together.

Insects.

Thoughtless people are in the way of calling any small animal an insect, and perhaps most people would be quite sure that a spider should be so described. But a spider has eight legs, while an insect has never more nor less than six, and the insect has three well-marked divisions of the body—head, thorax and abdomen—while the spider has apparently only two divisions. All insects have antennæ or feelers on their heads, very few are without wings, and all the higher types display in development a remarkable transformation or metamorphosis.

Insect types are so extraordinarily numerous that we must divide the Class into smaller groups or Orders, each consisting of creatures more or less resembling each other. The Butterflies and Moths (Lepidoptera) constitute one such Order, characterised by the possession of four wings covered with beautiful scales. The four wings of the bee are gauzy and transparent, so it is grouped with the Wasps, the Ants, the Saw-Flies, and the Ichneumon-Flies to form the Order of the Hymenoptera or membrane-winged insects.

Bees.

The Family of the Apidæ or Bees includes all Hymenoptera which collect honey and pollen, and perhaps even bee-keepers will be surprised to learn that, in addition to the honey bee (*Apis*), and the very familiar humble bee (*Bombus*), there are in Britain more than 200 species, which belong to the group of Solitary or non-social bees. Of these the burrowers are perhaps easiest to discover, for we can find them at work on sandy banks on any fine day in summer. Inside their burrows they make cells of a transparent material, like oiled-silk or

gold-beater's skin, provision these with a paste of honey and pollen, and then attach their eggs to the insides of the cells. There is no worker caste, and the larval bees have to feed themselves on the store provided.

More akin to the hive bees are the *Bombi*, or humble bees, so well described and so beautifully figured in Mr. F. W. L. Sladen's "Humble Bee." These are familiar to all dwellers in the country, but are not so nearly related to the hive bees as is commonly supposed. They are social indeed, but the colonies break up in the autumn, and only the young queens survive the winter, which they pass in holes in the ground. These queens start new colonies next season, and undertake every duty involved in the rearing of the first batch of brood. The drone of the humble bee is smaller than the queen, and leaves the nest as soon as he can fly, henceforth supporting himself on nectar obtained from flowers. Most of the humble bees working on flowers in late autumn will be found to be drones, as shown by the absence of a sting.

The Genus *Apis*.

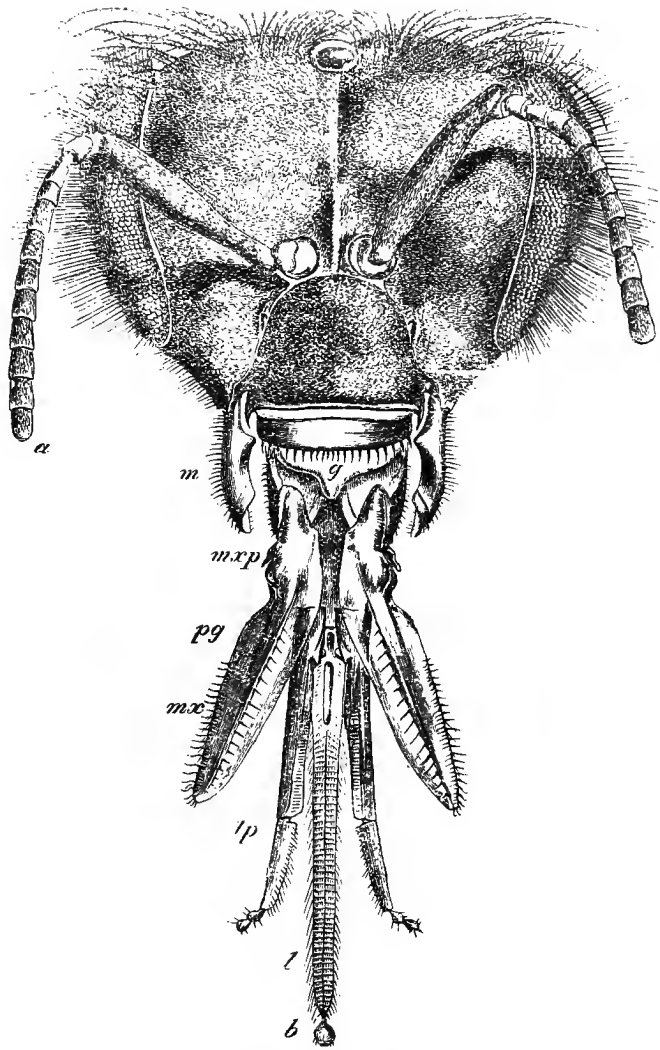
All Apidæ, which form colonies more or less permanent (perennial rather than annual) are grouped together to form the Genus *Apis*, which includes such species as *A. mellifica* (the common hive bee), *A. fasciata* (the Egyptian bee), *A. dorsata* (the giant bee of India), and *A. florea* (the tiny East Indian bee).

Having now defined the position of the honey bee in the animal world, and indicated its relation to other types, we are in a position to study *Apis mellifica* in more detail.

The Head of the Bee.

THE head of the bee bears five eyes, three simple and two compound. The simple eyes are arranged in a triangle on the crown of the head, and are sometimes called "ocelli." The two compound eyes are larger, and situated on the sides of the head. They consist of many thousands of simple eyes, hexagonal in shape. The eyelashes are not arranged in two fringes on moveable lids as in the case of the higher animals, but grow, so to speak, all over the eye-ball, being attached really at the corners of the simple eyes. Dust that would tend to obscure the sight of the bee is caught on these hairs, but as this cannot be winked away, since the bee has no eyelids, a special comb for cleaning the eyelashes is attached to the first leg of the bee. The head also bears the characteristic antennæ (*a*), two very slender jointed rods, which are attached to the face of the bee by ball-and-socket joints. They are extremely flexible, and are the seat probably of several senses. The bees feel with them, smell with them, possibly hear with them, and they certainly talk by means of their antennæ. Worker bees are all female, and apparently talk a good deal, but they do so without making a sound, simply by touching each other's antennæ. The outside of the bee consists of "chitin," an almost shell-like material, which is dead, insensitive, and which cannot be repaired when injured. In order that the bee, surrounded by this unfeeling envelope, may be able to come in contact with the outside world, it has to develop to an extraordinary extent the sensitive hairs that we see exemplified in the whiskers of the cat. For example, the sensitiveness of the antennæ depends on the fine hairs with which they are provided. Dust on these organs would render them less efficient, so the bee has an apparatus on the forelegs for combing the dust off the hairs of its antennæ. Both the comb for the eyelashes and the comb for the antennæ have been beautifully figured by Cheshire, who was the best worker on the bee that Britain has produced.

The mandibles or jaws (*m*) of the bee work sideways, like typical insect jaws, and are used for making comb, fighting,



HEAD AND TONGUE OF BEE.
(Magnified 16 times. From Cheshire).

a, Antenna, or Feeler; *m*, Mandible, or Outer Jaw; *g*, Gum Flap, or Epipharynx; *mxp*, Maxillary Palpus; *pg*, Paraglossa; *mx*, Maxilla, or Inner Jaw; *lp*, Labial Palpus; *l*, Ligula, or Tongue; *b*, Bouton, or Spoon of the same.

seizing robbers by the leg, and removing dead bees and debris from the hive. They also bear tactile hairs, and these probably ensure the delicacy of touch necessary in fashioning the wonderful comb. The so-called tongue or proboscis (*l*) is not really a tongue, but a prolongation of the lower lip. This is the organ which is unfolded and thrust down into the heart of the flower to reach the nectar. It is many-jointed and covered thickly with hairs, so that it is rather a brush than a tube. The bee does not so much suck up the nectar as mop it up with this brushlike organ.

The Thorax.

