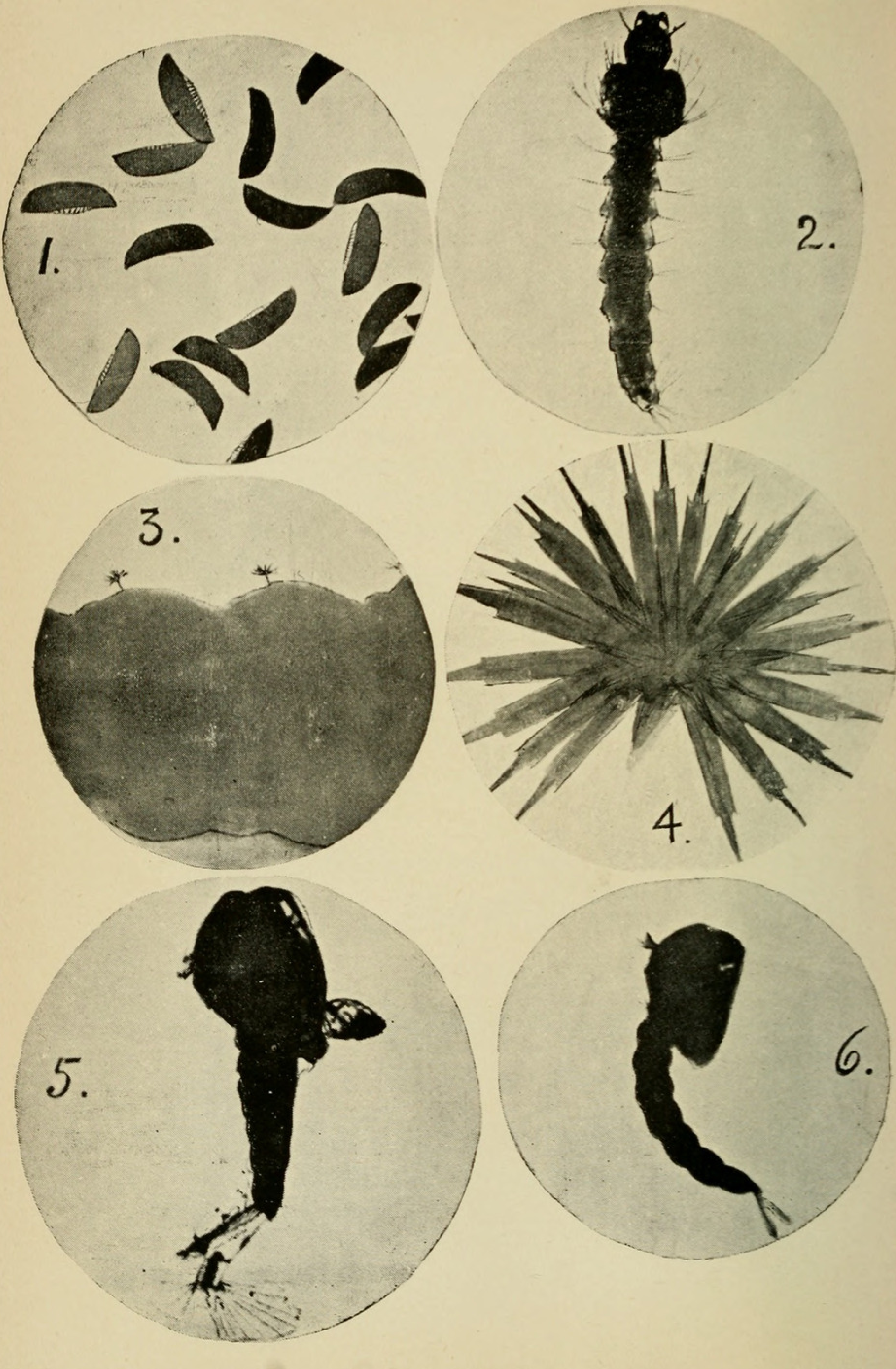
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NOTES ON A MALARIA-CARRYING MOSQUITO.

(ANOPHELES PICTUS.)

(Plates I.—IV.)

By W. R. COLLEDGE.

[*Read before the Royal Society of Queensland, 22nd September, 1900.*]

I have the pleasure of presenting to you a few notes and illustrations of the particular kind of mosquito which propagates malarial disease. It is only within the last few years that it has been suspected of fulfilling this function. But an elaborate series of experiments have been conducted in various places, and the suspicion has deepened now into a scientific fact. Pure bred mosquitoes have been allowed to bite patients suffering from malarial fever. Some of these insects have been dissected, and the malarial germs seen in the stomach, salivary glands, and proboscis. Some of the same batch of insects have bitten healthy persons and inoculated them with the fever. The chain of evidence is therefore so complete that the English experts do not require any more experiments on human beings. The evidence accumulated is considered amply sufficient to establish the fact. As probably ten millions of people die annually from this disease, and three or four times that number are disabled from pursuing active occupations for considerable periods, this discovery is fraught with deep interest to the inhabitants of the tropical world. Various experiments made in India, Africa, and Italy with the common mosquito, gave negative results, so that the ordinary kind is not thought to convey the decease. But a particular kind called the Anopheles is the one concerned. They are found around Brisbane, but in small numbers. Out of a thousand collected under ordinary circumstances, probably only one would belong to this particular variety. As you travel north I think the proportion increases. Some came to me from Cairns, and the batch contained twenty per cent. of the Anopheles. It must be understood that the Anopheles are naturally free from malarial germs. It is only where they can suck the blood of malarial patients and so receive the germs that they become propagators of the disease. The eggs are difficult to find. They are too small to be seen by the naked eye, being only the fiftieth of an inch in length and two hundredth in breadth. They are not massed together into a raft like the ordinary culex eggs, but are laid separately on the water. In Fig. 1 a number are seen. They are shapen like a beautiful little boat with curved ends. The boat used by the ancient Britons called a coracle bears a strong resemblance to them. On looking at the upper edge, or gunwale, a slender line is traceable. This consists of a thin loose membrane falling over the inside of the vessel in transverse folds. Turning a boat bottom up this silken canopy may be seen projecting on both sides. This no doubt helps the boat to preserve an even keel, and probably acts as an attachment to anchor it to a twig or stone, and when the egg is hatched its thin skin can easily be ruptured by the young larva in its effort to crawl into the water.

