A THIRD COMMUNICATION
ON THE
ENDEMIC HÆMATURIA OF THE SOUTH-
EASTERN COAST OF AFRICA.

WITH REMARKS ON THE
TOPICAL MEDICATION OF THE BLADDER.

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IN my previous papers I have described the general symptoms of this parasitic disease, and have given all the information respecting its cause which I was able to obtain up to the time of their publication.

Since I presented my last communication to the Society I have had almost daily opportunity throughout nearly a year of watching the progress of the disease, and am now enabled to give more precise information respecting certain features of this interesting malady.

My observations have reference, *first*, to the prostatic form of the disease and its treatment; and *secondly*, to the structure and development of the parasite.

1. *The prostatic form of parasitic hæmaturia.*—In the patient upon whom the following observations were made,

the disease was confined to the prostatic portion of the urethra, as was indicated, negatively, by the absence of vesical or renal disturbance; and positively by the following symptoms: an intermittent discharge, by the urethra, of venous blood never exceeding a teaspoonful, and always mixed with urine, recurring after variable intervals of from two to fourteen days, and continuing for several days in succession. Excepting a cloudiness of the urine from the presence of free mucus, which on settling formed a russet or drab-coloured fluffy deposit, the morbid appearances were confined to the last tablespoonful of urine. With this was discharged a variable amount of blood and the branched mucous or blood-clot casts of the burrows of the parasites so characteristic of the disease. The eggs were chiefly contained in these casts, but numbers were always to be found free in the urine. The secretion was always acid, and frequently deposited lozenges or spiculæ of uric acid. The blood usually, and most days exclusively, appeared in the urine voided after breakfast, the expulsive efforts of defæcation favouring both its flow and the discharge of the mucous casts. At later periods of the day the bladder was usually emptied without any appearance of blood; but if, after this was effected, the patient at any time used strong straining efforts for a few minutes, a teaspoonful of blood-stained urine, together with one or two little clots, were almost invariably ejected.

Apart from the passage of blood and the mucous strings or clots above described, and the annoyance—one day relieved and the next renewed—caused by these indications of the abiding of the parasite, there was no further inconvenience—no impediment to the flow of urine nor the slightest irritation of the genito-urinary apparatus, and the general health and activity were unimpaired.

Treatment.—Doubtful at first how high the urinary organs might be invaded, I confined my treatment for some months to the general use of henbane, turpentine, juniper, and iodide of potassium—remedies which are more or less completely eliminated by the kidneys and thus brought in contact with all parts of the urinary apparatus. Evident benefit resulted

from the use of these drugs, but at the end of six months I was satisfied that we were making no further progress in the eradication of the disease, for numbers of impregnated ova were still to be found in the urine. I therefore substituted local for general treatment. This consisted in the injection of various substances, in the form of solution or emulsion, into the bladder. The chief of these were iodide of potassium, quassia, wormwood and oil of male fern. As I am not aware of any observations on the topical medication of the bladder, I will offer a few remarks on the local use of each of these substances.

Wormwood (*Artemisia absinthium*), ℥v of a strong infusion of the dried plant (℥j to Oj of boiling water) were daily injected into the bladder every morning for ten days. It was retained for two, three, or four hours, and the urine when voided smelled strongly of wormwood. It was entirely without action either on the bladder or, as I soon discovered, on the free embryo of the parasite, which moved as actively and lived as long in the infusion as in water. I conclude, therefore, that this reputed vermifuge causes no annoyance to the adult *Bilharzia*.

Quassia.—I failed to obtain evidence as to the viability of the embryo in infusion of this wood. It was without local action on the bladder, nor did the prolonged use of the medicine appear to induce any constitutional effects. A little headache was occasionally complained of, but this was sufficiently explained by other causes. For many weeks ℥v of strong infusion (℥iv—℥viij to Oj of boiling water) were daily injected at a single operation.

Extract of male fern.—Judging from the rapid emetic or purgative action which invariably follows the ingestion of this medicine into the stomach, I proceeded cautiously, expecting that it might induce equally rapid and strong expulsive action of the bladder. I found, however, that I could inject sufficient of the extract to form a very nauseous emulsion with ℥v of water or infusion of wormwood without causing any great inconvenience. From 5 to 15 grains given in this way were, with a little effort, retained for two or even

three hours, but towards the end of this time the desire to relieve the bladder became irresistible, and the act was attended with strong expulsive efforts and followed by moderate spasmodic irritation for about an hour afterwards. The extract did not appear to be absorbed. The greater part certainly was rejected with the urine in the form of green spherules. That male fern directly affects the parasite injuriously, I have no positive evidence to show ; but it acts most beneficially in exciting strong expulsive efforts whereby the ramified passages in the mucous membrane are to some extent at least cleared of the parasitic products.