A very narrow white neck connects the head with the thorax, or chest. This bears the six legs and the four wings, and the cavity of the thorax is filled mainly with the muscles which work these limbs. The thorax is the meaty part of the bee, and is the only part carried away by a wasp, which has killed a bee for food. The wasp cuts off the head, the legs, the wings and the abdomen, and flies away to its nest carrying only the lump of red meat constituting the thorax of the bee.

The Abdomen.

A second narrow isthmus, the petiole, connects the thorax with the abdomen, which is the largest division of the body. This is in sections, and the sections move in and out a little way like the joints of a telescope. It is by this means that the creature breathes. The abdomen is enlarged or reduced by a telescopic action, and air passes in and out, not by the mouth or nose as in the higher animals, but through a series of holes situated along each side of the bee. Some of these holes, or spiracles, are found on the abdomen and some on the thorax, but none on the head. It is not possible, therefore, to drown a bee by holding its head under water, since the breathing of the bee would go on as usual with the head submerged. At the extreme tip of the abdomen is situated the sting, which is a very important organ, for without its presence the bee would long since have become extinct.

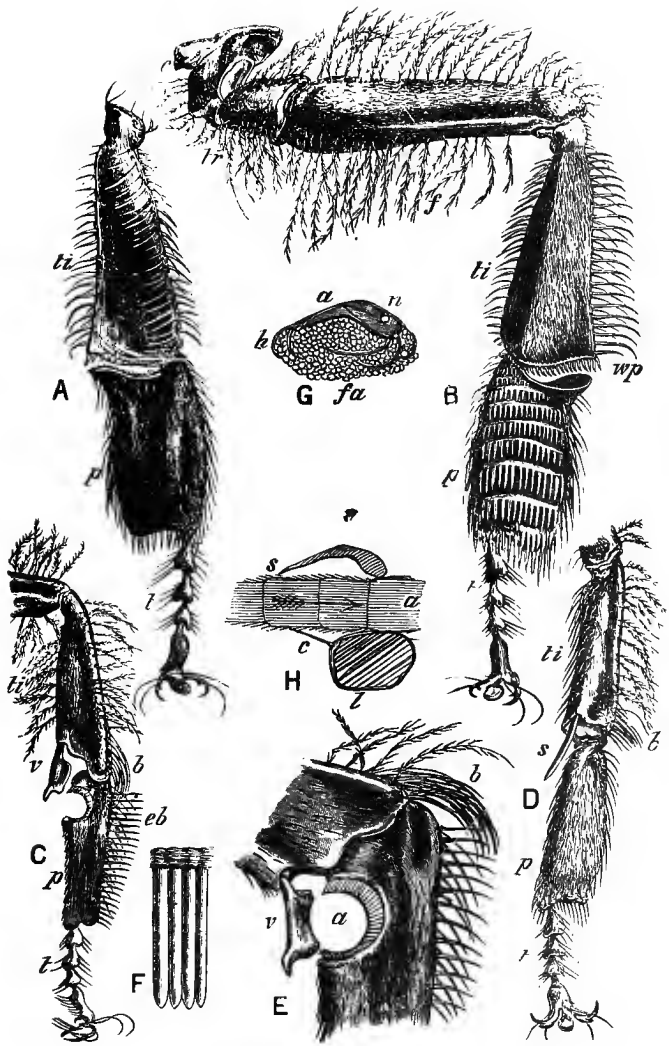
The Legs.

It has already been mentioned that the first pair of legs bear combs (C.*eb*) for the eyelashes, and a very elaborate pair of combs (E.*a*) for cleaning the antennæ. The use of these can be most readily observed on drones. When these issue from the hive on a fine sunny day they pause on the alighting board and put up their forelegs alternately to their heads. The old bee-keepers said they were wiping their eyes. Rather they were combing the dust out of their eyelashes, and securing also that the sensitive hairs of the antennæ were ready for use. If one touches the antenna of a bee with a moist finger the bee will immediately put up its foreleg and wipe the contaminated organ.

The second pair of legs bear prominent spurs, which are said to be used in removing the pollen pellets from the baskets on the last pair of legs. On the hind legs of the worker bee are the wonderful structures for collecting and carrying home the pollen. These have also been beautifully figured by Cheshire, who shows both the outside and inside aspects of the hind leg. The last broad joint which Cheshire has called the planta, or metatarsus, bears on its inside a set of beautiful combs (B.*p*). On the joint above this, called by Cheshire the tibia, is found the corbicula or pollen basket. The tibia on the outer side is bare of hair, hollow and polished, but along the edges are arranged numerous bristles. These correspond to the framework put on a cart when the load is light and bulky, as when leading home the corn.

The Collection of Pollen.

If we shake a full-blown flower over a sheet of paper we observe a fine dust falling out on the paper. The microscope shows that it is not dust at all, but that each little particle has a definite shape and colour, depending on the particular flower. In fact, the pollen grains always found in honey as an accidental admixture are the final test for the source of honey. Eucalyptus pollen found in a sample of so-called British honey would be held as a conclusive proof of adulteration with Australian or other foreign honey.



LEGS OF WORKER-BEE.

(Magnified 10 times. From Cheshire.)

A, third right leg, side from the body. *ti*, tibia, showing pollen basket; *p*, planta or metatarsus; *t*, tarsus. **B**, third right leg, side next the body. *c*, coxa; *tr*, trochanter; *wp*, pincers. **C**, front right leg. *v*, velum; *b*, brush; *eb*, eye-brush. **D**, second right leg. *b*, brush. **E**, joint of first leg, more enlarged. *v*, velum; *a*, antenna comb; *b*, brush. **F**, teeth of antenna comb, magnified 200 times. **G**, cross-section of tibia through pollen-basket. *n*, nerve; *h*, holding hairs; *fa*, farina or pollen. **H**, antenna in process of cleaning. *v*, velum; *s*, scraping edge; *a*, antenna; *l*, section of leg; *c*, antenna comb.

The bee engaged in gathering pollen alights in the heart of the flower and moves around, bringing its hairy body in contact with the anthers. The sticky pollen grains adhere to the webbed hairs of the bee, and, when it has got enough to be worth dealing with, the bee rises from the flower and apparently flies aimlessly about. In reality it has taken to its wings in order to have the use of all its legs at once. Close observation will show that the hind legs bearing the pollen combs are being passed over the under side of the bee, combing out the pollen grains adhering to the hairs. Then, by a motion too quick for the eye to follow, the two sets of combs are rubbed together and the collected pollen transferred to the pollen baskets. When the load is complete the two pellets of pollen are bean-shaped, of equal size, and almost invariably of one kind of pollen throughout. The bee-keeper, standing in front of his hives, sees bee after bee alighting on the board with pollen baskets heavily laden, the burdens being of different colours according to the flowers visited. They are light yellow from wall-flower; a sober brown from the clover; golden red from the whin, and blue-black from the poppy.

When the bee enters the hive it goes fussing over the comb, shaking its body in a very typical way, apparently looking for a cell in which to deposit the pollen. When this is found it hangs on to the upper wall with its fore legs, inserts its hind legs into the cell, and then pushes off the pollen with the middle pair of legs. The two pellets fall on the lower walls of the cell, and the pollen carrier pays no more attention to them. Another and younger bee presently comes along, inserts its head into the cell, and moves around for about two minutes. When it comes out of the cell it will be found that the pollen has been packed down firmly and neatly.

Honey is mainly a carbo-hydrate, providing energy and heat, but does not contain sufficient nitrogen to be used in forming tissue. The proteid or nitrogenous element essential for body-building, and specially necessary when brood is being reared, is supplied chiefly by the pollen. In Britain, pollen is so abundant that old combs

tend to be clogged with it, but in many parts of Australia there is a deficiency of pollen-bearing plants, and in such districts bees rapidly die out from what the Australian Bee-keeper calls the "Disappearing Sickness."

Propolis.

