ELEPHANTIASIS

AND

ALLIED DISORDERS

BY

JOHN MAITLAND, M.D.

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PREFACE.

ELEPHANTIASIS and other forms of filarial disease are so prevalent in many divisions of this Presidency, that the study of these disorders is of especial importance to medical men practising in Southern India.

The medical officer, in his position as the examiner of candidates for Government employment, or of recruits for the army, or of applicants for life insurance, should search for and be able to detect the early manifestations of these disorders. Yet, owing to the fact that filarial disease is often insidious in its approach and also owing to want of exact knowledge, due to the absence of information in the text books of surgery, cases of the disease are often overlooked. From similar causes, errors in diagnosis are sometimes made, and cases of varicose lymphatics are mistaken for herniæ. These considerations have led the Surgeon-General with the Government of Madras to recommend the publication of this work. It is hoped that the book may induce those who have the opportunity to make a study of, what is to surgeons, perhaps the most interesting of all diseases met with in this Presidency.

My thanks are due to Dr. Manson for permission to copy some of his drawings; also to Surgeon-Major W. R. Browne for the use of his picture of elephantiasis of the scrotum, and to Dr. Bourne for his drawing of the male filaria.

CONTENTS.

ILLUSTRATIONS.

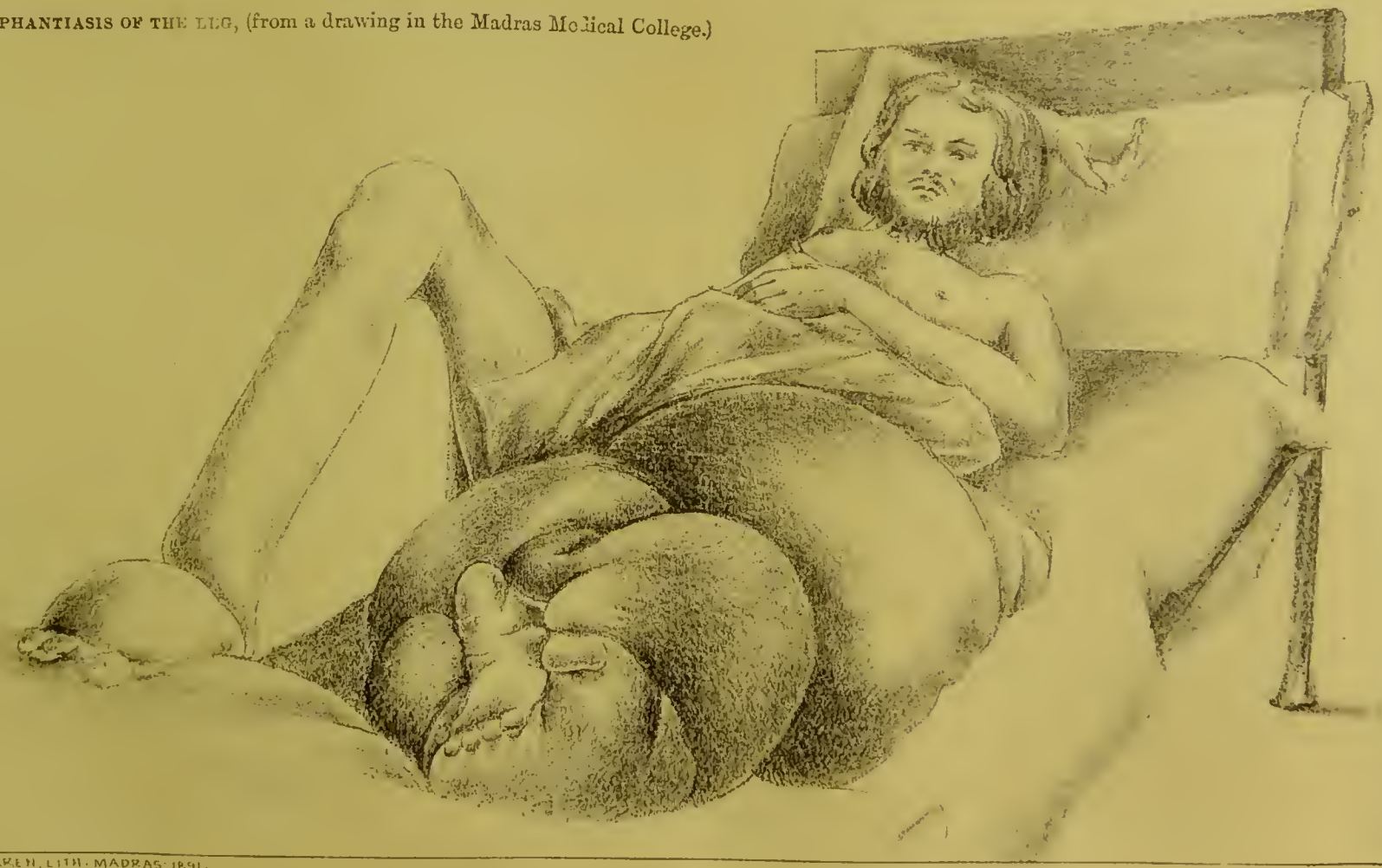
INTRODUCTION.