Iodide of Potassium.—In a previous communication and in reference to the injection of styptics or direct irritants into the bladder, I expressed an opinion that topical treatment in this disease is out of the question, for the obvious reason that even supposing the body of the parasite lay bare upon the surface of the mucous membrane, the injection of this class of medicines would do more injury to the host than to the parasite. I therefore directed my attention to the soluble non-irritant salts with the hope of finding some which by readily permeating the mucous membrane would reach the crypts and tunnels in which the parasite lay, and which, while exerting an injurious action on the parasite would still be devoid of direct irritant action on the mucous membrane. I found iodide of potassium to possess these qualities. A solution containing five grains of the salt in the ounce fails to produce the least irritation when placed in the eye, but if a healthy leech be dropped into it, the animal immediately begins to writhe, the movements then become arrested, and death occurs in the course of an hour or so. If a leech be merely immersed in the solution for a few seconds, and then washed and placed in clean water, it remains motionless and sick for several days. Having determined thus much, I began by injecting the following every other morning :

℞ Potassii iodidi, gr. x ;

Infusi quassiaë (ʒiv ad f. ʒxx) ʒv.

Solve et fiat injectio.

The iodide of potassium was gradually increased to gr. xxx,

and this treatment continued for two months, occasionally substituting an emulsion of extract of male fern for the iodide of potassium.

The iodine injection was usually retained for three hours, and on one or two occasions as long as five hours. The urine then voided showed the presence of iodine on using the proper tests. The salt was readily absorbed by the mucous membrane, and the catarrhal symptoms and iodine taste caused by these large doses of the salt were at first rather severe. The patient, however, became accustomed to them, and soon ceased to make complaints. The iodide of potassium never produced the least urethral or vesical irritation. This was the medicine upon which I chiefly relied.

The injection of the bladder was readily effected by means of an india-rubber bottle holding the fluid and attached to an elastic catheter with a terminal orifice. The only precaution needed was to prevent the catheter passing further than the membranous portion of the urethra, in order that the remedy should flow over the diseased part. This was of course prevented if the open point of the instrument slipped into the bladder, in which case the injection only came in contact with the urethra, when it was returned two or three hours afterwards diluted with the urine.

After a few lessons my patient was able to inject his bladder without assistance, and he has now returned to Natal with directions to use the following injections alternately every third day :

℞ Potassii iodidi, gr. xx ;
Aquæ tepidæ, ℥v.

Fiat injectio.

℞ Sodæ hyposulphitis, ℥j ;
Aquæ tepidæ, ℥v.

Fiat injectio.

Before leaving England, I washed out the bladder by means of a double channeled catheter. Owing to the morbid condition of the mucous membrane great care is needed in this operation, for if strong pressure be used upon the bag, the return current, by flowing forcibly against the mouths of the

passages, is apt to detach small fragments of the diseased and softened mucous membrane.

I have now to speak of *the results of this topical treatment*. The first effect of the injection was to bring away a great quantity of the branched mucous casts of the tunnels formed by the parasite with hosts of imbedded eggs. Some of these casts measured more than one fourth of an inch in diameter. After a few weeks the casts lost their solid cylindrical character, and were ultimately replaced by long skin-like membranes, destitute of structure, and only here and there thickened by the usual mucous corpuscles. These casts seemed to be formed by exudation from the walls of the emptied tunnels. They were almost destitute of ova, and some of them were three fourths of an inch long. At the same time free ova nearly disappeared from the urine. These tough membranous casts soon presented an appearance which I had not before noticed: here and there they entangled masses of round or more usually oval corpuscles of pretty equal size, faint in outline, of a smooth glistening appearance, and evidently composed of excessively fine molecules of fatty matter (fig. 12). These I take to be the excrementitious products of the adult parasites.

Attached to the membranous casts numbers of laminated corpuscles—the so-called colloid corpuscles—were occasionally observed, sometimes singly, sometimes in large groups. Fig. 11 represents such a group mixed with recent ova and dehiscent and collapsed egg cases. The corpuscles vary in size from that of a large mucous corpuscle to the $\frac{1}{36}$ th of an inch.

