

ON THE
ENDEMIC HÆMATURIA
OF THE
CAPE OF GOOD HOPE.

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ENDEMIC hæmaturia is a disease indigenous to hot countries. In these temperate regions we are, happily for us, altogether free from it. Medically speaking, there is but one drawback to this immunity—we are almost entirely precluded from searching into its cause and pathology. When, therefore, a case of endemic hæmaturia comes under our observation, it cannot fail to excite our interest and engage our careful attention.

Three months ago, a robust gentleman, between twenty and thirty years of age, a resident of the Cape of Good Hope, consulted me about a slight ailment. On his second visit he mentioned incidentally that for several years past he had frequently passed a little blood with the urine. He said this disease was very common in the Cape, in some parts of

which both men and women suffered from it. He mentioned Uitenhage as being a place in which it was particularly prevalent. It was commonly supposed there to be a gravel complaint, caused by drinking the water, which, he informed me, was derived from a good clear spring, arising nine or ten miles distant, in Winterhoek Mountain, and conveyed, partly through bush, in an open channel cut in the red ferruginous clay. The water thus brought to the town is distributed through the streets in open gutters, which are paved in some parts, but in others the bed is alluvial, and allows of the growth of numerous water plants. The drinking-water of Uitenhage is obtained from these gutters; horses and other animals have ready access to them, and by means of diverticula, the gardens are watered from them.

Having described to me the symptoms of his disorder, which I have detailed below, I requested him to send me some of his urine for examination, and while I was awaiting its arrival I made some further inquiries from my Cape friends and acquaintance concerning the hæmaturia of this part. Messrs. Edwin and G. D. Atherstone and Mr. Walter Mills corroborated the statements of my patient. Those of their schoolfellows, they told me, who came from Uitenhage all voided blood in the urine; it was a common complaint there, and was supposed to be caused by drinking the sandy water which flows through the streets.

From the foregoing evidence it is clear that there exists in some parts of the Cape an endemic hæmaturia, the cause of which is at present unknown.

Thirty degrees east of Uitenhage, and ten degrees nearer the equator, in Mauritius, hæmaturia is known to be endemic. Chapotin,¹ Salesse,² and Rayer,³ have each recorded several cases of the disease existent in the Isle of France. Dr. Todd, in his work on 'Urinary Diseases,'

¹ Chapotin, Ch., 'Topographie médicale de l'Île-de-France,' in-4, Paris, 1812.

² Salesse, Antoine-Emilien, 'Diss. sur l'hæmaturie ou pissement de sang,' in-4, Paris, 1834.

³ Rayer, 'Maladies des Reins,' vol. iii.

page 62, makes the latest mention of it ; he says, "Hæmaturia is so common in the Isle of France that few, I am informed, of the male population escape it." One young man, who had resided there for five years, came under his treatment for the disease. "The blood was always small in quantity, never so much as to discolour the great bulk of the urine ; it came with the last portion only, quite at the end of micturition, a few drops of apparently pure blood escaping at the last. Sometimes small clots were discharged, without any definite shape. After standing, the urine would deposit a sediment of a whitish or reddish mucus, composed of bladder-epithelium, crystals of oxalate of lime, and a few small cells, which presented all the microscopical characters and actions of those of pus- and blood-corpuscles. There was no appearance of casts of tubes or of renal epithelium. The source of the hæmorrhage," he continues to say, "was doubtless the bladder, and the disease seemed to be essentially a catarrh of that organ, with occasional hæmorrhage."

I will now enter into the details of the case which has come under my own observation.

Previous history.—About four and a half years ago my patient had the "low fever" of the Cape, and afterwards took a journey to Japan to recruit his health. He remained in this island three weeks, and dwelt during the whole of the time at Nagasaki. The drinking-water, he remarked, was dirty and disagreeable. A fortnight after leaving Japan, and while on board ship, he first noticed symptoms of hæmaturia. On his homeward journey he visited China, and remained there six weeks.