Our knowledge regarding the nature and causes of elephantoid diseases has of late years been so enlightened by the discoveries made by Manson, Lewis, and others, as to remove, to a great extent, the obscurity which formerly shrouded the origin and pathology of these disorders. Some of the views of Manson however have not received universal acceptation, and to many surgeons, more especially those who have had no practical acquaintanceship with the disease, there still remain some points of difficulty and doubt. These doubts are in a great measure due to inaccurate information, resulting from the absence of any systematic attempt to review the nature of the discoveries that have been made, to clear up the doubtful points, and so to piece together the various items of our knowledge, as to establish a definite and intelligible picture of the disease.

The want of a systematic treatise on the subject has long been felt, the only publications relating to the disorder being Manson's work on "*The Filaria Sanguinis Hominis*," and the fragmentary accounts contained in the modern text-books of surgery. In the following pages an attempt has been made to bring together the accounts of all the more recent discoveries, so as to form a more or less definite picture of the disease. There are so many points in regard to elephantoid disease which, at first sight, appear quite inexplicable, that there is little wonder there has been so much confusion on the subject, and so much incredulity regarding the more recent explanations of its pathology. These difficulties can only be overcome by a practical study, not only of each variety of the disease, but more especially of those transitional forms which serve to demonstrate the unity of the disease. It is also of extreme importance to study the nature of those causes that determine which variety of the disease will, in a particular case, be ultimately established. In discussing the treatment of elephantiasis of the limbs it seemed necessary to condemn, in the strongest terms, any attempt to ligature the main artery. It may seem unnecessary to condemn an operation which has not only received the disapprobation of many eminent surgeons in England, but has also long since been abandoned by all those who have had much experience in the treatment of the disease. The fact however that the operation is still treated of in some text-books as a legitimate one, and is still from time to time practised, not in England only, but also in other parts of the world, shows that the unjustifiability of the operation is not as widely recognized as it should be.

Another point upon which it is necessary strongly to insist, is the impropriety of attempting, in operating upon the scrotum, to preserve any portion of the latter to form a covering for the testicles. The results of practice have long since proved the uselessness of all attempts to preserve any portion of the scrotum, and the light shed upon the pathology of the disease by modern discoveries has served to demonstrate the cause of such failures. In spite of these facts, however, the operation has, from time to time, been revived.

ELEPHANTIASIS OF THE LEG, (from a drawing in the Madras Medical College.)



ALEX: BARREN, LITH. MADRAS. 1891.

Plate VIII.

CHAPTER I.

DEFINITION OF THE DISEASE.