Under a high power the smaller resemble starch-granules, being brighter and having more defined outlines than the mucous corpuscles. To the naked eye the largest appear like minute grains of boiled tapioca, possessing a jelly-like transparency and a faint amber tinge. They are all more readily and deeply stained by carmine than the growing mucous corpuscles. Prolonged maceration in concentrated solution of caustic potash causes no change. After soaking for twenty-four hours in fuming nitric acid (sp. gr. 1.42), a bubble of gas about one fifth the volume of the corpuscle was evolved, the latter was a little swollen, the laminæ partly disturbed

and partly effaced, and the whole imbued with the yellow tinge characteristic of the action of strong nitric acid on an albuminous body.

There can be little doubt, I think, that these corpuscles were derived from the prostate. Amongst the various morbid products described I did not fail to obtain evidence of the death and disintegration of the adult parasite.

Fig. 13 represents the structure of some fragments washed out of the urethra or bladder. One of these fragments measured $3 \times 2\frac{1}{2}$ lines: they were all of a dead white colour, perfectly smooth on one surface, and slightly shreddy on the other. It is unfortunate that no description of the tissues of *Bilharzia hæmatobia* exists to enable me to identify these fragments, which must belong to the parasite affecting my patient. They are composed of coarse branching fibre cells (fig. 13a), closely interwoven to form a compact tissue (b).

Thus it appears conclusively that the topical treatment was effectual in clearing away the accumulated products of the parasite, in securing their expulsion as fast as they were formed, and ultimately in destroying the adult parasite.

But some of these are doubtless more securely concealed than others, and so escape for a time the effect of the remedies employed for their removal. At the time my patient left England he still passed a few eggs of the parasite; they were all, however, imbedded, not in masses of mucus, but in soft and recently formed blood clot. The ova, moreover, were in a more lively condition, and by placing the blood clot in water and using a little pressure, the embryo was readily liberated and its structure and movements observed.

Structure and development of the embryo.—In my first paper on the parasitic hæmaturia of the Cape of Good Hope, I pointed out the similarity of the parasitic products in the cases therein narrated, to the description and figures of the *Distomum hæmatobium* given by Bilharz and Griesinger, but there still remained sufficient differences to induce me at that time to refer the objects of my study to some other species, and I provisionally called the parasite *Bilharzia Capensis*. I confess that I have never had much doubt of the

identity of the North and South African parasite, still I can only deal with facts, and my position with regard to the question is pretty much the same as it was seven years ago. The difficulty lies on the one hand, in my cases, in the almost complete concealment of the adult parasite—for as yet I have only seen fragments of the animal; and on the other, in the imperfection and insufficiency of the published figures of *Distomum hæmatobium*, together with the fact that both Bilharz and Griesinger describe and figure *two* forms of egg, the one with a terminal and the other with a lateral spine. In all my own cases I can say positively that only one form of egg has existed, viz. that with a terminal spine. Variation in the size, length, and outline of the egg is often observable ('Medico-Chirurgical Trans.,' vol. xlvii, p. 60), but I have never seen any egg with even a tendency to the formation of a side spine.

I even doubt whether this peculiar form exists in *D. hæmatobium* itself. To my mind the objects represented¹ appear to be escaped embryo masses and not eggs. Griesinger himself speaks of them as eggs or cocoons. If these two talented observers yielded this point of difference in the ova of the Egyptian parasite, then I grant that I find no difference between *Distomum hæmatobium* and *Bilharzia Capensis*.

To return to facts. As it is of the greatest importance to the residents of infected districts that the parasite should be recognised in every phase of its development, I will now conclude my observations with a full description of the living embryo, and with a statement of certain facts respecting the earliest phases of its existence.

Fig. 1 represents the ripe egg ready to dehisce and set free a living embryo. The rupture is preceded by strong writhing and retractile movements chiefly of the anterior half of the body and active movement of the cilia clothing its surface. These continue until the egg case gives way, when the animalcule is liberated more or less readily, and then it at once commences very active natatory and vermicular movements according

¹ Fig. 2, p. 562, 'Archiv für physiologische Heilkunde,' vol. xiii, 1854, Griesinger. Fig. 213 b, p. 622, 'Die menschlichen Parasiten,' vol. i, Leuckart.