Symptoms.—The first indication of the disease was the passage of a little blood after emptying the bladder of clear urine ; the blood was dark coloured, and amounted usually to a few drops ; it never exceeded a teaspoonful. For the first fortnight it appeared after every act of micturition ; it has continued, with weekly or fortnightly intermissions, ever since—a period of about four years. Unusual exercise and railway travelling always cause a slight increase in the quantity of the blood. For the last year the bleeding has

been frequently substituted by the passage of soft but consistent filaments, irregularly cylindrical, sometimes nearly colourless, but usually deeply blood-stained. They occasionally interrupt the flow of urine for ten or twelve minutes, but are then voided, and the obstruction is removed. Excepting the last table-spoonful, the urine itself is never coloured by blood. During the last few months, and when in a state of quietude, these red threads, or "veins," as he calls them, have altogether taken the place of blood. There is no increased frequency of micturition, no irritability of the bladder, but the desire to micturate is a little stronger than usual, and generally requires immediate attention. The quantity of urine voided is natural. There is no tenderness in the pubic or lumbar regions, but a sudden and sharp twinge of pain is occasionally experienced in the loins, such as, if it come on during a walk, necessitates a halt for a few minutes. It subsides as suddenly. The complaint causes but little annoyance, and the health is otherwise very good. He was travelling in company with a gentleman resident in Uitenhage, who was then suffering from precisely similar symptoms.

Condition of the urine.—In the early part of October, 1863, I received six ounces, which, on rising in the morning, had been passed directly into a clean bottle. Pale-amber coloured, specific gravity 1017·6, acid, deposits a deep layer of dirtyish-white flocculent matter, amongst which were two short opaque filaments about the $\frac{1}{35}$ of an inch in diameter, of a brownish colour and soft consistence, two shorter and wider fragments of the same substance, a little reddish mass the size of a hemp-seed, like a little clot of blood, and numerous white specks. The clear limpid urine, when acidulated with HO,NO_2 and heated, deposited a trace of albumen.

The secretion was examined from time to time, and presented little or no variation. It was usually pale and whey-like, deposited the flocculent matter, furnished a trace of albumen, and contained the filamentous bodies and specks. Sometimes the specimen was loaded with

fine crystals of uric acid and urates; oxalate of lime was never altogether absent—in most samples it was abundant; sometimes there was a little blood-stained, slimy mucus.

Abnormal constituents of the urine.—Except the albumen and crystalline deposits above mentioned, these were composed of pus-corpuscles, which, with the fine amorphous deposit of oxalates, formed the flocculent matter, a few blood-corpuscles; and the filamentous bodies and coagula. It is these latter which will now engage our attention. Examined under a half-inch object-glass, they were found to be composed of round or flattened, often branched masses of mucous cells and soft molecular mucous fibres, forming together a firm coherent matrix, more or less stained with blood, and imbedding a variable number—sometimes three or four, sometimes thirty or forty or more—bright, highly refractive, oval bodies (Plate II, fig. 2), which I had no difficulty in recognising as the ova of some entozoon. The mucous casts were sometimes dirty white, and composed wholly of mucus; sometimes they contained a considerable number of red blood-corpuscles. They varied much in diameter, the smallest measuring about the $\frac{1}{500}$ of an inch. The larger were generally flattened, the smaller were cylindrical. *a*, Fig. 1, are all the filaments and coagula which were contained in one sample of urine; *b*, Fig. 1, all those from another.

Ova.—Composed of the immature embryo contained in the egg-case, elongo-ovate, $\frac{1}{170}$ inch in length, $\frac{1}{400}$ inch wide, being about the same size as the advanced eggs of the cheese mite (*Acarus domesticus*); anterior extremity acuminate. Spine $\frac{1}{6000}$ inch long, sometimes straight (Fig. 6), sometimes deflexed (Figs. 7 and 12), the base usually confused with the rest of the egg-case (Fig. 6), sometimes abrupt. Egg-case a bright hyaline, chitinous envelope, unaffected by alkalis and acids, the $\frac{1}{10000}$ of an inch thick, presenting a double contour line, and dehiscing longitudinally (Figs. 4, 8). Contents enclosed in a distinct vitelline membrane, and composed of a solid mass of clear spherules and granules (Figs. 3, 7, &c.). The former average the $\frac{1}{4500}$ of an inch in diameter. The largest are usually aggregated about the

centre and anterior extremity of the embryo mass. After maceration in water slightly acidulated with HCl, the albuminous constituents appear to be dissolved and the interior resolved into a mass of strongly refractive spherules of fatty matter (Figs. 8 and 9). Generally no organs can be distinguished. Fig. 6 represents the nearest approach to organization that I have observed. In this ovum the anterior extremity of the embryo mass forms a papillary projection, and there is an appearance of lines and of two little pyriform bodies converging to it. Here and there a minute cell or two is observed to lie between the egg-case and the investing membrane of the embryo. Sometimes the ova are much elongated, and when this is the case they either remain straight or become elegantly curved, their opposite extremities being waved in different directions (Fig. 12).