In the next stage the larva are easily distinguished by certain peculiarities of structure and habit. They can be found in our district at all times of the year in suitable places. The most likely are low-lying grass fields, which are often submerged and form shallow pools not sufficiently deep or permanent for the existence of fish. I have never but once found the larva separate from those of the ordinary mosquito. In Queensland the two varieties are generally together, and I have found them so at Southport and the Tweed Heads in old barrels containing water in the open air. The most distinguishing feature is that while the culex larva hang with the tip of the tail above the water, and the body hanging down in an almost perpendicular direction, the Anopheles stretches himself out on the surface like a bit of stick. It may be vanity that induces him to assume this position, for he is certainly more handsome than the common variety. The body is usually of a mottled brown colour, occasionally they are black, with a white collar and one white abdominal segment. On the back of the thorax is often seen a shield, in shape like a diamond, a heart, or the letter U.

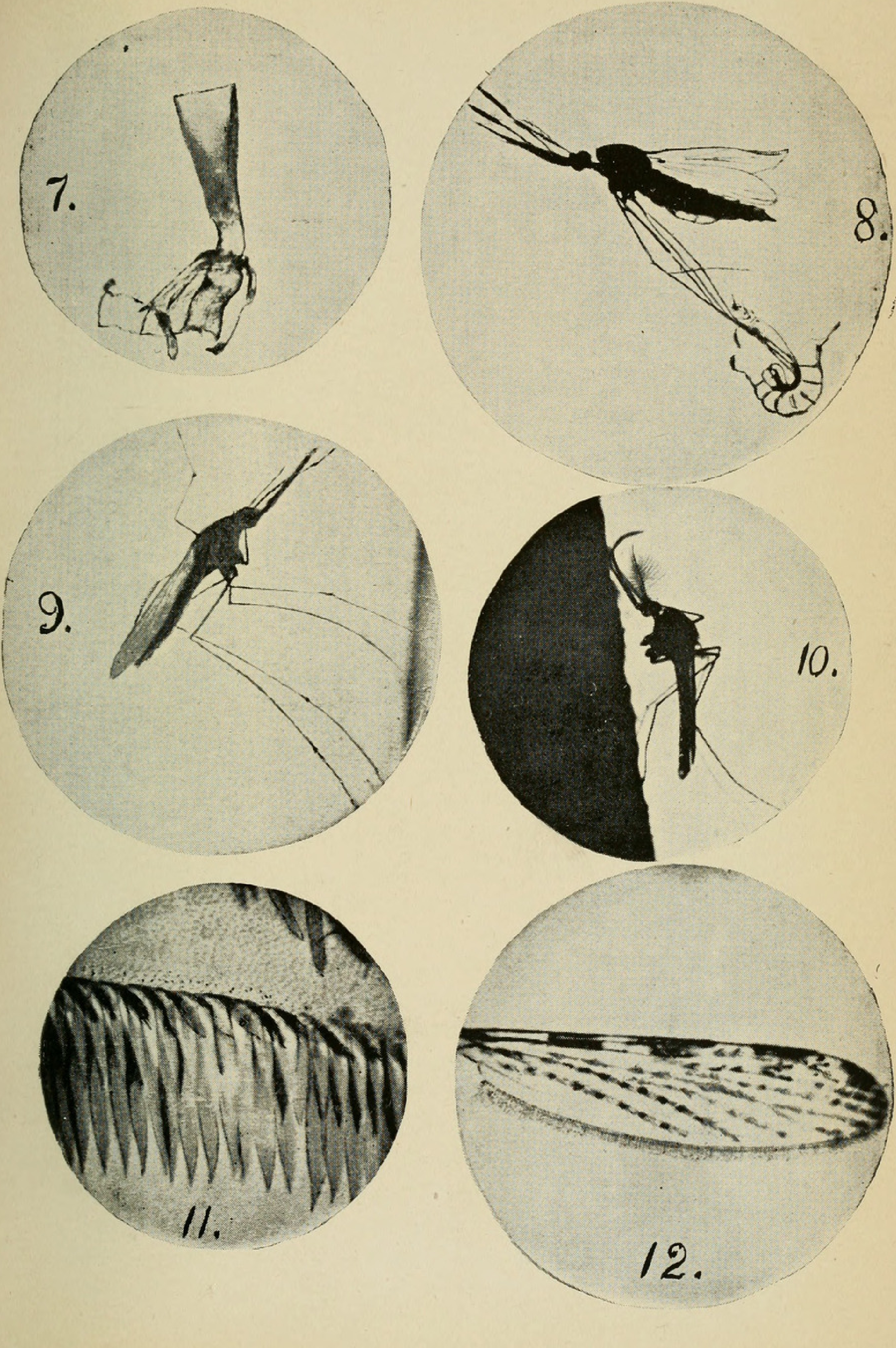
The colour is sometimes cream, or varying shades of pink up to red. Patches of the same colour are often repeated on the centre of the third, fifth and seventh dorsal segments. Sometimes two stripes run parallel down the back. They are therefore more handsome and interesting than the common mosquito. Its head is also smaller, the maxillary brushes curve in the opposite direction and are less complicated. The neck is very flexible. A frequent practice is to twist the head round so that the forehead lies in the same plane as the abdomen. This position does not appear to be inconvenient, for it eats and swallows food all the time. One of these gentlemen is seen in Fig. 2. You can see the small, narrow, slightly oval head, the expanded brushes, and the tail differs entirely from the ordinary kind. The long projecting tracheal tube has disappeared, and though a paddle with four triangular blades is there, yet it is small, and projecting downwards is a broad fan composed of setœ or strong bristles, enabling it to swim rapidly through the water. Three of the terminal segments are seen in the next slide, showing more clearly the propelling apparatus with two of the triangular paddle blades, the other pair are hidden by the bristles. One peculiarity of the Anopheles is what I have called a series of epaulettes on the segments of the back. Their discovery about a year ago was, to me, a source of great pleasure. I do not know whether they are actually new to science, but I have not seen any reference to them in the literature on the subject, so it is possible that they may be so. Six of the abdominal segments bear a pair of these peculiar organs on their dorsal surfaces, so that there are twelve altogether. They rise on a short channelled stalk from the skin and then spread out their star-shaped leaves like a flower. The radii would form a complete circle or star, but that on the side directed to the body a few of the points are always missing. It therefore forms three quarters of a circle. In Fig. 3 are three abdominal segments showing how they rise upward from the back. The next slide is a perpendicular view showing how they are arranged on the back; one is traceable in each corner of the segments. Fig. 4 gives a good idea of the structure, but the view being taken at an angle does not give so natural an idea as the succeeding slide. Rising upwards like a flower, anyone familiar with high power photography will know the difficulty experienced in representing the parts lying in different planes in one picture.