Elephantiasis is known by a great variety of names, such as Bucnæmia tropica,[1] Morbus elephas, Elephantiasis indica, Spargosis, Hernia carnosa, Phlegmesia malabarica, Egyptian sarcocele, Barbadoes leg, Glandular disease of Barbadoes, Yam leg, Cochin leg, Galle leg, and Toa-kha-tung (China). In India it is known by a great variety of designations, all of which signify the term "elephant's foot." Almost all these terms have reference to the most manifest symptom of the disease, that is to say, to the thickening of the legs. Only one of them namely "glandular disease of Barbadoes," refers to an affection of the lymphatic system. "*Varix lymphaticus*"[2] or "*lymphatic varix*," is known also as "*Naevoid elephantiasis*," or "*Lymphangiectasis*." When it affects the scrotum, the disease is termed "*Lymph scrotum*."

Although the terms "elephantiasis" and "lymphatic varix" are convenient as indicating the characteristic appearances of these particular varieties of the disease, yet it must be borne in mind that both of these affections, as well as chyluria, are the result of one and the same cause, namely, of lesions of the lymphatic system produced by the parasite *filaria sanguinis hominis*. Hence these diseases collectively are termed "Filarial disease."

Elephantiasis may be defined as a disease which is endemic in certain localities, which is characterised by progressive hypertrophy of the subdermic connective tissue, usually of the limbs or genital organs; and which is the result of obstruction of the lymphatic channels that drain the affected area, the obstruction being the result of plugging of these channels by the ova of the *filaria sanguinis hominis*.

Lymphatic varix is a disease which manifests itself by dilatation and varicosity of the lymph channels of some part of the body, and is the result of causes similar to those which produce elephantiasis.

The difference between the two diseases lies in the fact that in elephantiasis the damage to the lymphatics is so complete as to produce stagnation and subsequent organisation of lymph, whereas in lymphatic varix the obstruction of the lymphatics is only partial, and the lymph continues to flow, although at a diminished rate, and accompanied by increased tension of the vessels. This increased tension results from time to time in rupture of

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[1] "Tropical Dysentery," p. 258. Fayrer.

[2] "Transactions of the Medical and Physical Society, Bombay," 1861. H. V. Carter.

These discoveries have enabled us to trace the relationship of the parasite to elephantoid disease. It is important in the first instance to bear in mind that the presence of the *filaria sanguinis hominis* in man does not necessarily involve disease, but, on the contrary, a number of filaria-bearing persons remain quite healthy. Under certain circumstances however such persons become the victims of disease, and the disorders which most frequently manifest themselves are elephantiasis and lymphatic varix. The following table, which is taken from Manson's work,[1] shows the proportion of filaria-bearing persons who become the victims of disease, and the proportion of the latter who suffer from elephantoid disease. From this table it will be seen that out of a total of 62 filaria-infected persons, 10, that is to say 16 per cent. were healthy. It is seen, on the other hand, that more than 36, that is to say considerably more than one-half suffered from elephantoid disease. Another interesting point connected with this table is the fact that out of 63 persons affected with elephantoid disease 58·25 per cent., or 1 in 1·1 were infected with filariæ.

—	Number examined.	Totals.	Number of filaria cases.	Total filaria cases.	Corrected for temporary absence.	Proportion affected.	Percentage contributed.
Elephantoid disease—							
Elephantiasis of leg	10	63	1	36	58·25	1 in 1·1	58
Elephantiasis of scrotum	15		4				
Lymph scrotum ...	13		10				
Lymph scrotum and chyluria ...	2		2				
Enlarged and varicose groin glands.	23		19				
Inflamed scrotum and fever	2	412	2	16	25·81	1 in 16	25·8
Hydrocele	410		3				
Other diseases ...			11				
No disease	195	195	10	10	16·18	1 in 12	16·2
Total ...	670	670	62	62	...	...	100

In this table the correction for temporary absence of hæmatozoa is too great, whilst on the other hand the number of cases of lymph scrotum or enlarged glands is probably under-estimated, as the patients were not always examined for these affections.