In one branched mass of mucus the ova appeared to be in a more advanced stage of development, the ovisacs dehiscing very readily on pressure, and liberating the immature embryo, as is represented in Fig. 4. It is broader and less symmetrical than the egg-case, is attenuated at one end, but as yet there is no apparent differentiation into distinct organs. Numerous dehiscid and empty egg-cases lay in the mucus.

Mature embryo.—Outside another mucous cast, and entangled in the meshes formed by its branches, I was fortunate enough to discover several free mature embryos (Figs. 10, 16). They measure $\frac{1}{300}$ to $\frac{1}{160}$ of an inch long, and the $\frac{1}{350}$ inch broad, being a little larger than the egg-case. The general shape is elliptical, but the sides are rarely symmetrically curved; the posterior extremity is a little contracted and rounded; the anterior terminates in a papillary sucker-like prolongation, possessing a central depression leading to a canal into which two or three smaller canals appear to converge. These canals are lost below in the spherules which are contained within the interior, or in a pyriform mass of them, which is sometimes observed to occupy the anterior part of the embryo. Besides this there is in some of the embryos indications of a

differentiation of the interior, which is composed of granules and spherules of various sizes, partially distributed. The whole external surface, which is formed of a distinct thickish integument, is clothed with delicate, exceedingly close-set cilia; they are best developed at a little distance from the sucker-like anterior extremity, where the surface is minutely punctated by the origin of the cilia. Fig. 15 shows the escape of a mature embryo from the egg-case.

Seeking to get some knowledge of the animal in the more advanced stages of its existence, I have met with a small portion of ciliated integument, which, as it may belong to the parasite, I will briefly describe. The minute fragment is delineated in Fig. 11. From its rounded form I think the individual to which it belonged was more spherical than cylindrical. The cilia or hairs are simple, homogeneous, and elongato-conical; they average the $\frac{1}{300}$ of an inch long, and are distributed at intervals of the $\frac{1}{800}$ of an inch. The integument itself is delicate and homogeneous, or only very faintly granular. The relative sizes of this bit of integument and the mature embryo may be judged of by comparing Figs. 10 and 11, bearing in mind that Fig. 10 is magnified thrice as much as Fig. 11.

So far for facts. I have now to inquire to what particular animal the parts above described belong. They have no relationship whatever to the cestoid entozoa; the form and structure of the egg and hooked embryo in this class are quite different. The anatomical characters of the ovum, its development into a ciliated embryo, the form of that embryo (which is that of an adult *Distomum*) and the probability, suggested by the piece of ciliated integument—which, in the absence of other means of diagnosis, I may fairly, I think, use—that the adult parasite possesses a ciliated integument, all point to the trematode worms. The ciliated embryo closely resembles a certain species of *Monostomum*, and it possesses also several characters in common with the embryos of such of the *Distomata* as have been described. *Monostomum* does not, as far as is known, inhabit the human body; I shall therefore limit

myself to a comparison with the genus *Distomum*. Six species of this genus inhabit man, viz., *D. hepaticum*, *crassum*, *lanceolatum*, *heterophyes*, *hæmatobium*, and *ophthalmobium*. Too little is known of the last-mentioned species to allow of any comparison. The ovum and ciliated embryo above described are quite distinct from the corresponding parts both of *D. hepaticum* and *D. lanceolatum*, and probably also from those, which have not yet been observed, of *D. crassum*. The eggs of the former two species are wanting in the anterior spine; the ciliated embryo of *D. hepaticum* is conical, and the papilla which terminates its anterior extremity is depressed. The ciliated embryo of *D. lanceolatum* is oblately spherical, and ciliated only about its anterior extremity.¹ We may therefore confine our attention to the two remaining species. *D. heterophyes* is very minute; its length does not exceed three fourths of a line. The skin is beset with small spines, directed backwards, and they are particularly numerous in front. The intestinal canal is composed of a short, narrow, membranous œsophagus, terminating in an oblong muscular pharynx, which is continuous with a narrow cibarian canal, dividing, as usual, in front of the ventral sucker into two lateral intestinal tubes.² This rare parasite was discovered by Dr. Bilharz in Egypt. He found them in two cases only, inhabiting the small intestine in great numbers. But it is to *D. hæmatobium* (*Bilharzia hæmatobia*, *Gynæcophorus hæmatobius*) that the organisms in question have the greatest resemblance. Bilharz,³ and Griesinger,⁴ followed by Derseble,⁵ Kückenmeister,⁶ and Leuchart⁷ have described this parasite. It is a white, soft-skinned, elongated entozoon, resembling a nematoid worm. The anterior part of the body is smooth, the posterior part

¹ See figs. in Leuchart's 'Die Menschlichen Parasiten.'