It is a problem of some interest to determine the function of these beautiful organs. I think they mainly fulfil a mechanical office in enabling the larva to float on the surface with the least muscular effort. The body, denser than water, will tend to sink, but the epaulettes being flush with the surface must by capillary attraction lay hold of the air film. Their slender star-like points will lay hold of it. There will thus be twelve epaulettes pulling at the air film together, counterpoising the specific gravity of the body and enabling the larva to lie and breathe without exercising any muscular effort in maintaining that position.

I have found another variety with longer epaulettes much finer in structure, the rays rising more in a perpendicular manner, not unlike a feather duster, and when it died the leaves clasped a bubble of air, like the fingers of the hand clasping a cricket ball. In confirmation of this opinion I have seen the tips of the epaulettes showing slightly above the water's surface. Likewise on moving they do not sink like the culex larvæ, but slide over the surface with a sharp zigzag motion, first in one direction then in another. But when alarmed the body is bent into a curve, so breaking the adhesion of the outer epaulettes to the air, they then sink to the bottom of the pool lying motionless for a considerable time. They may likewise be the receptive organs of some special sense of which we have no knowledge.

An excellent book on Gnats and Mosquitoes has just come to hand as these pages are being revised for printing. In it one of the epaulettes is figured and termed a natatory hair from the body of the larva. But this is a very insufficient description of the beauty, and does not form a satisfactory idea of the functions fulfilled by these beautiful organs. Their position on the dorsal surface and the break in the leaves being directed inwards towards the back seems contrary to the idea that they are swimming hairs, and a fuller investigation I think will confirm the opinion I have expressed.

As the larva grows the old skin is shed, and it acquires another more suited to its development. More practical than men and women, their habits of economy are carried so far that when they have stripped off their old clothes they generally eat them. Frequently there is a rush among the members of the family as to who is to catch them first. The next slide represents a part of one of these discarded garments. It shows the skin covering the tail segments, the long branching hairs by which it was propelled through the water. Further up eight of those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beautiful epaulettes may be counted. The ladder-like structure consists of the two tracheal or air tubes, which traverse the sides of the body, while the cross bars are the dorsal plates. These two air tubes terminate in the tail segment. In the culex they project beyond the body. Here they are cut off flush with the skin of the back, forming two circular apertures. These are closed by valves when they descend so as to shut out the water. Occasionally some obstruction gets into them and they bend like a ring, and sweep the maxillary brushes across until the obstruction is removed.

The larva feed on organic forms attached to the stems and leaves of aquatic plants. They can be seen industriously sweeping their head brushes along and swallowing the product. And I should think the hunter after diatoms might be rewarded by finding some of these beautiful forms in the stomach and intestines.

They remain in the larval state much longer than the ordinary variety, and likewise show the remarkable effect of cold in retarding their development. During mid summer, the cycle of change from the deposition of the egg to the fledging of the matured insect may occupy a month, but in cold weather double that period is required. This is about three or four times longer than the time occupied by the ordinary variety. This is a great check upon the production of the insect in Queensland. It so often chooses shallow pools for the reception of its eggs, and these pools, under the dry winds and porous soils of our colony, dry up long before the period of incubation is ended, so that a very large portion of the insects die in the immature state. The next slide represents a composite creature. I had the good fortune to secure one of the larva passing into the pupa stage (see Fig. 5). It has burst through the larval skin, and the round projection on the shoulder is the head of the old larva, whose skin partially invests the pupa. The tail, with its propelling setœ, and a number of those beautiful epaulettes, are seen at the side. The next view (Fig. 6) is one of the pupa entirely free. This is a lateral view of his lordship. Attached to the last segment of the abdomen are two broad flappers, which are used to propel him through the water. From the sides of the head arise two breathing tubes, or thoracic spiracles. They project, and are thrust through the surface of the water for the purpose of inhaling air, which is distributed by various tubes through the body, and helps to develop the future mosquito. Through the partially transparent case of the pupa may be traced parts of the insect. The head, with its organs, wings and long legs are very neatly packed up inside. To show how these spiracles are situated, I have a view of the gentleman's back, taken as he floats on the water. He was alive, and had the good manners to remain still on the stage of the microscope while he was having his portrait taken. In the succeeding view (Fig. 7), is one of the spiracles detached. It differs in shape from the organ of the ordinary Culex, so that the pupa may be distinguished by this feature alone. In the Culex it has a resemblance to the leg of a Wellington boot with the top cut off transversely. In the Anopheles it is shorter and open for the most part of its length. It is not unlike the coal scoop seen in the parlour coal boxes in the old country. Before leaving I will show you the powerful swimming apparatus attached to his latter end. Being almost transparent, it does not photograph well, so this is taken on a dark ground, and brings the outlines very distinctly before you. The next object is a live cell with a number of the pupa disporting themselves in the water. You see the way in which the tail fans strike the water backwards, the rebound projecting the insect through the water as though it were a football driven by a powerful kick.