The fact of the almost constant presence of the hæmatozoa in cases of chyluria and lymph-scrotum, coupled with our knowledge regarding the behaviour of the parasite, and the manner in which it induces disease, point so strongly to the filaria as the

[1] "The Filaria Sanguinis Hominis," p. 80.

cause of these diseases, that probably there are few who do not admit their association as cause and effect. But whilst most authorities admit that chyluria (and chylous discharges generally) are produced by the *filaria sanguinis hominis*, yet there are many who deny that a similar connection has been established in the case of true elephantiasis, and who look upon the latter as a disease quite distinct from chyluria and lymphatic varix. According to Tilbury Fox and Farquhar,[1] the association of elephantiasis with chylous discharges is purely a coincidence. Manson, however, has shown not only that the association of elephantiasis with chyluria and varicose lymphatics is very frequent, but that there is little, if any, room for doubt as to their etiological identity.

The following are the more important facts which go to prove this identity :—

(1) Many cases are met with, in which either chyluria, or lymph-scrotum, or both, are found co-existing with elephantiasis. Manson records a case[2] in which lymph-scrotum followed an operation for the removal of elephantiasis of the scrotum; also a case[3] in which elephantiasis of the leg followed the removal of a lymph-scrotum. He also records cases[4 and 5] in which lymph-scrotum and elephantiasis of the leg were combined ; and a case[6] of lymphorrhagia in an elephantoid leg, combined with varicose groin glands and filariæ in the lymph. In the latter case chyluria subsequently developed. Aranjo of Brazil reports a case[7] in which both the adult and the embryo filaria were found in a person suffering from combined elephantiasis, lymph-scrotum, and chyluria. Another interesting case[8] is reported by Manson in which elephantiasis and lymph-scrotum were combined, and both the exuded lymph and the blood contained embryo filariæ. After the removal of the scrotum, no more filariæ were found. Lewis in his work "On a Hæmatozoon," gives an exceedingly interesting case in which elephantiasis of the leg and scrotum and chyluria were all co-existent in the same individual. Other cases of a similar nature have been published by Carter,[9] Sir Joseph Fayrer,[10] McLeod,[11] and others, and all surgeons, who have practised in countries where the disease is endemic, must be familiar with cases of this nature.

(2) The early history of many cases of elephantiasis of the scrotum resembles that of lymph-scrotum, and it is not unusual

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[1] "On certain Endemic Skin and other Diseases, &c." Tilbury Fox and Farquhar.
[2] "The Filaria Sanguinis Hominis," case XVII.
[3] "*Idem*," case XVIII.
[4] } "*Idem*," cases XIX and XX.
[5] }
[6] "*Idem*," case XXI.
[7] "Lancet," vol. I, 1878, p. 464.
[8] "Medical Times and Gazette," vol. I, 1883, p. 189.
[9] "Transactions of the Medical and Physical Society of Bombay," 1861, and "Transactions of the Medico Chirurgical Society," vol. 45, 1862.
[10] "Clinical Surgery in India," "Practitioner," August 1875, "Clinical and Pathological Observations in India."
[11] "Operative Surgery." K. McLeod.

to meet with cases in which one disease is seen to be passing into the other. In the early stage of elephantiasis of the scrotum there is often exudation of lymph from the surface of the skin, and as the discharge diminishes in quantity the scrotum commences to enlarge. Amongst the author's cases of elephantiasis of the scrotum, one-third of the whole number suffered from discharges from the surface, either previous to coming to the hospital, or during the time that they were under observation. Manson relates two cases [1] of a transitional nature.

(3) Other proofs, if they were wanting, of the identity of these diseases are furnished by the fact that they affect the same parts of the body, that they affect persons living under similar conditions, and that they are accompanied by the same kind of fever and by inflammation of the lymphatics. These facts appear to me to be in themselves sufficient proof of the etiological identity of all these diseases.