² Bilharz and Siebold, 'Zeitschrift für Wissenschaft Zool.,' iv.

³ Ibid., § 59, 72, and 454.

⁴ 'Archives für physiol. Heilkunde,' 1854, Jahrg. xiii, § 561.

⁵ 'Wiener medic. Wochenschrift,' 1856, N. 4.

⁶ 'Manual of Parasites,' vol. i.

⁷ Op. cit., p. 491.

is beset with short hairs; its length is three lines; it has an oval and a ventral sucker, and a gynæcophoric canal. The ova are strongly pointed at one end, the egg-shell dehisces longitudinally. The ciliated embryo measures 0·37 millimètre, = $\frac{1}{67}$ of an English inch, in length, and the 0·11 millimètre, = $\frac{1}{327}$ of an inch, in breadth. It has a cylindrical form, and is rather thicker anteriorly than posteriorly. It is covered all over with tolerably long cilia, and is furnished at the anterior end with a probosciform projection, presenting a sucker-like impression from which run two slender lines, terminating in a pair of closely approximated sacs. The presence of the gynæcophoric canal is a sufficient reason for separating this animal from the genus *Distomum*; I shall therefore follow Dr. Cobbold, and call it, after its discoverer, *Bilharzia hæmatobia*.

The resemblance of the parts above described with the corresponding parts of *Bilharzia hæmatobia* will now be readily inferred, and they will be found to be very close indeed. The two parasites further agree in other important particulars.

B. hæmatobia is the cause of the endemic hæmaturia and gravel complaint, or lithiasis, of Egypt, and the parasite is so abundant in this country that Griesinger found it in 117 out of 363 human post-mortem examinations. It chiefly inhabits the small veins of the mucous membrane and substance of the urinary apparatus.

After careful comparison, however, of the ciliated embryo, which I have described, with Griesinger's figures of *B. hæmatobia*, there remain sufficient differences to induce me for the present to refer the former to some other species; and from the locality in which I have discovered the parasite, I will call it *Bilharzia Capensis*.

With respect to the distribution of *Bilharzia*, it is worthy of remark that Cairo and Uitenhage of the same continent are equidistant, north and south, from the equator, and within 15° of the same longitude. I ought, however, to mention that my patient, who is a very observant man, believes he derived the urinary disease from the water in use at Nagasaki; but, according to this supposition, the animal

must have arrived at mature development, and have manifested its presence in the urinary organs, within four months. I am rather inclined to believe that he received the animal at the Cape.

It were unsafe to conclude from this single instance of the association of the parasite above described with hæmaturia, that it is the constant cause of the hæmaturia of the Cape, but from what we know of endemic hæmaturia the probabilities are greatly in favour of this conclusion.

Since writing the above I have received, through my friend, Mr. E. Atherstone, an introduction to Mr. George Dunsterville, F.R.C.S., surgeon to the infirmary at Port Elizabeth. This is a singular piece of good fortune, for Mr. Dunsterville has been in practice in that town for twenty-seven years, and is therefore familiar with the disease.

Mr. Dunsterville has most courteously furnished me with the following particulars :

1. Hæmaturia is common in Uitenhage and in Port Elizabeth. It has been long prevalent in the former town. The female sex and the native population, as far as Mr. Dunsterville is aware, are free from it. It affects boys at the age of three or four years, and is most prevalent between this age and sixteen. Two, out of every three schoolboys, are affected with it. It gradually disappears about the age of puberty.

2. The symptoms are a smarting or burning sensation in passing urine, and at the end of micturition a flow of about a teaspoonful of pure blood, or a discharge of ropy mucus tinged with blood. The shirts of boys affected with the disease are often stained as if they had the menstrual discharge of the other sex. There is no pain in the urinary organs. The urine is never stained with blood. Gravel is a common complaint, stone is not uncommon.

3. Of the cause of the disease nothing was known. It was so common, occasioned so little inconvenience, and fairly exhausted without avail every plan of treatment; while, at the same time, experience showed that it generally subsided after the age of puberty, and apparently entailed

no subsequent complications, that the medical practitioners, in the absence of proper means and sufficient leisure for making minute investigations, had long ceased to pay particular attention to the disease.

4. The drinking-water in Port Elizabeth is partly derived from the superficial drainage of twenty miles of plain by means of wells ten or twelve feet deep, and partly from rain water conveyed by zinc or iron roof-gutters into tanks of various material. The well water is brackish.

Almost the whole of the vegetables, including salads, used in Port Elizabeth are obtained from Uitenhage. Periwinkles are very abundant in Algoa Bay.