The succeeding picture (Fig. 8) shows the final stage being completed. Here the insect has been matured in the pupa case. This may occupy three days in summer or a fortnight in winter. It has been preparing for a change of life, and has seemed conscious of some impending change, for it manifests a general uneasiness, darting through the water with quick, jerky movements. Then, if carefully watched, the skin at the back of the head is seen to split; then the mosquito's head appears. Slowly the slit enlarges, and the shoulders and chest appear. No decided motion is traceable for a while, but still there is progress. Now the insect bends forwards, releasing a little of the wings and body; then bending backwards a little more of the legs is freed. So this alternate movement continues until the forelegs are free. These are then placed on anything near, and by the leverage they give the rest of the body is soon cleared. When the wings have been outstretched a few times they are put to their intended use, and bear the insect away to new fields and pastures green. In this figure the insect has succeeded in disengaging itself with the exception of the tips of its long legs, which are entangled in the pupa case. When once free the Anopheles are easily distinguished from the common variety. Here is one of the common kind (Fig. 10). It was photographed alive, so it is in a perfectly natural position. Its body hangs nearly parallel to the surface upon which it rests. It is supported by the fore and middle pair of legs. The hind pair curl backwards and project into the air. If ever you see a mosquito with its hind legs in that position, you may be sure it does not belong to the Anopheles variety. The latter uses the whole of his six legs to support itself. They are very long, the hinder ones much more so than the front. When they are planted firmly down the body projects at an angle varying from 30 to 45 degrees. The next slide (Fig. 9) is a natural photo. of one of these gentlemen. He was good enough to allow me to operate upon him, and the position shows very distinctly the difference between them and the ordinary mosquito when at rest. They can be picked out by any ordinary observer.

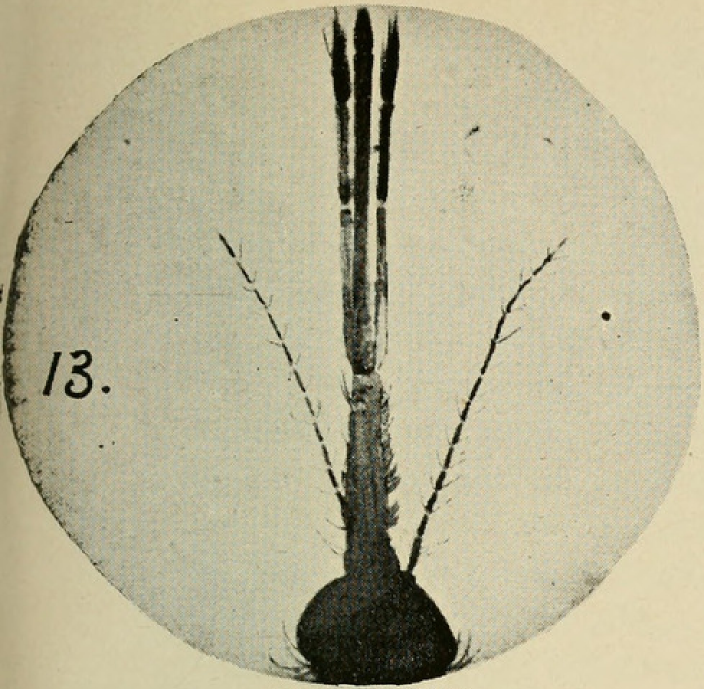
Another distinguishing feature is their spotted wings. One variety of the ordinary kind, usually called the Scots grey, have faintly spotted wings, but the marks are not nearly so distinct as in the Anopheles. In the figure (No. 12) the dark spots and light spaces are clearly manifest. In the light portions the scales appear to be absent, but a careful search shows them to be still there, but almost devoid of colour. This peculiarity of the wings is most beautifully seen when the microscope is arranged for dark ground illumination. The nervures of the wings are traversed by a double row of scales, set at an angle to each other, and a deep fringe of long sword-shapen ones hang from the lower border of the wing. The next slide (Fig. 11) shows this beautiful fringe. Here is one with scales taken from various parts of the body. They differ a good deal in shape, and are inserted like shingles on the roof of a house, the tip of one being overlapped by the base of the next. An exception to this is found on the back of the head ; here the scales are wedge-shaped and set upright like plumes.

Certain appendages of the head differ from the ordinary mosquito. One of these is the length of the palpi in the female. On the screen is the head of a female of the common kind. The palpi are short, not more than one-fifth of the length of the proboscis. In the next view (Fig. 13) is seen the head of the female Anopheles. The antennæ stretch out on each side, but the palpi are prolonged until they nearly equal the proboscis in length. That is a characteristic feature of this family.

The male organs of the head also have their peculiarities. The succeeding slide (Fig. 14) shows the proboscis in the centre. The palpi are longer, and near their tips expand into a club-like form. Below are seen the beautiful feathery antennæ so characteristic of the male sex. Many of you are aware that these are musical instruments, made and pitched to receive the notes of the female's song. She is the player, he the instrument upon which she plays, a relation not exclusively confined to the mosquito family.

The palpi are supposed to be organs of touch, but the insect does not appear to use them for that purpose. The organ of touch is the proboscis, the fleshy tube in which the lancets lie. The tip of this organ is deeply cleft, so as to form two fleshy lobes bearing hairs which are probably tactile. I have seen it pass over fruit, and up and down the ridges on the skin of my hand apparently seeking for a suitable place wherein to bore.