The pollen baskets are also used for the carrying home of a resinous material that the bees gather mainly off trees. In a treeless country various substitutes, such as tar, wet paint, and varnish, are used for the same purpose. This material is called "propolis," and is used by the bees to varnish the inside of the hive, to fill up any cracks in the walls, and to fasten down the quilt so as to prevent the escape upward of warm air. When collected in quantity it may be used to daub the honey-comb, marring its beautiful appearance. Bees vary greatly as regards tendency to collect and use propolis. The black bees of Austria, known as Carniolans, use very little propolis, and consequently produce section honey which is beautifully white. The Caucasian bees are the worst offenders, fastening everything firmly together with propolis so that the whole hive may be lifted by the top crate. The word "propolis" in Greek means "in front of the city," and implies that certain bees build ramparts at the hive door to exclude robbers, and specially to exclude the death's-head moth. Such ramparts are beautifully seen in a nucleus stock of Punic bees which has been provided with too large a door. The whole of such a door will be closed by a curtain of propolis, leaving only two small round holes at the two lower corners, just large enough to admit one bee at a time. The bee-keeper who uses plenty of quilts, and takes care that there are no openings near the top of the hive to permit the escape of warm air, will usually have little trouble with propolis. Vaseline is frequently used to prevent propolisation. It may be smeared on the runners carrying the lugs of the frames, and on the bearing surfaces of section crates.

Feet.

Each of the six feet of the bee is furnished with sharp curved hooks, two large and two small, and with these the bee

can cling securely to any ordinarily rough surface, such as the face of the comb. On polished wood or glass there is no foothold for the hooks, so the bee folds them out of the way and brings into action a soft, white, moist and sticky pad situated between the hooks. So also the fly walks on the window-pane, and with a lens it is actually possible to see on the glass the footprints of a fly. The ignorant or thoughtless bee-keeper sometimes worries his bees by placing right over their combs a piece of blanket or other rough material. This entangles the hooked feet of the bees, with the result that they rapidly lose their tempers and sometimes even their lives. The quilt placed on the top of the combs should be light and smooth, of such material as window-blind, bed-ticking, or plain calico. The bees readily slip from under such a quilt, and, when they are down among the combs, other and heavier quilts can be added till the loss of heat upward is reduced to a minimum.

Wings.

The wings of the bee are four in number, two large front wings and two smaller hind wings. A single pair of large wings, as in the blue-bottle, would be very effective for flight, but very much in the way inside the hive, where the bee has to walk about amid the thronging multitude, and even to enter the very narrow cells. Before entering the hive the smaller hind wings of the bee are tucked away underneath the larger front wings, enabling the bee to move more readily in small space. In flight, however, the advantage pertaining to a single pair of large wings is obtained for the bee by a device consisting of a set of hooks on the anterior border of the small hind wing, which engage in a kind of curved ledge on the posterior border of the larger front wing. Thus the flying bee is apparently provided with a single pair of large wings.

Breathing.

As already mentioned, the bee breathes through a series of apertures on each side of its body. These apertures or spiracles lead to an intricate system of tubes, which ramify through every part of the body of the bee

conveying oxygen directly to the tissues. In the higher animals the blood is a carrier of oxygen, but the colourless blood of the insect is not a gas carrier, the oxygen being distributed directly through the tubes or "tracheae" to every part of the insect's body. To ensure the free passage of air, each of the tiny tubes is provided with a spiral thread of "chitin," which acts like a coiled spring and prevents the tube from collapsing. One result of having such a multitude of air-tubes within its body is that the insect is extremely light and buoyant, so facilitating flight. This lightness is well exemplified in the Pond-skaters, which can be seen on a summer day actually walking on the surface of the water in any clear pool.

Wax.

Wax is a secretion produced by eight glands situated on the under surface of the abdomen. Bees about to produce wax consume a quantity of honey and then hang in clusters motionless within the hive. After several hours the newly secreted wax oozes like oil from the glands and solidifies in eight little wax pockets. The little bits of wax so produced are not unlike fish scales, and are frequently found in large numbers among the debris on the floor of the hive. The leaves of a bush on which a swarm has remained overnight are sometimes found glittering with newly made wax scales. When the bee is about to make comb it picks off the scales with its feet, carries them to its mouth, and works them up with its mandibles. The comb so produced is white—or almost white—although the wax scales are transparent. So snow is white while ice is transparent, and the explanation is the same in both cases. The snow and the honeycomb are full of little caves which reflect the light and produce the effect of whiteness. If the caves in a snowball be filled with water the whiteness disappears.

Honeycomb.

Honeycomb is one of the wonders of the world. It has extraordinary delicacy and beauty, and is so fragile that it can hardly be touched without danger of breaking the cells.

The sheets of comb are vertical and parallel, but may not be plane. That is to say, if there should be convexities in one there will be corresponding concavities in the adjacent comb. In each sheet there is a central mid-rib with sets of cells arranged on both sides. The cells are not quite horizontal, having a slight upward tilt in order to retain thin unripened honey. The shape and delicacy of the cells is not evident from an outside view, because each cell is finished off with a thickened rim, which tends to make it look round and clumsy. If these outside rims be shaved off with a warm sharp blade it will be seen that the cells are perfectly hexagonal, and that the walls are thinner than tissue paper. How the bee with its horny mandibles is able to thin them down with such admirable precision is one of the things that we find difficult to understand. Possibly the hairs displayed on the mandibles may be the sensitive mechanism which gives to those horny tools the necessary delicacy of touch.

The Worker Bee.

In a hive in the summer time there are three well marked types. There is the worker bee, of which we have been writing hitherto. It does all the spectacular work of the hive, the gathering of nectar, the collection of propolis and pollen, the carrying of water, the tending of brood, the building of the comb, the fighting and the stinging. But there is one very important bit of work which it cannot perform. Although the workers are all female and developed from an egg identical with that which produced the queen, yet the essential organs of sex are comparatively undeveloped, and the worker bee as a rule is incapable of laying eggs. Under stress of circumstances a stock that is hopelessly queenless may develop laying workers, that is, a number of workers (not one as is generally stated) will start laying eggs in the cells, but these eggs produce only drone bees, and it is not generally believed that a laying worker can ever become the mother of a worker bee or queen. A stock consisting, therefore, solely of workers would ultimately

come to an end, because the old bees would die out, and there would be no young worker bees to replace them.

The Queen Bee.

The queen or mother bee is the specialised egg layer. She is the state mother whose sole function it is to lay eggs. Her other activities are limited as far as possible in order that all her energies may be directed to this one end. Her tongue is too short to reach the nectary of any flower, so that she would starve in a garden of plenty. She has no apparatus for collecting or carrying home pollen. The wax glands are entirely wanting, so she could not produce the smallest bit of comb. But her ovaries are enormously developed, and Dzierzon—the greatest of German Beemasters—showed, by actual count, that a queen is capable of laying at least three thousand eggs in a day. She does not maintain that rate throughout the year, her egg-laying being appropriate to the season. She can as a rule continue laying for about three years, so that a stock provided with a young fertile queen may remain in a prosperous condition for that period. On the other hand, a stock consisting only of workers would become extinct in a few months.

But the queen will ultimately become exhausted, and will fail in the business of laying eggs. So she must be replaced by a daughter, reared by the workers for this purpose. The young queen, however, is not perfectly fertile unless mated to a drone. This occurs once in her lifetime in the open air on a fine day, and this is why hundreds of drones are produced by every prosperous stock during the summer season. The drone dies in the act of mating and the queen returns to the hive. She will not lay any eggs that day, nor the next, but will start laying on the second day after mating, and will continue to lay eggs, producing either male or female offspring, for a period of two or three years.

The Drone or Male Bee.