The natives and colonists are affected with *Tænia* and *Ascaris lumbricoides*, both of which parasites are very common. Some time ago the latter appeared in great numbers, and infested both old and young. Some patients evacuated during this epidemic as many as forty worms.

A year ago a number of horses died from an epidemic of "bot worms," which attacked the stomach.

Mr. Dunsterville kindly introduced me to his two sons, young gentlemen of the ages of seventeen and twenty respectively. They had, in common with the other young men of Port Elizabeth, suffered from hæmaturia, but it had disappeared of late, and they considered themselves to be free from the disorder. The elder (Mr. G. Dunsterville, jun.), however, had been greatly troubled during the last six months with gravel, and had passed during this time four or five renal calculi. He described his urine as being like chalk and water. On examining it, I was able to demonstrate to Mr. Dunsterville the presence of several ova of *Bilharzia*. One is delineated in Fig. 13. The secretion was highly acid, and loaded with a fine crystalline deposit of oxalate of lime and uric acid.

The urine of the younger gentleman (Mr. C. Dunsterville) was full coloured and clear, but usually contained a little deposit of oxalate of lime in distinct octahedra. In the first sample which I examined I could detect with a pocket lens a few floating ova, which under the microscope presented all

the characters of those above described. Besides these I found a long sinuous tube (Fig. 14), dilated at one end into a pyriform enlargement (*a*), about $\frac{1}{80}$ of an inch long and $\frac{1}{120}$ of an inch wide; another similar dilatation of half the size (*b*) occurred about the middle of the length of the tube. At the extremity of the first dilatation or sac, and apparently attached to it, was a third pyriform sac (*c*), corresponding in size to the second. From this, two secondary tubes, smaller than the primary one, parted, the one (*f*) being continuous with it below; the other (*g*), which was indistinctly connected with it, passed away for a distance, and, after apparently joining the first, terminated in a free extremity. The main tube was considerably contracted at a distance from the second dilatation, and around this part, and apparently connected with it, were a number of excessively fine linear processes (probably tubes), some of which were very long (*d*); below this the tube dilated into a wider terminal portion (*e*). The length of the extended tube was about one sixth of an inch. The whole organ was structureless and of the most excessive delicacy; it contained only a few bright granules. It is probably the intestinal canal of the parasite.

I have repeatedly examined (during December) the urinary secretion of both these gentlemen, and have never failed to detect ova; generally they were numerous, and some hundreds must have been passed most days. When the crystalline deposits were abundant, the ova were usually encrusted with them.

Mr. G. Dunsterville, jun., has suffered much of late from the passage of small renal calculi, and has brought me several for examination. They are of a dirty white colour and crystalline structure, and are chiefly composed of oxalate of lime. On crushing them and treating them successively with nitric acid and solution of potash, I was enabled to detect the presence of considerable numbers of ova, which had, no doubt, afforded a nucleus for the crystalline deposit. In this case the symptoms indicate that the parasite inhabits the kidney.

It is remarkable that the hæmaturia should thus disappear while its original cause still remains. It can only be accounted for by supposing that the animals form non-vascular cysts around them, which retain communication with the natural passages.

The parasitic origin of the hæmaturia of the Cape being thus satisfactorily, I believe, determined, I would say a few words on—

Treatment.—Mr. Dunsterville tells me that every remedy which exists for hæmaturia has been tried to the full without effect. But it must be borne in mind that the medicines were administered empirically, and with a view to check a symptom, and not to remove the cause, which, being now known, we may at least hope to prevent.

In the treatment of the disease our efforts must be directed—(1) to kill or expel the adult sexual parasites; and, should our efforts to do so be unavailing, (2) to secure the regular expulsion of the ova, which, so long as they remain in the body, may at any time become the nuclei of urinary calculi. It has been already stated that gravel is very prevalent in the same localities as the hæmaturia; and, as I have shown in one case, there can be very little doubt that it is caused in the majority of the inhabitants of these parts, who are thus afflicted, by the parasite in question, the presence of which induces a highly saline condition of the urine, and the formation of crystalline deposits around the ova.