Very exaggerated statements are heard about the piercing capabilities of the lancets. My own experience goes as far as this: I have gone into their haunts with soft chamois leather gloves, such as housemaids use, on my hands, and they have pierced through these into my hands. The female possesses six lancets, these are so constructed that they all fit together like one weapon. The lingua or tongue is the largest and takes the form of a long hollow tube, the end sloping down to a sharp point. Around this the other lancets are grouped, these are too slender and delicate to be used separately, and fit closely around the stronger barrel of the tongue. Two of these lancets, the maxillœ, however, are barbed for a short distance from the tips on their exposed sides. Here is a highly magnified representation of one: a dozen teeth fine at the tip and then gradually enlarging are clearly visible. This constitutes a neat double surgical saw, not meant for cutting bone but flesh. These two barbed lancets are longer than the rest and project backwards into the head where they terminate in a sort of hammer head. In this photo, Fig. 16, you see how they project backwards beyond the rest. To the ends of this cross hammer, strong muscles are attached, and by them these two special lancets can be pulled up and down, sliding over the tongue which acts as a guide. So they are used to enlarge the original puncture and cause a freer flow of blood for the tubular tongue to suck. It is a peculiar and interesting provision for the insect's welfare. If the hypodermic needle of the principal lancet were simply thrust into the skin, unless it pierced a blood-vessel, little blood would flow, for the flesh would close round the sloping aperture and choke it up. But by the action of these little perpendicular saws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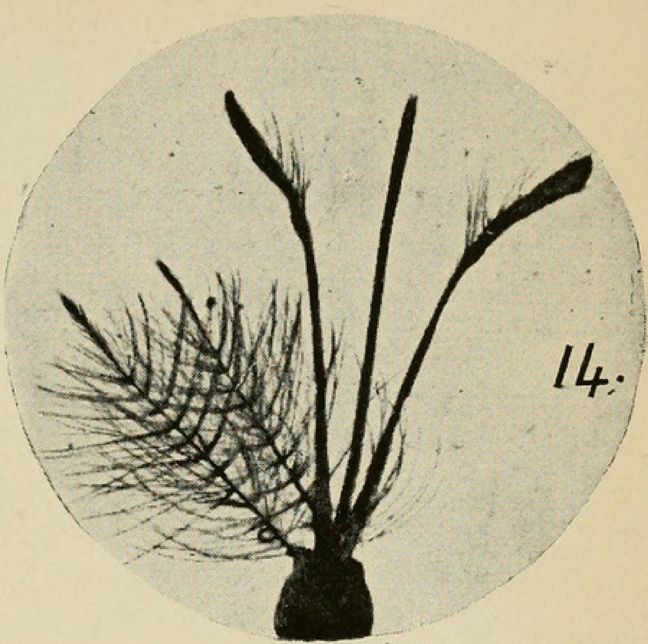
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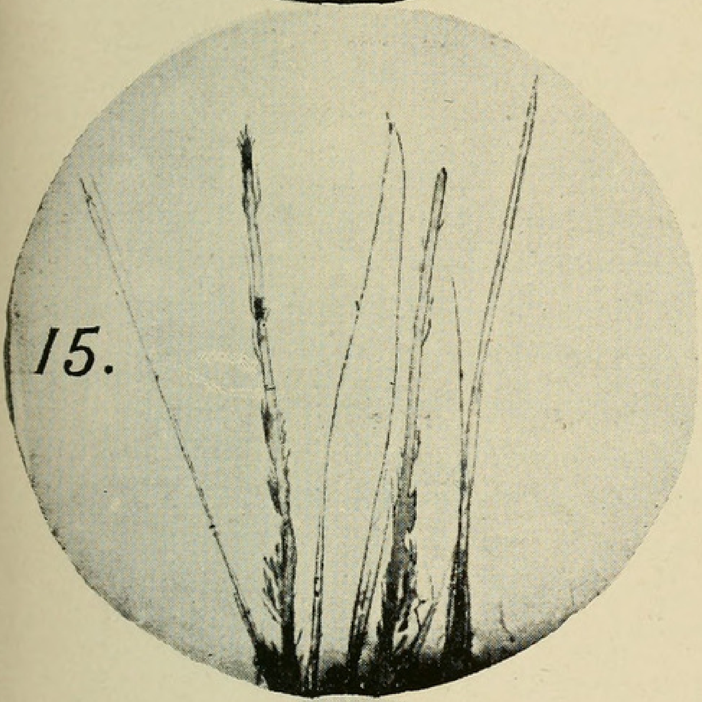
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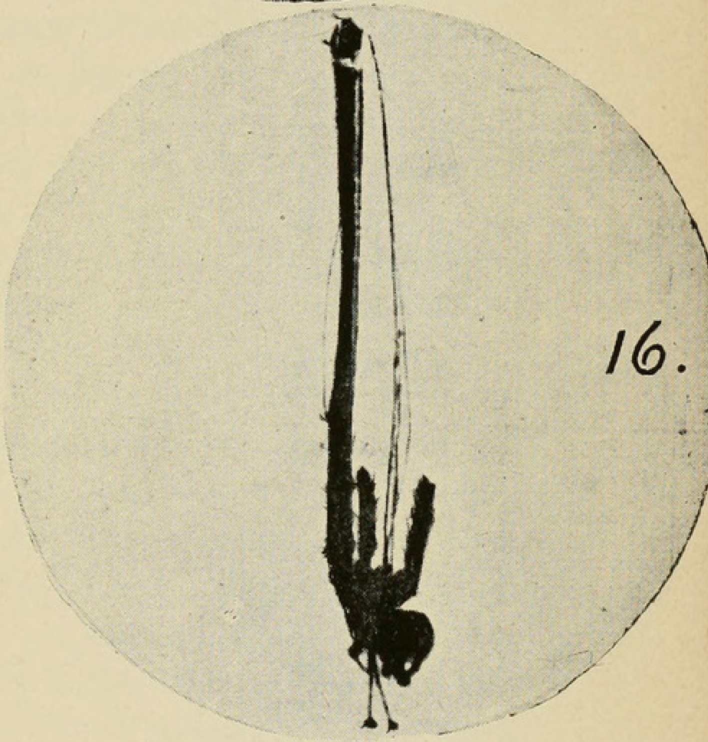
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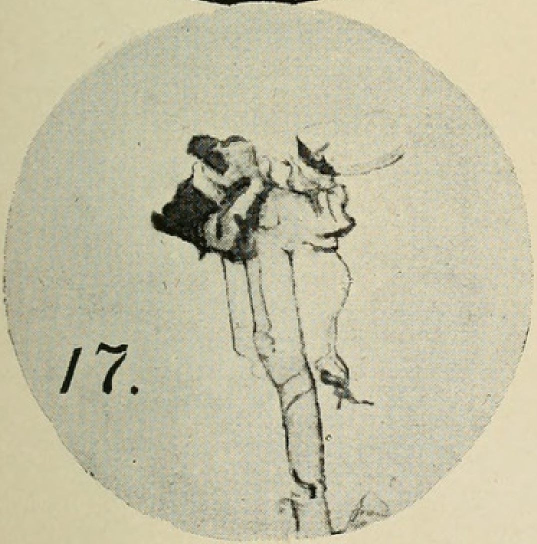
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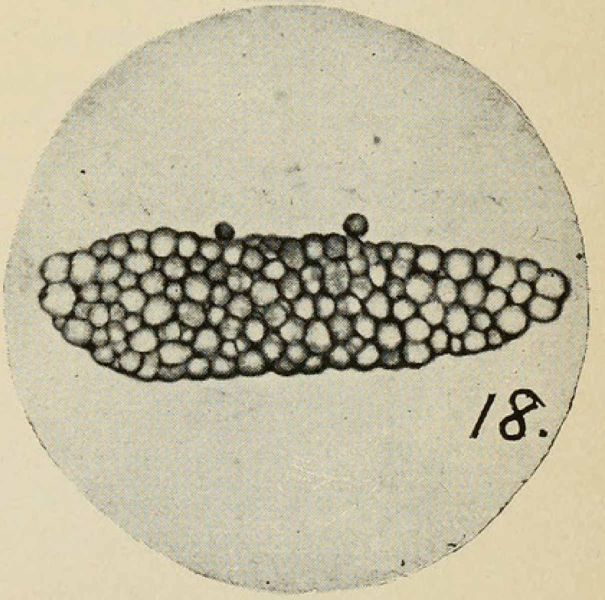
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the muscular structure of the victim is sawn around the point, the aperture is kept clear and a freer flow of blood insured. I made a little glass cell, big enough to hold a mosquito, and capable of being strapped to the finger, or on any other object, and of being placed on the stage of the microscope at the same time, and I found that they could not pierce the fruit of the fresh pineapple. They could freely suck up the juice, but when they tried to pierce the fruit they failed. I could see the combined lancets bending like a fishing rod under the force with which they were thrust against the fruit, but it was too tough for them to penetrate. The poison and salivary glands of this species are small and delicate and difficult to separate in an uninjured state. They lie in the prothorax contiguous to the neck, and appear like three long sacs, the central being the largest, and somewhat larger at the base. They have a granular appearance, and are each traversed centrally by a fine ductule, which collects the secretions. The three ductules then unite, forming one tube which joins at the neck, the tube proceeding from the opposite set of glands. It passes along the under part of the head until the base of the large sucking lancet is reached, where it terminates in a circular cup. This is now on the screen, see Fig. 20, the lancet is magnified so that it appears like the mast of a ship, and out of the centre of the cup there hangs the poison duct, looking like a ship's cable. This enables you clearly to understand how the poison and salivary fluids are conveyed from the glands to this tiny reservoir. When the lancet is thrust into the skin, that exertion probably injects the poison fluid into the wound, then the suction apparatus is brought into play. The base of the lancet curves back in the shape of a tube, and then expands into a hollow bulb or pump, Fig. 19. It really acts as a reservoir, and I think the work of sucking is performed by the ringed muscles of the æsophagus and proventriculus which are attached to spiny processes at the further end of the bulb.