The drone's activities are even more restricted than those of the queen. He has no wax glands; no apparatus for collecting

pollen; his tongue is even shorter than that of the queen; and he has no sting. An examination of his structure will show that he is specialised for rapid, powerful, and long-continued flight. He has a great spread of wing, a highly developed thorax to accommodate the great museles that work the wings, a spacious abdomen to ensure the supply of oxygen necessary for rapid motion, a magnificent pair of eyes so that he may detect from afar that small dark object, which is the queen in flight. His legs are relatively weak, because they are never in use except inside the hive, and for a few steps on the alighting board on entering and departing. The function of the drone is to be on the wing every fine day during the sunny hours, when young queens are likely to come forth for mating purposes. This is the only duty for which drones are fitted, and this they perform with the utmost diligence, their whole time outside the hive being spent in active flight. Their life is indeed strenuous, although the drone has been called lazy by those who apparently expect him to do what he cannot possibly do, namely, gather honey and pollen like the worker. To compare a lazy man to a drone is therefore an injustice—to the drone.

At the end of the honey harvest, every "queen-right" stock of bees drives forth its drones to perish of cold and want. But the drones may be destroyed at any time if the stock comes within sight of starvation. First the adult drones are expelled, next the drone brood is pulled out of the cells, then the worker brood is sacrificed, and finally the old worker bees begin to die of starvation. The bee-keeper who sees the drones being killed out of season should take prompt measures to supply food to the stock. When the hive does not contain a fertile queen, the drones will be allowed to live until very late in the season, or even until the following spring, and the presence of drones in a particular stock at a time when most drones have been killed off indicates that there must be something wrong with the queen.

The Laying of the Queen.

The most noticeable thing about the queen is the great development of the abdomen, which projects beyond the wings. It accommodates the huge ovaries, which, in the laying season, are extremely active, producing in one day more than twice the weight of the queen in eggs. The legs of the queen are highly developed, because she spends her life in walking. The first man to describe the laying of the queen was a Scotch clergyman, the Rev. William Dunbar, Minister of Applegarth, who, in 1840, wrote a beautiful book on the bee, and was so modest that he did not put his name on the title page. When Langstroth, the father of American bee-keeping, published his book in 1851, he was content to quote, with acknowledgment, the Scotch parson's description of the laying of the queen. During the laying season she walks over the surface of the comb, examining cell after cell until she finds one empty, freshly varnished, and situated well within the warm part of the hive. She bends her body sharply, inserts her abdomen into the cell, turns round until she is looking downwards and deposits an egg in the cell. At this period she is waited upon by a number of workers, who keep their heads towards the queen at all times and supply her with anything that she requires. It is their duty to see that she does not waste her time looking for food, or in making her toilet. They perform all offices for the queen, and thus enable her to set her whole mind to the business of laying eggs.

The queen bee requires mating only once in her life, because she has a little reservoir or sperm sac in which she can store the sperm received from the drone at her mating. The sperm cells remain alive and ready to become active for years. Very old queens, however, begin to produce what might be called accidental or inadvertent drones — drones produced in worker cells—and it has been suggested that the sperm has become exhausted, but it is more likely that the queen has lost the power of working the mechanism of fertilisation.

Sometimes a queen fails to mate, possibly through the scarcity or entire absence of drones. In such cases she remains a virgin queen, and, if weather permit, she makes frequent flights in search of a drone. At last she seems to give up hope, and commences laying without being mated at all. The eggs develop in the normal way, but produce only drones, whether laid in drone or in worker cells.

Brood Rearing.

The egg laid by the queen is quite unlike a fowl's egg in shape. It is elongated, wider at one end than the other, slightly curved, and both ends are rounded. It is attached by the smaller end to the bottom of the cell, and is just large enough to be easily detected by the naked eye. In the bottom of the cell it looks like a bit of bluish white thread, and is clearly visible to a close observer. Under normal circumstances the egg hatches in about three days, and the creature that emerges is a tiny white grub with no legs, no wings, and no sting. It is fed by the worker bees on a kind of thin white jelly, which has an acid pungent taste. Its origin is undecided, but there is good reason to suppose that this "Royal Jelly" is the secretion of two glands situated in the head of the worker bee. These glands are not found in the drone, are undeveloped in the queen, are shrunken and apparently functionless in the old forager bees. But they are large and apparently active in the younger worker bees, which are known to feed the brood. At a later stage it is said that raw honey and pollen are added to the ration of the worker bee and the drone, but queens are fed throughout on "Royal Jelly." Whatever its origin it must be very nourishing, because the little grub grows apace, and in six days its weight has increased more than a thousand times.

On the sixth day from the hatching of the egg the worker-grub is fully fed, and the bees cover it over with a porous cap composed of pollen and wax, so as to allow the young bee to breathe. The rest of the development goes

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Supersedure of Queens.

Some bee-keepers imagine that an old queen cannot be replaced except by swarming, but a little thought will suggest that since the old queen normally accompanies the first swarm, there will come a time when the old queen must be superseded without swarming. In such circumstances the bees make a few queen cells, usually not more than three, and generally at the close of the honey harvest. The selected queen is allowed to emerge, and she may live for weeks in the hive along with the old mother. Sometimes, indeed, both mother and daughter may be laying in the same hive. The supersedure of the queen occurs so quietly that it may be missed even by an observant bee-keeper, and we thus get stories of queens that have been supposed to live to phenomenal ages, the fact being that the old worn-out queen had been quietly replaced by the bees without the knowledge of the bee-keeper.

Swarming.

Swarming is a natural function which must occur if bees are not to become extinct; for it is by swarming that stocks lost by disease, by queenlessness, and so forth, are replaced. Bees about to swarm make preparation inside and outside the hive. The inside preparation consists in storing the hive from floor to ceiling as it were. There must be abundance of bees, brood, honey, and pollen, and, as a rule, the whole available space must be filled with comb. The old home is never left destitute, while those that have helped to gather the stores leave all behind and go out to start the world over again with only as much honey as can be carried by each bee filling its honey-sac. Preparations have also been made to replace the queen that is to go forth with the swarm. A number of queen cells are started on successive days so as to provide queens that mature on different dates. The normal time for the leaving of a first or top swarm is fixed by the sealing of the most advanced queen cell in the hive. As a queen takes only seven days to develop after

sealing, this means that the old hive may have a new queen in about seven days after the leaving of the top swarm. In about two days more this new queen will be able to fly, so that bee-keepers expect the second swarm on the ninth day after the first. During those two days of waiting one or two of the other queens may be so far developed as to be ready to come out of the cell, but the worker bees will see to it that they are retained in the cell until the first hatched queen has left with the swarm. During the period of detention those imprisoned queens will be fed through a tiny hole in the cell. It is just at this time that piping can be heard. It is most noticeable at dusk when all around is quiet, and there are two distinct sounds. There is the clear note like "peep peep," emanating from the queen which is loose on the comb, and a deeper note, like "waa waa," produced by the other queens inside the cells. The hearing of those two sounds means two things to the bee-keeper; (1) that a swarm will issue in a day or two, and (2) that it will be accompanied by a virgin queen. The outside preparation for swarming consists in searching the country round about for a new home. The scouts travel far farther than foragers, and may be observed round hollow trees, going into cracks in roofs, or carefully examining empty hives. They are looking for a new home for the prospective swarm, but, if the owner of the swarm knows his business, and is able to attend to it, his swarm will never be allowed to take up residence.

The actual swarming occurs near the middle of a fine day. Bees pour out of the hive in a continuous stream, and fill the air like a cloud of midges. At first they dart about in all directions, but they soon begin to cluster on a selected spot, very frequently within the garden in which the hive is located, at any rate very rarely more than a short distance away When fully clustered there is a mass of bees clinging closely together. If on a small branch it sometimes bends with their weight right down to the ground. As soon as the cluster has begun to form, the scouts go off once more to see whether the new home is still available, and in due course they will return to take away the swarm. The

interval of absence may be short or long, but is usually long enough to enable the bee-keeper to secure his swarm and to remove it from the neighbourhood of the bush on which it is clustered, and which was duly marked by the scouts. If it is inconvenient to hive the swarm at once, the skep, or other receptacle used to contain it temporarily, ought to be shifted from the neighbourhood of the bush, so that the scouts may not be able to find it on their return.