to circumstances. The former are very rapid and graceful. Assuming an elongated, elliptical, or more commonly a cylindrical form, the embryo advances itself by a rapid undulatory action of the cilia. When the animal is actively swimming, only those cilia which clothe the shoulder (fig. 9) are usually visible, and being stronger than the rest they form a beautiful circle, by the motion of which alone, as it appears, the movements of the embryo are directed. In its progress the animal assumes a variety of forms. It often retains the original elliptical shape (figs. 2, 3, and 4). Sometimes the anterior half of the body is contracted to vermiform proportions (fig. 5); sometimes only the posterior portion is thus affected (fig. 10). More rarely the body is doubled by a transversely median constriction (fig. 7). If the animalcule meet with an obstacle the anterior third of the body may be quickly retracted as far as the line of attachment of circle of stronger cilia (fig. 6); or the whole body is still further elongated and advanced by vermicular contractions through or by the opposing object.

I have many times succeeded in liberating simultaneously from the ripe ova as many as twenty embryos, and watched their varied movements in a drop of water under a half inch object glass.

No sight can convey either a more vivid impression of the activity of animal development, or a more complete realisation of the energy of parasitic life; but how much soever our interest is excited by the sight, its attractiveness is certainly not increased by the unavoidable reflection that the tissues and fluids of the body may readily become the prey of these invaders.

The viability of the embryo in respect of temperature is considerable. I have succeeded in hatching active embryos at 42° Fahr., and after they have been exposed in the urine to that temperature for twenty-four hours.

After swimming actively about for two or three hours under the covering glass on a microscopic slide, the motions of the embryo become gradually slower and then soon cease. But even in death the little animal retains its protean character.

One of the most remarkable of its forms is that represented in fig. 8, in which there is a distinct segmentation of the body, a character which is foreshadowed in the constrictions which affect the living embryos, and which no doubt determines the regularity of these. (Compare figs. 5, 6, 7, 8, 9, and 10.)

During the life of the embryo its organization is readily observed. The anterior view of the rostrum (fig. 3 *a*) presents a depression, at the bottom of which appears two little orifices; these communicate below, each with a delicate tube which terminates, about the junction of the anterior and middle thirds of the body, in an equally delicate globular or pyriform sac (figs. 1, 2, 3, 4, &c.). At the lower and internal part of this sac a minute rounded vesicle is occasionally visible (fig. 2): it is probably the indication of an opening into a further prolongation of the alimentary canal, which, if it exist, is lost to view amongst the granular spherules which are conspicuous in the posterior half of the body. Whether the posterior continuation of the alimentary canal forms a tubular network, as in the adult distomata, is therefore doubtful, but on watching the writhings of the embryo delineated in fig. 2, in its prolonged efforts to withdraw itself from the egg case the interspherular spaces were elongated so as to present the appearance of a network of the finest tubes. To the outside of each pyriform sac a second smaller one is occasionally observable; the space included between the pyriform sacs and their tubuli is occupied by a molecular mass which during the movements of the animal undergoes strong contractions. It is probably the retractor muscle by which the anterior extremity of the body is invaginated within the body (figs. 2 and 6). In fig. 4 there is an indication of a third tube: it is probably nothing more than a cordiform condition of the retractor muscle.

After the death of the embryo the parts above described are usually indistinguishable; the cilia are rarely visible, and the body appears to be made up of a homogeneous mass of granules (fig. 10). In water the integument is detached and raised by imbibition. This is represented in fig. 11 in which the rostral aperture appears to be relaxed and dilated.

One or two interesting questions as to the primary mode in which the parasite attaches itself to the body remain to be considered. *Firstly*, for example, "does the embryo become liberated as above described within the system?" The presence of groups of dehiscent egg cases in the urinary products seems at first sight a sufficient answer to this question. But it is remarkable that I have never observed the liberation of a living embryo from the egg when immersed in the urine, nor have I even met with a free living embryo in the urine. Eggs which split open and liberate active embryos immediately after they are placed in water, remain quiescent for an indefinite time when left in the urine, and all my attempts to hatch them in this fluid kept fresh and warm have invariably failed.

Again, the female appears to be incapable of receiving the disease from an infected male. The wife of one of my patients has three or four healthy young children, and the husband has been passing numbers of the eggs of the parasite every day of their married life. The lady has never had the slightest symptom of the parasitic disease, and the urine is free from all traces of the parasite. I conclude, therefore, that, if the parasites increase in the body from development of the eggs, this takes place in the nidus of solid mucus, in which they are for the most part imbedded, and that those which escape free into the urine are retarded in their development, and ultimately undergo destruction.