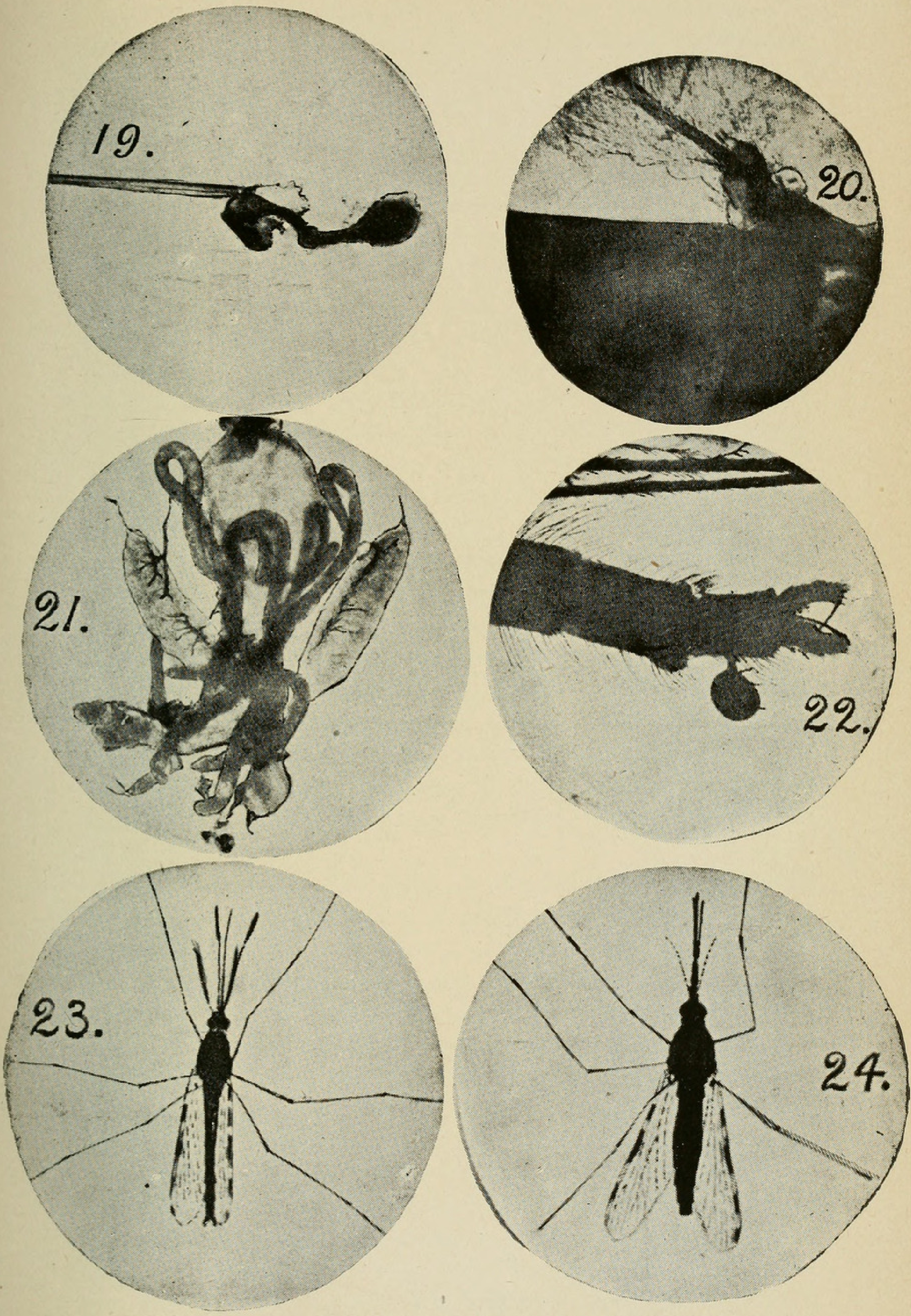
With regard to the function of respiration very elaborate organs are used to ensure it The oxygen of the air is as necessary for its existence as it is for us. We inhale air into the lungs, the corpuscles of the blood extract the oxygen and carry it to all parts of the body where blood vessels go. But if we could empty out all the blood, and after filling all the arteries and veins down to the minutest capillary vessels with air, and send it circulating through the system, that would be an illustration of the way in which insects breathe. The whole insects body is like a lung. Air is received by openings on the body called spiracles. Here, Fig. 17, is a photo. of one on the pro-thorax, immediately behind the first pair of legs. It is oval and fringed with a row of hairs like eyelashes, for filtering out dust. From the orifice large tubes proceed. These are built with a spiral fibre running round the interior wall. The india-rubber tube of a gas stove, with its spiral wire furnishes us with an illustration of it. So these tracheal tubes are kept distended for the passage of the air. They branch like a tree, gradually growing smaller the further they extend. By this means air is carried to all parts of the body. On each of the lower part of the abdominal segments are a pair of these spiracles, but so minute as easily to escape observation. This tracheal system is the source of an immense amount of trouble, and annoyance to the anatomist. Their tiny branches clasp every organ of the body, and being so tough and elastic are very difficult to separate without injuring them.