How Bees find their Hives.

It is known that the bees of a stock range the country in every direction for a distance of about 2½ miles, so that the area covered exceeds 12,000 acres. How then do the bees manage to find their way back to their own hive? It has been suggested that bees and homing pigeons and certain other animals possess a special sense—"homing instinct"—or sense of direction—which is represented very poorly, if at all, in the human species. The practical bee-keeper is aware, however, that bees do not need any special extraordinary sense for locating their home. The behaviour of a stock of bees liberated in a new situation is very characteristic. They issue cautiously from the hive, fly in front of it with their heads towards it, obviously observing minutely the appearance of their hive, and the objects in its immediate neighbourhood. The area of their flight gradually increases until finally they are high up in the air describing great circles, evidently observing the greater landmarks—a big tree, a church spire, a prominent building, a stretch of water. The cloud of bees which has been darting about in every direction over a wide area is now seen to gradually condense and again to enter the hive. Their observations have been made, their new situation located, and they are now ready to proceed on a foraging expedition. A stock of bees sent by steamer on a journey, which took three days to complete, was liberated on arrival. Within 45 minutes bees with full loads of pollen were seen entering the hive. It had taken the strangers just three quarters of an hour to locate the position of their home, and to find the

treasures of the field. The foraging bee may wander far from the hive and find itself in surroundings more or less unfamiliar, but it only requires to rise high in the air to perceive the great landmarks for its home—the church spire, big tree, or prominent house, as the case may be. Queens also in preparing for their mating flight carefully locate the position of the hive, and, at the final stage, rise by great circles high in the air. It is the observation of this which has given rise to the quite erroneous idea that the mating of the queen takes place in the "blue empyrean, remote from the haunts of birds, who might otherwise profane the ceremony."

It is evident that the shifting of a stock of bees without due precaution may lead to great confusion and the loss of a number of bees. If the hive, for instance, be lifted at night to another part of the apiary, bees going forth in the morning will be unaware of any change, and, returning to the spot where the hive formerly stood, will become greatly perturbed, will either perish on the old stance, or attempt to enter neighbouring hives. If the stock be shifted a distance of two or three miles the issuing bees will observe that the stance has been changed and will take steps to relocate themselves. Difficulty then arises when a bee-keeper requires to move a stock of bees within the area of twelve thousand acres with which they are acquainted, but it can be readily accomplished if steps are taken to inform the bees that they have been moved. The Americans claim that closing the hive and wheeling it round on a barrow for a certain time is sufficient. The bees will then take care to mark the position in which they have been placed. Another method is to transfer the stock towards evening to a temporary box, in which the bees can be closed up, when all have entered for the night. They are kept confined until the afternoon of the next day, and then transferred to their own hive at the new situation. This enforced sojourn in a strange receptacle makes the bees very cautious in coming forth, and they proceed to mark carefully the new position.

Conclusion.

We know a great deal about the natural history of the bee, but many authors have got into the way of copying, without verification, statements that have appeared in the publications of earlier writers, and we are undoubtedly still ignorant of many facts about the bee which would be interesting and profitable for us to know. It is noteworthy, also, that most discoveries of first class importance concerning bees have not been made by trained scientific men but by earnest bee-keepers, who had no thought of systematic research, but followed knowledge for its own sake, and with a patience which is becoming rare in these days of hustle and haste to be rich. This Bulletin may be concluded, therefore, with the suggestion that the thoughtful and intelligent bee-keeper may do much to advance our knowledge of the bee, if he will only observe carefully, record methodically, and in due course publish the result of his observations.

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How to Handle Bees.

BY

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LECTURER IN BEE-KEEPING.

ABERDEEN: MILNE & HUTCHISON

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NOTE.

THE blocks for Figs. I., II., and IV., which appear in this Bulletin, were kindly lent by Messrs. J. T. Burgess & Son, Exeter; and for the use of the other four blocks I am indebted to Messrs. Steele & Brodie, Wormit, Fife.

J. A.

HOW TO HANDLE BEES.

By

JOHN ANDERSON, M.A., B.Sc., E.B: S.B.A.,

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INTRODUCTION.

MANY people are afraid to keep bees because they have the impression that a bee is a creature going about seeking for somebody to sting. In reality, a bee is a very inoffensive insect, which never volunteers an attack unless the intruder is quite near the hive and likely to interfere with the private property of the colony. A bee inside a room is anxious only to get out, and a bee at work in the garden attends strictly to the business of the moment. The thoughtful bee-keeper is actually grateful that bees have stings, because, if they had not been possessed of some means of defence the species would long since have become extinct—their product is so delectable, and they have so many enemies.

The handling of live bees seems to the novice a matter of such extreme difficulty that the expert bee-master who handles bees without veil or gloves is regarded as a kind of wizard, and receives a great deal of credit to which he is not entitled. We are frequently told of such and such a man who "worked among the bees, and the bees seemed to know him, and he never got stung." The suggestion is that the management of bees cannot be acquired, that a bee-master, like a poet, has to be born, and cannot be made. On the contrary, any person of average intelligence, and possessed of an ordinary amount of patience, can easily and quickly learn to handle bees. It is true, also, that all the experts will admit, when closely questioned, that they began by being dreadfully afraid of the bees. But there are a few simple principles which must be kept in view by those who would handle bees and receive, in the process, a minimum of stings.

Situation of the Hive.

It is a frequent practice to set the bee-hives in a back garden, behind a hedge, or in some other out-of-the-way place, where the bees are usually out of view. In such a situation, the bees have unpleasant associations connected with the visits of the bee-keeper, and they are likely to attack him on sight. If placed near a dwelling-house, where people are frequently passing, the bees soon get used to the appearance of human beings, and come to regard them as harmless animals. This proximity to dwellings has the additional advantage that swarms are not so likely to be lost, for someone in or about the house is almost sure to hear or see them.

The hives must be so placed that the bee-keeper can get in behind them, in order that he may be out of the way of the bees coming from and going to the fields. On this account, a hive should not be set with its back close to a wall, or be placed in one of those low sheds built originally to shelter straw skeps. The shed provided excellent shelter for the straw hives, and did not interfere with manipulation of these, since a skep has to be turned right over in any case. On the other hand, a modern hive must be moved as little as possible, and the bees should be able to use it freely, even while the bee-keeper is handling the combs.

Protection for the Bee-keeper.

Beginners are frequently so nervous at first that they are glad to wear both veil and gloves. The latter can be obtained of material that is quite sting-proof, and with long sleeves attached to the gloves (Figure I.), the bee-keeper is quite safe from stings on the hands. He will soon discover, however, that the gloves hamper his movements very much, and deprive him of that delicacy of touch and deftness in manipulation that is so important in handling bees. His mere clumsiness will irritate the bees, and make them less easy to control. To meet this difficulty, and to help in eliminating the gloves, Messrs.

Figure I.

J. T. Burgess & Son, of Exeter, provide bee gloves which leave the points of the fingers bare, as shown in Figure II. On certain special occasions the experienced bee-keeper may find gloves useful. He may have to take bees out of a hole in a wall, or from some odd corner of a roof or floor, where the use of his bare hands would lead to the receiving of a needless number of stings. Then, during transit, one or more combs might be jerked out of their frames and be found lying on the bottom of the travelling box. With gloves, these could easily be lifted, and, perhaps, most of the brood in them saved. In general, however, it will be found that the gloves are soon thrown aside, never to be used again, except on the very rarest occasions.