The success which attends the treatment of intestinal parasites leads one to hope that some specific may be found against *Bilharzia*, which, long after the disappearance of the more obvious evidence of its presence—hæmaturia—is liable to prove a very dangerous associate. But the case of the urinary parasite is very different from that of the intestinal. The *Bilharzia* is not simply attached to the free surface of the mucous membrane, but lies within the orifices of the smaller veins; and the substances which pass through the kidney on their way out of the system are very few compared with those which find a more direct passage through

the intestinal canal. It appears, therefore, that in order to fulfil the first object, we must either sufficiently saturate the blood with a remedy poisonous to the parasite, or lead through the kidneys some substance which may prove hurtful to it. The aromatic diuretics (essential oils), such as turpentine, copaiba, cubebs, bucco, give some promise. Santonine, being an anthelmintic which becomes diffused in the blood, is worthy of a persevering trial. I have found that a draught, composed of mxxv each of oil of turpentine and male fern, and miv of chloroform, in ʒij of tragacanth mixture, given every morning, brought away great numbers of the ova. The saline condition of the urine is much diminished, and the renal irritation and pain due to the presence of crystalline concretions are much relieved by the administration of bicarbonate of potash in copious draughts of water. The alkali dissolves the uric acid, which I believe to be the cementing medium of the oxalic deposits, and thus the disintegration of the calculi is facilitated, and their formation prevented.

Here I must conclude. I have sought in vain for more knowledge of the complete sexual animal, but with this I feel sure that we shall soon become acquainted. I have made known the chief facts above recorded to Mr. Dunsterville, who has already communicated them to a medical friend at the Cape; and, as Mr. Dunsterville will himself shortly return thither, we shall not long, I feel convinced, remain ignorant of the whole of the history of that animal, the early stage of whose existence I have had the pleasure of bringing before you. I have been minute in my description of the forms, and particular in my illustration of them, because during the life of the patient they must needs constitute the chief, if not the only, evidence of the particular disease to which they give rise.

APPENDIX.

On February 26th, 1864, my friend Mr. Dunsterville wrote me as follows:—"You will be sorry to hear that my younger son passed a small calculus a day or two ago, similar to those passed by his brother—confirming your anticipations." This is an interesting fact, since it shows how soon after the disappearance of the hæmaturia another disease, apparently unassociated with it, but really dependent upon the same cause, may manifest itself. The young gentleman alluded to had not been troubled with hæmaturia for more than a year, and believed himself to be perfectly free from any urinary or renal disorder. His urine, as I have previously recorded, invariably contained ova of the parasite, and usually a slight deposit of oxalates, but not sufficient to excite his attention.

With regard to the distribution of the disease, I have since ascertained the following additional facts—viz., (1) that the disease prevails in Natal; (2) that in the Cape Colony it appears to be limited to Port Elizabeth and Uitenhage.

Dr. J. W. Johnston, resident for four years in Natal as assistant-surgeon to the 85th Regiment, has made the following communication to my friend Dr. E. Symes Thompson:—"Hæmaturia prevails to some extent among the children of the civil community of Natal, and attacks both sexes, but boys more frequently than girls. I could not determine satisfactorily the source of the hæmorrhage; sometimes the blood would be uniformly diffused in the urine; occasionally in the same patient, after the bladder was emptied, about a teaspoonful of blood would be passed, sometimes with, generally without, pain; at other times

coagulated blood would be passed, having the size and shape of the ureter. The hæmorrhage appeared to be passive, the result of simple congestion. There was neither lumbar pain, pyrexia, irritability of the bladder, turbid urine, or other indications of nephritis or vesical disease."

Adults are also liable to become affected. Mr. Joseph Henderson, whose acquaintance I have lately had the pleasure of making, and who has resided for many years in Natal, informs me that a family of colonists, consisting of three adult brothers, having settled between Port Natal and Pietermaritzburg, on the banks of the Sterk Spruit,¹ a tributary of the Umlazi, became affected with hæmaturia, and were obliged, after a residence of two years, to leave the country on this account. They believed the water of this stream to be the cause of the disease. Mr. Henderson writes me the following, which has an obvious bearing upon the identity of the disease prevalent in Mauritius:—"A friend of mine from the colony, who is now with me, says hæmaturia is a very common complaint in Natal, and names several people who were subject to it; he also says it is common in Mauritius."

As to the prevalence of the disease in the Cape Colony, Mr. George Saunders, staff-surgeon, has most obligingly furnished me with the result of his own observations, and also those of some of his friends. He writes—"While at Port Elizabeth I was greatly struck with the number of cases of hæmaturia in young boys, and on inquiry was informed that the disease was very common at Uitenhage, which is about ten miles distant from Port Elizabeth. I never met with hæmaturia at Graham's Town, which is ninety-five miles from Port Elizabeth, nor at Fort Beaufort or Alice, fifty miles up the country."

Mr. Robert Speedy, of the 45th Regiment, writes—

¹ The Sterk Spruit is a small stream about thirty miles from D'Urban, on the old road between D'Urban and Pietermaritzburg.