In the interior of the body occupying the space between the chest muscles and the stomach is a long transparent air sac, filled with separate bubbles of air or gas, Fig. 18. The bubbles vary in size from the three to two-hundredth part of an inch in diameter. A transparent silk bag filled with india-rubber toy baloons would resemble on a large scale the air bag of the mosquito. The walls of the air vesicles consist of some oily fluid, on rupturing the sac they float on water some time before they disappear. On the back of the thorax, where it joins the abdomen, are two club like organs projecting outwards. They look like an aborted pair of hind wings. Here is a view of them on the screen. The connection between them is simply a piece of skin torn from across the back. Scientists are not agreed as to their function. They are called halteres or balancers, because if one is cut off the insect cannot fly straight. They are therefore thought to be helpful in preserving a balance, just as the pole of a tight-rope dancer enables him to adjust. By some they are thought to be organs of hearing or of some special sense. They are freely supplied with nerves, and are jointed at the base so that they can be moved through the portion of the arc of a circle. I have seen them sink down to the sides, and then rise in a step by step motion until they have attained their altitude, then sink and rise in the same way every six or eight seconds.

We have in Fig. 21 a view of the stomach and other organs of the abdomen. The air sac is attached to the upper part of the gullet or æsophagus. The latter tube possesses strong muscular rings, and gradually expands as it enters the stomach. This is a very expansible muscular bag, swelling out to a considerable size after a good meal of blood. It may be dissected into five coats. The outer consists of a network of trackeal or air tubes, below this are two coats of muscular fibres crossing each other at right angles. Then comes a thin structureless membrane, and lastly the lining membrane of the organ. From the lower portion of the stomach five blind tubes arise, they look as if they had been grafted on the organ ; they rise parallel to the sides, then bending backwards, curl about the lower part of the abdomen, the outer end of each tube lying free in the cavity of the body. They are called the malpighian tubes, and are supposed to exercise functions similar to the liver. They appear to be divided into angular partitions, and large circular cells of a glandular nature dot their walls at regular intervals. A little lower on the screen lies the intestine. It is attached to the last segment of the body, showing the two terminal hooks. The whole of the organs of the abdomen are subject to a perisaltic motion ; they are drawn upwards towards the chest, and then thrust downwards with a regular rhythmic movement every few seconds. In the downward act, the muscular walls of the large intestine roll in concentric waves and force the contents onwards, and in the upward act the contents return to the end of the section in which they lie. There is thus a continual movement of the contents of the intestines, exposing them thoroughly to the digestive fluids.