Figure II.

The veil (Figure III.) is in a different category, and the writer has no hesitation in affirming that it would make for the comfort of the bees, and for an increase in the honey crop, if expert bee-masters would use the veil more and the smoker less. The most convenient veil is made of fine black net, of a shape that can be readily slipped over the hat or cap, and tucked under the collar of the coat. Veils of coarse netting, or of any other colour except black, interfere seriously with clearness of vision, and wire-fronted veils are inconvenient to carry.

Figure III.

In carrying out any operation which involves shaking the bees off their combs, one may find that several bees, still too young to fly, are crawling over the ground. Trouser clips, such as are used by cyclists, may be found convenient to prevent those young bees from crawling up the legs.

When the bee-keeper has his hands on the combs within the hive any bees flying upwards are likely to be caught within the outstanding cuffs of his coat. These are brought

to a dead stop very suddenly, and are too surprised to fly out immediately. Presently, they reflect that the fabric with which they are in contact is like the quilt of the hive, and the warmth also suggests the proximity of the cluster of bees. So those bewildered insects proceed upward in the hope of soon getting in among their fellows. By and by the bee-keeper, while bending his arm, will pinch the exploring bee, and will be stung. To obviate this danger, gauntlets, as shown in Figure IV., may be worn. Alternatively, an elastic band may be slipped over the sleeve, or the cuff may be merely turned back so as to tighten it round the wrist.

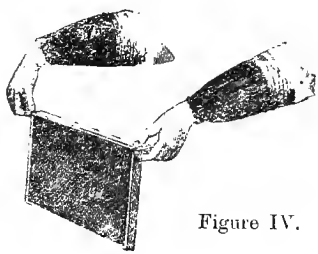

Figure IV.

The Smoker.

The smoker is the most useful implement available for the modern bee-keeper. It consists essentially of a fire-box to contain some fuel, with an attached bellows for puffing the smoke on to the bees. The Clark Cold Blast (Figure V.)

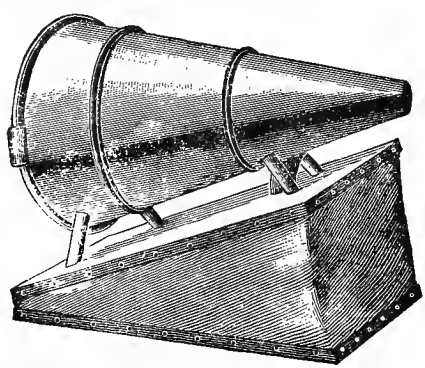

Figure V.

though very largely used in this country, is not recommended, because it is difficult to light and keep lighted, and is not very efficient. In this type the blast of air does not pass through the fire-box. The popular Bingham Smoker

(Figure VI.) is of the hot blast type, is less liable to "go

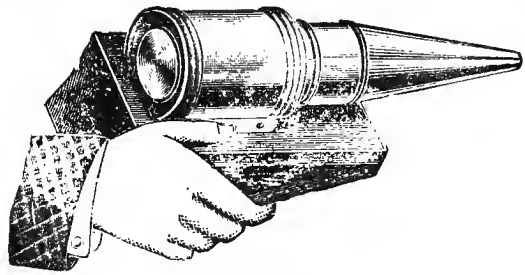

Figure VI.

out" when in use, and has a shield to keep the hands from getting burnt by coming in contact with the fire-box. The Root Standard is a very fine implement indeed, with the one defect, that it has no shield for the fire-box. As one can see from Figure VII., every detail has been well thought

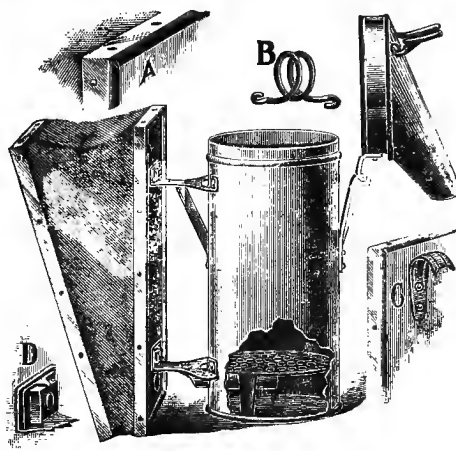

Figure VII

out, even to the provision of a hook with which to hang the smoker on to the side of the hive. The Root Junior is a smaller smoker of the same type, but without the front hinge to the nozzle.

For fuel many employ corrugated paper, such as is used for packing glass-ware. It lights very readily, but burns away very quickly, generating great heat in proportion to

the smoke produced. Ordinary brown paper goes out very readily unless it has been treated with saltpetre. Punk or rotten wood lights easily, and rarely goes out till all is consumed. "Moleskin" and corduroy are excellent, but not always readily obtainable. Very convenient, and usually very plentiful, is sacking or burlap. New material may be used, but, frequently, there is more old sacking lying about than the bee-keeper will use in a season. This fuel is not so easy to light as corrugated paper, but it produces abundance of smoke that is not too hot, and it is not easily extinguished.

The fuel should be rolled loosely in the form of a cylinder of a size to fit easily inside the barrel of the smoker, and it should be lighted at the lower end. The beginner may find it easier at first to light the smoker at the fireside, but he will soon acquire the art of lighting up outside, even in windy weather, by holding the lighted match within the barrel of the smoker until the fuel has caught fire. Then, by working the bellows, a powerful cloud of smoke will be produced.

Subduing Effect of Smoke.

The question is frequently asked why it is that bees which have been lightly smoked are disinclined to sting. Langstroth, the great American bee-keeper, suggested that it induced the bees to fill their honey-sacs with honey, and made it physically difficult for them to curve the abdomen sharply so as to apply the sting. Another view is that the bee full of honey is like most well-fed animals, full of good humour, and at peace with all the world. In any case, it is a fact that bees brought in contact with smoke seem very rapidly to forget that they have stings at all.

We shall probably get a more correct view of the effect of smoke upon bees if we try to imagine what it would have meant for them in their natural habitat, when they dwelt mainly in hollow trees in great forests. There they would be attacked by animal enemies who desired to rob them of their honey. In their effort to burgle the home of the bees, such marauders would necessarily shake the tree and attract

the attention of the bees on the combs. The most effective behaviour in such circumstances would be to rush out of doors and attack the intruding animal with all the might of thousands of stings. By such prompt action the home and property of the colony might be efficiently preserved. Assuming that this instinct of self-preservation has been inherited by modern bees, we can readily understand why it is that the clumsy manipulator is so promptly and severely punished for any jarring or banging of the hive.

But another enemy of quite a different type might menace the home and property of the bees. There might be a forest fire, sweeping all before it, and reducing the great trees to blackened stumps. The bees which survived such a fire, and transmitted the instinct which made for self-preservation, behaved exactly as human beings do in similar circumstances. As soon as the clouds of smoke blowing in at their doors indicated the proximity of an enemy against which stings were of no avail, the provident insects rushed to their stores, while there was yet time, and began to fill their honey-sacs with honey. If the worst came to the worst, and the fire spread to their own tree, they could abandon their combs stored full of honey, pollen and brood, and go out with their queen to find a new home. Every honey-sac being filled with honey, the homeless bees would be in the position of a swarm, having enough stores with which to begin the world over again in some hollow tree that the fire had not reached.

When we know what smoke means to the bees we can use it with much greater effect and with less discomfort to them. It is not necessary to stupefy the bees—as many erroneously suppose—so long as one uses a little smoke now and again to keep up the suggestion of fire; one must avoid, meanwhile, any shaking or jarring of the hive that might suggest an animal robber. The smoker, therefore, when not in actual use, should be set with the nozzle upward, in which position it will draw like a chimney, and be always ready for the moment when the bees show signs of recovering from the notion that they are threatened with fire.