“Hæmaturia was not prevalent either at East London or King William’s Town. I know that at Uitenhage many cases occurred. I met two gentlemen from the Cape who were labouring under the affection in an aggravated form. They stated that they had derived little benefit from treatment.”

After reading the cases narrated by Chapotin, Salesse, and Rayer (op. cit., p. 56), I feel convinced that the disease prevalent in Mauritius is in all respects identical with that existent in parts of the neighbouring continent. The following extracts carry conviction with them, while they serve at the same time to indicate the theories which up to the present time have been held respecting the cause of endemic hæmaturia :—“In the Isle-of-France children of both sexes are affected from the tenderest age with hæmaturia, which announces the weakness of the mucous membrane of the kidneys. With some the disease is slight and continual; with others it returns at intervals with different degrees of force. It generally disappears at the age of puberty, but it is often prolonged beyond that time. The hæmaturia is frequently replaced by attacks of nephritic colic, which appears to depend as much upon a too abundant mucous secretion as upon engorgement of the blood-vessels of that part from the presence of renal calculi” (Chapotin). “Three fourths of the children of the Isle-of-France are attacked with hæmaturia. Masturbation and spiced dishes are the determining causes of it. The malady has also been attributed to a bad quality of the water employed for drink” (Salesse).

Prophylaxis.—As the prevention of the disease is a matter of the gravest importance to the communities amongst which the parasite is found, a few suggestions on this subject, for the consideration of those who are more immediately concerned, will not be out of place. According to the observations of Professor Siebold on the trematode worms, it may safely be assumed that between the ciliated embryo above described and the adult sexual animal there are probably two

other distinct forms, which serve to complete the chain of metamorphoses connecting these two extremes of development. What these forms are, and what their transmigrations, are the questions which require careful elucidation. The ciliated embryo is adapted for an aquatic existence. Swimming freely about, these minute organisms probably come in contact with certain mollusca, and become developed within them into what have been called *cercaria-sacs*, but which may perhaps be more significantly termed *free pseudovaria*. In the interior of these, we may still further assume, little caudate worms, or *cercariæ*, are budded off, and, leaving the pseudovarium, bore their way out of the body of the animal, to again become free inhabitants of the water, from whence they may be directly transferred to the alimentary canal of man, or indirectly by means of some other animal used by him as food. Once admitted to the body of a suitable vertebrate animal the cercaria loses its tail, and becomes developed into the perfect sexual form. Fresh-water mollusca and fish are probably the victims selected by the parasite during its development through these intermediate stages. How far these assumptions are correct is the subject matter of further investigation. Whatever may be the truth, the following precautions are positively indicated:—1. The water should be conveyed from its source to its destination in covered channels, so that the ova contained in the urinary, and probably the fecal, products of those infested with the parasite may be prevented mixing with it. It is obviously desirable to ascertain whether any of the domestic animals are the means of thus disseminating the parasite. 2. Drinking-water should be filtered. 3. Salads which may entangle small mollusca containing parasites, and uncooked molluscs and fish (as smoked fish), should be carefully avoided.

EXPLANATION OF PLATES II AND IIa.

- Fig 1.—*a*. Filaments and lumps of mucus, containing ova, derived from one specimen of urine. Natural size.
b. Ditto ditto from another specimen.
- „ 2.—A portion of *b*, fig. 1, magnified 50 diameters.
- „ 3.—Impregnated ova—*a*, *a*, *c*, as they appear in the fresh urine; *b*, *b*, after maceration in carbolic-acid water or glycerine; *d*, spherical mass, probably the escaped embryo mass, which has assumed a spherical figure. $\times 100$.
- „ 4.—Embryo mass, escaped from the longitudinally dehiscent egg-case. $\times 100$.
- „ 5.—Ovum, imbedded in mucus. $\times 200$.
- „ 6.—Ovum, in a more advanced stage. $\times 320$.
- „ 7.—Ovum, $\times 200$, common appearance, showing spherules of the embryo mass.
- „ 8, 9.—Ova, after maceration in water acidulated with hydrochloric acid. Fig. 8 shows longitudinal dehiscence of the egg-case, and liberation of fatty spherules and granules. $\times 320$.
- „ 10.—Ciliated embryo. $\times 320$.
- „ 11.—Ciliated integument, probably belonging to an adult Bilharzia. $\times 100$.
- „ 12.—Elongated and waved form of ovum. $\times 320$.
- „ 13.—Another form of ovum, with abrupt spine. $\times 320$.
- „ 14.—Compound sacculated tube, probably the intestinal canal of the parasite. $\times 50$.
- „ 15.—Ciliated embryo escaping from the egg-case. $\times 320$.
- „ 16.—Another form of ciliated embryo. $\times 320$.