This is the interior of a female, and these two large projections on each side are the egg sacs. In the unimpregnated state they are made up of clear globular cells, each with a nucleus not unlike two masses of colourless grapes. A big air-tube passes over the upper portion, giving off branches, which ramify not only over, but right through the egg mass. From one end of each sac, a tube leads to the lower orifice of the body, and when the eggs are ripe they pass down singly and are conveyed to the outside, being placed into position by the terminal hooks on the body. At the lowest point of the slide is seen what appears to be one of the renal capsules. It is an oval brown vesicle.

The parasites of Malarial fever have received a large amount of attention. Successive observers in various countries have been gathering up facts, and their life history is being steadily unravelled. Drs. Manson and Ross state that blood drawn from a malarial patient has a peculiar character. A large number of the red corpuscles are filled with pale protoplasm. In it are a number of black specks or rods. These concentrate in the centre, the protoplasm arranging itself around forming a little rosette. The walls of the blood vessels collapsing, the rosette floats into the liquor sanguinis. Afterwards the rosette splits, the black clump remaining and spores are set free. Some of these penetrate red blood corpuscles, as pale specks. These soon begin to throw out feelers in various directions, at the same time wandering round the limits of the cell wall. They increase in size by assimilating the hœmoglobin. By-and-bye appear the characteristic specks of black pigment again. These little detached feelers which wander about the blood fluid, and penetrate corpuscles, appear to be of the nature of spermatozoa, and propagate the disease. And the problem that struck Manson was, how do they first find their way into the malarial patient. In studying the matter, he concluded that the mosquito was the most likely source. Not having the opportunity of working out the subject thorougly, he enunciated his views and consulted with Dr. Ronald Ross, then about to proceed to India. By a series of most patient and careful experiments, he demonstrated some of the leading links in the process. Other experimentors look up the subject and none more enthusiastically than the Italian doctors, who have completed the subject. On Manson's recent visit to Rome, Professor Grassi showed him the pigmented vermicule in the inside of the mosquito's stomach. It had got there by being fed on the blood of a fever patient. Another specimen showed it penetrating the stomach wall between two epithelial cells. In another it rested in the interspace formed by the crossing of the muscular fibres. Then it was shown as a wart on the outer stomach wall. In the inside of this were seen the little black rods having gone through their cycle of development in the mosquito's body. When the walls of the capsule gave way these rods passed into the mosquito's body. Endowed with moving and penetrating powers, they travel along and easily penetrate the delicate skin of the poison and salivary glands. Sections of these glands were also shown him, actually containing large numbers of the little germinal rods, this clearly tiacking step by step the whole process from the blood of the patient up to the gland connected with the proboscis of the mosquito. Numerous experiments have been made on healthy Italian peasants, and recently Dr. Manson's son offered himself as a subject. Pure Anopheles bred from larva were sent to Rome and allowed to bite fever patients.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Carefully protected from other contaminating influences, they were sent to London, and there permitted to bite young Manson. There in the English climate malarial fever was developed, and in his blood was seen the black pigmented and crescentic forms so characteristic of the disease. Italian doctors who have studied the subject, and whose opinion must carry weight, give their deliberate conviction that the mosquito is the only source of human infection. They believe that it does not originate from residence in a malarial district. It cannot be received from drinking impure water, neither is it spread from personal contact with a malarial patient, but solely by the bite of this peculiar species of mosquito. Being a blood disease, it requires a blood channel for its propagation, and this is found in this little insect. Break down the bridge of the mosquito and malaria will be stamped out. "A consummation devoutly to be wished." The scientists may be too sweeping in the assertion that the disease only originates in this way from a fever patient. I do not think it has been proved that malaria does not exist in any other living creature ; if it does, that might be the original source. The question of it is only derived from a diseased patient, Where did the first mosquito receive it ? This opens up a wide speculative field, but as the first mosquitoes are found in the Tertiary rocks of the Lower White River, Colorado, long before the beginning of human history, it is evident that the answer would be difficult to find. The practical fact that this is the main source of contagion now is too clear to admit of doubt.

Another fact of great value to the world has recently come to light in these researches. Medical men in tropical countries have a great many patients who are seriously ill, but yet there are either few peculiar symptoms, or they are of such a general character that the doctor cannot put them down to any special disease. A large number of these cases are of malarial origin, which can be determined by a simple examination of the blood. A few minutes with a good microscope now settles the question, which formerly worried for months earnest medical practitioners.

I have another slide, Fig. 22, which I am sure will interest Mr. Pound. He knows a good deal about cattle ticks, and our pastoralists have been sore sufferers from their ravages. I do not know whether they will derive any consolation from the fact that they are not the only sufferers, but that mosquitoes likewise suffer from ticks. And the cattle tick to them is but a pigmy. Comparatively speaking, these ticks would be about the size of a man's head to the human body. I caught a male Anopheles lately which looked sickly. He had good reason. Three ticks were boring into his neck, another on his chest, a fifth just below the insertion of the wing, and a sixth was affixed to the last segment of the abdomen. Here is a photo. of the last one. In colour they are of a warm orange approaching to red; possess six jointed legs, the body being oval, measuring one hundredth of an inch in diameter and a little more in length.

Two more slides will complete our subject. The Anopheles male and female. The gentleman comes first, Fig. 23, because he is an innocent and good-hearted fellow. He never soils his lancets with blood. By nature and practice he is a strict vegetarian. The juices of fruit and the nectar of flowers are his banquet. Now then for his missus, Fig. 24. Could he only persuade his wife to follow his example we would not grumble. But the missus has a strong will of her own, and prefers the ruby wine of blood.

Professor Celli states that the Anopheles do not make the humming sound so characteristic of the ordinary Culex, and persons may be bitten unconscious that they are near. Perhaps, like the little black bush mosquito, they go straight to business without hovering around. Those that I have kept in captivity make as much noise as the ordinary variety. The sound is more shrill, and reminds me of nothing so much as the skirl of the Scottish bagpipes at a distance.

During the day they are quiet, sometimes they will stand in one place for hours together. At the approach of sunset they become active, singing and flying continuously, as if that was their particular time for work and they were determined to make the most of it.

INDEX TO PLATES.