Use of the Smoker.

In the case of a stock of unknown temper, the bee-keeper will be well advised to start by blowing a little smoke in at the door of the hive. This startles the bees stationed near the entrance, who will pass into the interior of the hive, and spread the alarm among the other bees. The operator then passes to the back of the hive, and quietly removes the roof. This, when placed upside down beside the hive, provides a convenient receptacle in which to place the quilts, all of which, except the lowest, are removed entirely from the hive. The quilt next the bees is now rolled gently back, while a little smoke is blown over the tops of the frames, and sometimes between them also. In most cases not a single angry bee will be seen, since all are obsessed with the idea that it is a fire with which they have to deal, and they will be too busy filling up with honey to think of using their stings. In such a frame of mind they will crawl over the bee-keeper's hands and face without making the slightest attempt to sting, unless he is clumsy enough to pinch or otherwise injure them.

Some experts do not approve of blowing smoke in at the entrance, and begin by lifting off the roof. With a good-tempered stock, or in the height of the honey harvest, this may be all right, but there is always the chance that the removal of the roof may jar the hive to such an extent that a few bees may rush out of doors in search of the disturber of their peace. These have not encountered any smoke, and the sight of a bee-keeper so close at hand confirms them in their first notion that it is a robber they have to deal with. They will fly at the intruder, menacing him with their stings, and will go with him from hive to hive, annoying him all the time he is in the apiary. If such angry bees are numerous, and it is essential that the bee-keeper should proceed with his work, he will have to apply more smoke to the bees in the hive. These will become so alarmed that in time the panic will be communicated to the bees on the wing. The necessity for such extreme measures should be avoided.

Manipulation of the Combs.

It is not advisable to have a hive completely filled with frames. There should be room for at least one dummy, by the removal of which extra space can be obtained at one side. The adjacent comb is then gently loosened—if propolised—and moved to the centre of the available space. It can then be lifted clear of the hive, without the necessity of brushing the bees against their fellows on the next comb. When fully examined, this comb is replaced against the side of the hive, and the next is handled in the same way. When all the combs have been duly examined, the dummy is replaced at the other side of the hive. If at any time during the process the bees are observed to be recovering from the alarm of fire, and to be assembling in a threatening manner on the tops of the combs, a little more smoke should be applied.

In accordance with the theory advanced, it will be evident that ease and comfort in handling the bees will depend largely upon correct construction of the hive. If roofs or lifts fit tightly, they will have to be wrenched off, and volumes of smoke may not then suffice to convince the bees that stings are not the best means with which to preserve their property. The dimensions of the inside of the hive must be just right if the combs are to be really movable. If the bee space of a quarter of an inch at the ends of the frames has been exceeded, the bees may build combs joining the frames to the sides of the hive. On the other hand, if these end-spaces are less than a quarter of an inch, the frames may be fastened in with propolis. In either case the combs cannot be removed without some degree of violence, which is sure to arouse anger in the bees. If the half-inch space at the bottom has become reduced through shrinkage of the wood to such an extent that the bees can no longer pass, this narrowed space may be filled with moth-cocoons, which often fasten the bottom bar so firmly to the floor that it is left behind when the frame is forcibly removed.

If the frames have not been nailed through the dovetails at the upper corners, these joints frequently give way, the comb sinks down, and the bottom bar will be found propolised

to the floor. When one attempts to remove such a frame in the ordinary way, it often happens that only the top bar is lifted out. There is no excuse for such unwisdom when bee firms supply special $\frac{7}{8}$-in. nails for making those joints secure. Similarly, if the frames have not been properly wired, or inferior foundation has been used, the consequent irregularity of the combs will make it difficult to remove and replace them without crushing bees and producing undue vibration.

Gentleness and Deliberation.

Too much stress can hardly be laid on the necessity for slow movements when handling bees. Under favourable conditions, it is perfectly possible, especially with pure Italian bees, to go right through the combs of a hive without any smoke—if the bee-keeper has plenty of patience, and time is no object. The bee, like most other insects, moves normally at a high rate of speed, and is scarcely conscious of slow movements. The experienced bee-keeper, as if by instinct, does everything slowly, so as to avoid attracting the attention of the bees. This explains why a visitor to the apiary is more liable to be stung than is the bee-keeper himself. The visitor is alarmed when bees fly past his face, and indulges in rapid gestures which irritate the bees, and increase the number flying about his head. This induces further movements of the visitor's hands, and these provoke further hostility on the part of the bees. The result is that the novice arrives at two conclusions, both of which are erroneous, (1) that he is peculiarly obnoxious to the bees, and (2) that the bees know the bee-master, and consciously refrain from stinging him. The fact is that they would sting anybody who was nervous enough to indulge in rapid movements.

Suitable Time for Manipulation.

There is sometimes real danger that the enthusiastic beginner may manipulate his first stock of bees so excessively that he may lose them, and it should be impressed on him that needless handling of the bees, or opening of the hive at unseasonable times, can only do harm. If no veil is worn,

and stings are to be avoided, a good deal of smoke may have to be used, so as to demoralise the bees. Under these circumstances, an examination in the middle of the day, when the bees are very busy in the fields, might result in great disturbance, and consequent loss of honey. At such a time the bee-keeper is advised to use as little smoke as possible, and to wear a veil, in order to frustrate the attack of the one or two bees that might become dangerous during the handling process.

Many advise opening the hives only in the late afternoon, when the work of the bees will be less interfered with, since foraging has largely ceased by that time. Others recommend the very middle of the day, holding that at this time the older and more irritable worker bees will be mostly in the fields, leaving at home the younger and more docile.

The weather and the season have great effect on the temper of the bees. Cold and wet days, and especially showery weather, make the bees very irritable, because it interferes with their work in the fields. In the late autumn, when the natural flow of nectar has largely ceased, and robbers are prowling round, the bees appear to have their nerves on edge, and may attack anyone who approaches their hives. At such unfavourable seasons they are much more difficult to handle, and more smoke will have to be used.

Influence of Race and Strain.

So-called "black" bees are nervous and irritable, but easily subdued and reduced to a state of panic. If too much smoke is used, they "boil over" the sides of the hive, pour out at the door, and produce much disturbance and inconvenience. They can be readily shaken off their combs, and will run into a new hive without trouble. This characteristic makes it easy to "drive" or "drum" a skep of black bees.

Pure-bred Italians are much more docile, and can frequently be handled without any smoke at all. If a comb of Italians be gently lifted out of the hive, the bees will remain at their work, and the queen will frequently go on laying while the comb is held in the sunshine. In similar circumstances, black workers would be running up and down over the comb, and

the black queen would cease laying at once. She then usually retreats to the bottom of the comb, where she can readily pass over to the dark side, through the slot generally found between the edge of the comb and the bottom bar of the frame. Italians are not readily shaken off their combs, are difficult to drive, and, when fully roused by unskilful handling, are more vicious and difficult to subdue than are blacks.

When the Italian bee is crossed with the black, a mongrel or so-called hybrid is produced, which, like most crosses, is an excellent worker, very vigorous and active, and resistant to disease. They are also very prolific, but are sometimes uncertain in temper and difficult to handle. Experienced bee-keepers find hybrids excellent for the production of extracted honey, but their comb honey is not so white as that produced by blacks.

Manipulation of Bees in Skeps.

Bee-keepers are a conservative class, and many thousands of skeps are still in use. In many cases the knowledge of the skeppist as to what is going on inside his skeps is very meagre indeed, but the expert should be able to handle bees in skeps as readily as those in frame hives. The first step, as with the modern hive, is to create an alarm of fire by blowing smoke in at the door, and more is required than with a frame hive, because the interference is bound to be greater. The skep is then lifted bodily from its board, and turned, mouth upward, at a little distance from its stance. By this manœuvre the operator is less likely to be stung by returning foragers. The weight of the hive gives some indication of the amount of stores, and, by pressing the combs a little apart, one can readily observe sealed brood, and distinguish drone from worker brood. Queen cells are particularly noticeable in an upturned skep, and the bee-keeper thus gets warning that preparations are being made for swarming. One cannot see eggs or grubs unless by cutting out a piece of comb.