This conclusion is corroborated by the following experiments. Two young rabbits and two dogs were allowed to take at intervals with their food pellets of the mucus containing swarms of the eggs. Three of these animals were killed after an interval of two, three, and six months respectively, and carefully examined for *Bilharzia*. The dog had abundance both of *Tænia serrata* and *T. elliptica* in the intestines. Both rabbits had one or two small pyriform vesicles hanging from the omentum near its attachment to the stomach, and each of these vesicles contained a larval *tænia* (*Cysticercus*). In one of these animals I found numbers of the "*oviform bodies*" peculiar to this animal. They resemble the ova of

Ascaris lumbricoides in form and appearance, but are not one third the size, while the ova of *Bilharzia* are at least six times larger. The genito-urinary and biliary passages, and also the mesenteric and hepatic veins, of both the dog and rabbits were explored, but no trace of *Bilharzia* could be found.

I conclude from these observations, and from some other experiments which I need only allude to here, that, as a rule, *Bilharzia* is incapable of development within the animal body, the bare unprotected egg being the starting point.

This may, perhaps, be due to the retarded liberation of the embryo; for, *secondly*, the question still remains whether the liberated embryo is capable of maintaining its existence, and undergoing development into the adult sexual parasite within the body. I am strongly inclined to think that it may, and especially if it soon come into contact with a nourishing fluid such as the blood. At all events, this form of the parasite which so closely resembles some of the animalculæ found in the stagnant water of this country, should be carefully sought for in the water of the infected districts of Africa.

Lastly, as to the manner in which the animal gains access to the body. Is it by the mouth, by the urethra, or by the skin? My last patient, a colonist of Natal, made me acquainted with a fact which renders it possible that he, in common with many others, may have received the animal through the skin. He states that every colonist is attacked during the first year or two of his residence in the country with large indolent sores, which spread like a syphilitic ulcer and leave deep scars. He showed me two large, deep, white scars on his own body, one on the outside of each ankle.

It may be that the minute, leech-like animal fixes itself to the skin of the bather, and by means of an ovipositor implants the ova in some superficial vein, the operation being so delicately and quickly performed as scarcely to attract the notice of the individual. If such be the case, it is easy to understand that the hatching process and irritation attending the movements of the free embryos would result in an indolent form of ulceration, and that the little animals may be carried by the circulation from the ankle to the pelvis. A

careful microscopic examination of these sores from first to last would either throw considerable light on the origin of the endemic hæmaturia, or suffice to disprove the correctness of the above theory of infection. As we know nothing of the pathology of these endemic ulcers a careful account of them would, in any case, form a most acceptable contribution to pathology. (See note on endemic ulcers, Appendix.)

If such a mode of infection be possible, we may assume that it would be still more easily effected by the passage of the animal or its eggs through the mucous membrane of the stomach or rectum; and Bilharz has, indeed, associated the parasitic disease of the veins and dysentery in such a manner as implies cause and effect. In all my own cases, however, the mucous membrane has never, either by dysentery or the appearance of blood, shown the slightest trace of lesion; and hence we are led to account for a remarkable fact, viz. the localization of the disease in the genito-urinary organs. This *may* happen in the way I have just described, but it has always appeared to me *much more probable* that the animal, in one of its early forms, gets to this part of the body by the more direct route of the urethra.

The question of a general blood infection cannot be entertained, for the size both of the ovum and of the most attenuated forms of the ciliated embryo preclude its entrance into the smallest arteries or veins.

APPENDIX.

My friend, Dr. Symes Thompson, has told me more than once that a very intelligent medical man who has resided for a considerable time in the infected parts of S. Africa, disbelieves entirely in the existence of parasitism as a cause of endemic hæmaturia. This will in some measure explain that dearth of information on a matter of fact as plain as bloody urine itself, which has existed since the time I first made my investigations known.

It is satisfactory to me therefore to be able to adduce the following corroborative evidence from a gentleman who has

taken up the subject with the earnestness and ability requisite to clear up the gaps in our knowledge indicated in the foregoing paper. Dr. J. Vacy Lyle, of Durban, Natal, is the gentleman I refer to. I extract the following from his letter to me, dated August 25th, 1870:—

“I have for some time been engaged in collecting information on this curious disease, and have notes of a great number of cases occurring in both males and females—Europeans, Asiatics, and Kaffirs, neither of which races are free from the parasite. But the symptoms caused by it are much more severe in the effeminate Indian than in the more vigorous European and African.