Fig: 1.

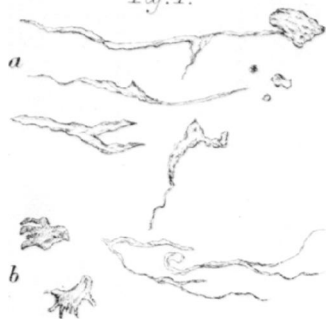


Fig: 2.



Fig: 4.

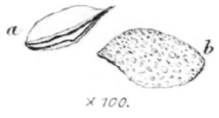


Fig: 3.

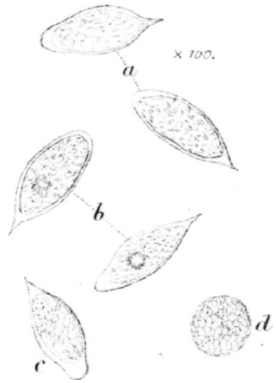


Fig: 5.



Fig: 6.



Fig: 7.



Fig: 8.



Fig: 9.

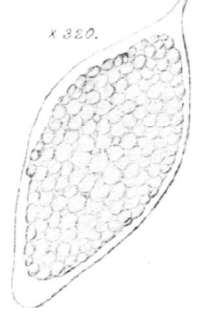


Fig: 10.

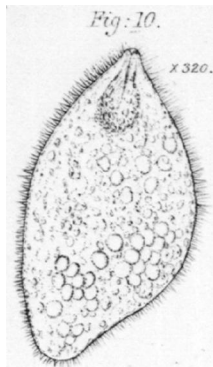


Fig: 11.

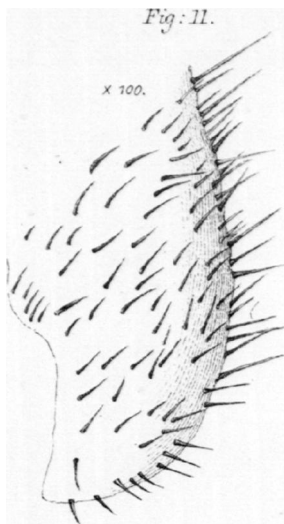


Fig: 12.

x 320.

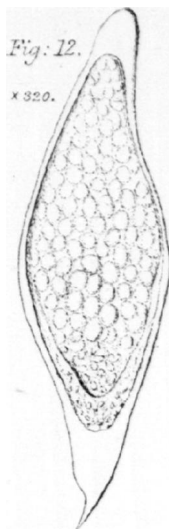


Fig: 13.

x 320.

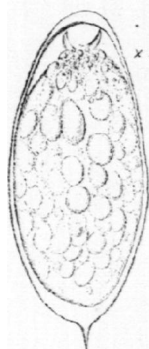


Fig: 14.

x 50.

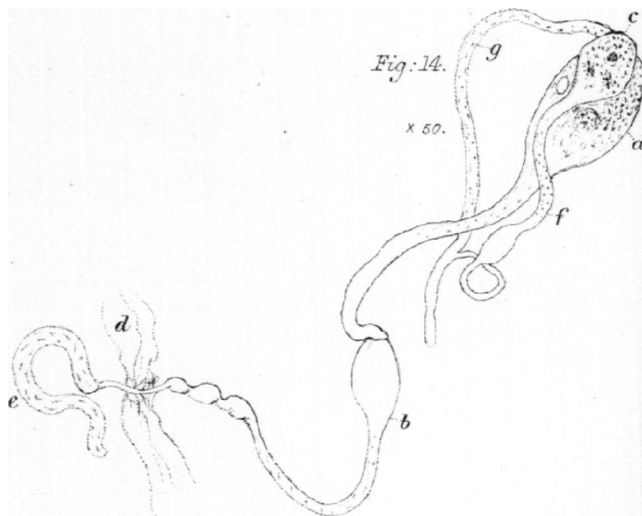


Fig: 15.

x 320.

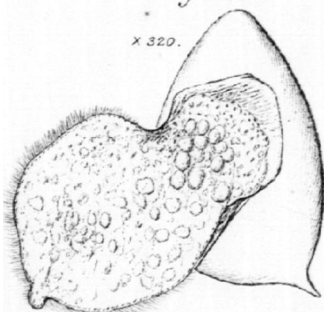


Fig: 16.

x 320.