It is not easy to handle a skep furnished with ekes or "tops," but it can be done with a little more trouble. The

combs are usually fastened to the eke only to a slight extent, and it is frequently not difficult to lift the straw skep off the eke without breaking any of the combs. In other cases it may be advisable to keep the eke attached to the skep. A top may also be left in position, or it may be more convenient to remove it temporarily.

With an old skep filled with combs, toughened by the cocoons of several generations of larvæ, there is little danger of combs breaking, especially in skeps furnished with cross-sticks, but a skep filled with new combs pretty well filled with honey, even when these are built round sticks, must be handled with very great care. The danger of disaster is greatly increased if the skep be held with the combs horizontal.

While the skep is being examined the field bees will have returned in large numbers, and will be crawling over the board. These should be jerked off by striking the edge of the board against the ground. The board is then scraped clean, the skep replaced on it, and the whole placed back on the old stance.

Other Methods of Subduing Bees.

Bee-keepers who are smokers frequently use tobacco and a pipe instead of a special bee-smoker, and it must be admitted that tobacco smoke is very effectual in creating panic among bees. But one cannot wear a veil while smoking, and the result is that too much smoke is frequently used.

More generally useful than the pipe is the subduing cloth, frequently used alone or in conjunction with a smoker. It consists of a cloth large enough to cover the tops of the frames and sprinkled with some strong-smelling chemical diluted with water. Carbolic acid is frequently used, but has the disadvantage that it is not soluble in water. Jeyes' Fluid, being non-corrosive and readily mixible with water, has been used with success. It is frequently convenient to use two cloths, unrolling the one and rolling up the other, so that only one or two combs are uncovered at one time. During the

robbing season this affords considerable protection to a stock that would be very liable to attack if its combs were fully exposed while the defenders were demoralized by smoke.

In making use of the cloth it is necessary, as with the smoker, to intimidate the bees just inside the door of the hive. Placing the cloth in front of the entrance for half a minute or so will be sufficient. The quilt next the bees is peeled off and replaced in the same action by the subduing cloth, and this may be accomplished so deftly that not a bee will fly up. The bees set up a great humming, and retreat from the "poison gas." In about a minute one edge of the cloth may be rolled back and the bees handled as usual. When not in use the cloth should be kept in a canister or in a sponge bag in order to keep it moist as long as possible.

Effects Produced by Stings.

A bee can kill another bee only by stinging it between the joints of its chitinous armour, and a sting so delivered is usually rapidly fatal. A bee that has received a mortal wound crawls out of the hive, using mainly its fore-legs, since the others are frequently paralysed at an early stage. The abdomen of such a bee has a typically twisted look, which persists after death, and enables the bee-keeper to tell by examination of the dead bees when fighting has been going on at a hive.

Applied to the human skin a sting produces a sharp pain, followed later by characteristic swelling. We cannot promise that the bee-keeper will never be stung, but we can assure him that in most cases he will acquire "immunity" after receiving a certain number of stings. The pain of the sting at the moment of infliction will still be felt, but this will not persist for more than a second or two, and there will be no swelling or other after effect. This immunity is almost certainly due to the development in the blood of the bee-keeper of an antitoxin which neutralizes the sting-poison.

As indicated in the Bulletin for Prospective Bee-keepers, there are a very few people to whom even a single sting continues to be a serious matter. In such cases, a sting

received on any part of the body produces swelling of the lips and face, a choking sensation in the throat, and frequently blisters or red spots all over the skin. Those who are affected in this way should not try to keep bees. Beginners should avoid getting their first stings on the face, because such stings give considerable pain and sometimes cause quite remarkable swelling. Both eyes may be completely closed by a single sting. On the hands bee stings are much less serious and quite as effective so far as acquiring immunity is concerned.

Structure and Action of the Sting.

The sting of the worker bee consists essentially of two barbed darts working inside a brown sheath, which is frequently, but erroneously, believed to be the sting proper. These darts get so firmly fixed in the human skin that the bee as a rule is unable to free itself except by tearing the sting and its appurtenances away from its body. An examination of the sting thus detached will show the brown sheath with its hollow point embedded in the skin, the white muscles which work the darts, and a little bladder containing a crystal-clear fluid with a characteristic aromatic odour. This is the sting-poison which is pumped into the wound by the alternate action of the darts, and which is responsible for the pain and the swelling. The diffusion of the odour of bee-venom incites other bees to sting. For this reason one should avoid killing a bee if at all possible, for the bee *in extremis* always thrusts forth its sting, thus producing the characteristic odour. Apart from this effect, the killing of a bee causes no concern to her companions. If any honey is exposed in the crushed body of the slain bee the others near at hand will calmly insert their trunks and lap it up so that nothing may be lost. On account of the irritating effect of this odour a bee-keeper, who has received stings in his coat or veil, may find it advisable to exchange these for others or to wait till the sting-poison has dried up and become odourless.

For some minutes at least after the bee has freed itself, the white muscles of the detached sting will be observed to twitch rythmically, and close observation will prove that the

sting is visibly digging itself deeper into the skin, while more and more poison is being poured into the wound. This indicates that the sting should be removed with all speed, and it must not be simply plucked out by finger and thumb, for this would squeeze the poison-sac and drive more venom into the wound. The finger-nail or the blade of a knife should be placed against the point of the brown sheath just where it enters the skin, and the sting should be scraped out without any pressure being applied to the poison-sac. In order that stings near the eyes should be quickly removed it is advisable that the bee-keeper should carry a tiny pocket mirror.

A whole host of specifics have been recommended for bee-stings, each being guaranteed to allay the pain immediately and to prevent all swelling. Alkalis, such as ammonia, are frequently recommended, on the ground that bee venom is a weak solution of formic acid. The fact is that sting-poison is just as effectual after its acidity has been completely neutralized, and, in any case, the microscopically small aperture made by the sting has completely closed long before anything can be applied. The active principle in the poison is probably a very subtle substance, and the only efficient antidote is that prepared in Nature's secret laboratory, situated in this case within the body of the bee-keeper that has been frequently stung.

Conclusion.

An attempt has been made to explain to the beginner the methods used by the expert in handling bees. In most cases the principles underlying the practice have been discussed at some length so that the bee-keeper may use the various methods with intelligence. It is not claimed that perusal of a bulletin is the quickest or best way of learning to handle bees, but a study of the problem beforehand, with an occasional revisal as experience is acquired, should be of considerable service.

It is essential, however, that the novice should have an opportunity of seeing bees handled by a competent bee-

master. Every summer the Lecturer in Bee-keeping conducts a number of public demonstrations at various centres throughout the College area, and bee-keepers are always welcome to visit the College Apiaries maintained at Craibstone and in Aberdeen City. Beginners, who may be unable to avail themselves of such opportunities, should apply to a competent bee-keeper for a lesson or two. In the selection of such a demonstrator the novice should not too hastily assume that one who has kept bees for some time must necessarily know how to manage them. Many who have "kept" bees for years are quite unable to handle them, and may be almost entirely ignorant of what is contained in the brood chambers of their own hives. On the other hand, we have in the north of Scotland a large number of bee-keepers who have little to learn in the art of handling bees, and any one of these would be delighted to give a private demonstration to a beginner. Once the initial difficulties have been got over, the budding expert will make very rapid progress if he is willing to assist others not so far advanced. He will thus profit by the mistakes of others as well as by his own, and will crowd into one season the experience that might otherwise have been spread over several years.