“I have not yet met with a case in a resident in this town (where rain or well water is used). As far as my experience goes, the disease is confined to the rural population—to labourers, planters, hunters, and temporary residents in the country—people who are forced to use river water, or water from marshes or pools. Nor is the disease confined to a limited area, the whole coast line from the Umkomas to the Umvaloos, which flows into Delagoa Bay, nearly 300 miles in extent, is, I believe, within its influence.

“No fatal case of the endemic hæmaturia of South Africa has come to my knowledge; on the other hand, I am acquainted with more than one instance in which after a long time all the symptoms disappeared, and this without any treatment at all.¹ I write by this mail to ask a friend, who is now in London, to consult you about his daughter. I extract from my note-book the following notes respecting her:—

“Isabella G—, æt. $6\frac{1}{2}$, resident in Durban, irritable, anæmic, losing flesh, passes blood in the urine; the blood is only observed in the last drops voided. Under the microscope ova of *Bilharzia* observed to be plentiful. The child

¹ On this point see my first paper, ‘Medico-Chir. Trans.,’ vol. xlvii, p. 65–7. The hæmaturia, indeed, ceases, but the parasite remains probably as long as life continues, and causes a new set of symptoms in some cases at least. As late as February 20th, 1871, Mr. Dunsterville, of Port Elizabeth, wrote me as follows:—“The elder of the two patients (Mr. G. D—) occasionally, nay rather

has been accustomed to visit Isabella's estate on the Umhlanga river, and whilst there to drink its water, and bathe in it.

"I regret to say our patient"—the subject of the present paper—"is not very attentive. He came once for examination since returning from England; I then found ova still existing in his urine, but few in number. His health was otherwise perfect."

Note on endemic ulcers.—The pathology of Delhi boil, which may be taken as the type of the various endemic ulcers, has lately received the attention of Staff Surgeon-Major Alexander Smith and Staff Assistant Surgeon J. Fleming (see the 'Army Medical Department Reports,' vols. x and xi). The former of these gentlemen has figured "egg-like bodies," which abound in the open sores left by the boils; Dr. Aitken, who has examined them, thinks them "quite in keeping with the extremely varied forms in which *distoma* are found in the bodies of man and animals" (vol. x, p. 334).

Dr. Fleming's figures remind one strongly of concentric growths of connective tissue, and in his last communication he appears to have resolved the objects which he formerly supposed were ova of parasites into growths of the areolar tissue (vol. xi, p. 513).

frequently, suffers from the passage of renal calculi. I enclose you some. The largest were passed after two days of suffering about a year ago, the smaller appeared at frequent intervals." It is now ten years at least since the hæmaturia disappeared in this case, and yet the eggs of the parasite occur in these calculi.

DESCRIPTION OF PLATE I.

FIG. 1.—The ripe egg, containing the ciliated embryo. $\times 400$.

FIG. 2.—Embryo escaping from the egg shell. $\times 350$.

FIGS. 3, 4, 5, 6, 7.—Various forms assumed by the same embryo. $\times 270$.

FIG. 8.—Dead embryo, showing a regular tripartite segmentation of the body. $\times 300$.

FIG. 9.—Living embryo, cylindrical form, with a similar fore-shadowing of segmentation. $\times 300$. The more distinct play of the cilia around the shoulder of the animalcule is represented in this figure, as also in Figs. 5 and 6.

FIG. 10.—Dead embryo, in which the posterior part of the body is contracted. $\times 270$.

FIG. 10 *bis*.—Another dead embryo, in which the ciliated integument is raised by the imbibition of water, and the stomatic aperture is relaxed. $\times 270$.

FIG. 11.—A group of laminated or colloid corpuscles of various forms and sizes, mixed with eggs and old dehiscent egg cases.

a. The smallest. One of the larger is fractured, displaying the nucleus.

b. Mucus corpuscles, in which the whole of the objects delineated in Fig. 11 were imbedded; a few only are represented, in order to show the relative size of the mucus and smallest colloid corpuscles.

c. Recent ova.

d. Dehiscent and collapsed old egg cases. All $\times 100$.

FIG. 12.—Delicate molecular fatty corpuscles imbedded in membranous and stringy mucous exuviations, with mucus corpuscles adherent.

FIG. 13.—Areolar tissue, composed of—

a Large fibre cells. This is probably a portion of the integument of the adult parasite.