If then elephantiasis is merely a modification of the same disease as lymph-scrotum and chyluria, there can be no reason to doubt that the former is filarial in origin. It is true that filariæ cannot always be found in the blood in cases of fully-developed elephantiasis, and this fact has been the great stumbling block to many in regard to belief in the filarial origin of the disease. But in elephantiasis proper it is probable that the parent worm is often, if not always, choked by the stagnating lymph and dies; and hence the embryo filariæ disappear. When the hæmatozoa are found in these cases, they are probably the progeny of a second worm. The presence of the hæmatozoa in cases of elephantiasis should be the exception, rather than the rule; and this is what we actually find to be the case. It must further be borne in mind that filariæ are not always present even in chyluria or lymph-scrotum, and that their absence in these cases is, in like manner, explained by the death of the parent worm. In opposition to this, it has been urged that the death of the parasite, and consequent removal of the source of disease, should be followed by recovery of the patient. But, although the parent worm may be dead, yet the lymphatic system has been so damaged as to be beyond repair. Another explanation of the absence of the hæmatozoa in cases of elephantiasis is furnished by the fact that all means of access to the blood has been shut off by the closure of the lymphatic channels, above the location of the parent worm. In such cases the young filariæ may be found in lymph, either discharged spontaneously, or extracted from the lymphatic glands by means of a hypodermic syringe. This fact will be more fully discussed when we come to consider the pathology of the disease. In a case [2] reported by Manson, although the blood was examined daily for nearly a month, no embryo was ever found in it, yet lymph extracted from the inguinal lymphatic glands contained filariæ. The value of these facts and arguments will be better appreciated when we come to

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[1] "The Filaria Sanguinis Hominis," cases XV and XVI.
[2] "*Idem*," case XIV.

study the pathology of the disorder, and when we understand the manner in which the parasite produces disease, and why in one case elephantiasis results, and in another lymph-scrotum.

The manner in which the *filaria sanguinis hominis* finds its way into the body of its ultimate host will be more appropriately discussed in connection with the life-history of the parasite. Here it will suffice to state that drinking water is the probable medium whereby it is introduced. The inhabitants of eastern countries, and notably those of India, are so careless regarding the nature of the water which they drink, that the young filariæ have little difficulty in finding their way into the stomachs of their hosts. Almost every Indian village is furnished with a stagnant pool of fœtid water, which serves as bath, washing-tub, and drinking fountain to many of the inhabitants; and it is needless to say that this water is never filtered or boiled. The following statements, taken from Waring's article on elephantiasis, will suffice to indicate the manner in which the disease is acquired in eastern countries. In the district of Shertullay [1] near Cochin, on the western coast of India, 21 per cent. of the inhabitants are affected with elephantiasis. This district consists of a sandy strip of land, situated between the sea and a back-water, and the chief, if not the only, water-supply consists of "low shallow pools and tanks; and for the most part the water thus obtained, especially during the hot and dry seasons, and after heavy rains, is vilely bad, almost black in colour, thick, opaque to the eye, and brackish to the taste. This is used for drinking and bathing, and for other domestic purposes." This water no doubt forms the last resting-place of many thousands of filaria-bearing mosquitoes. Very similar conditions, as regards water-supply, exist at a place called Streharikota on the east coast of the Madras Presidency, and here also a very large proportion of the inhabitants become the victims of elephantoid disease.

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[1] "Indian Annals of Medical Science," vol. V, p. 1.

CHAPTER III.

THE FILARIA SANGUINIS HOMINIS.

Before entering into the study of the pathology of the disease, it is essential that we should be acquainted with the anatomy and life history of the parasite.

The description of the *mature female parasite*, as given by Cobbold, is as follows :—

"Body [1] capillary, smooth, uniform in thickness; head with simple circular mouth, destitute of papillæ; neck narrow and about one-third of the width of the body; tail simple and bluntly pointed; reproductive outlet close to head; anus immediately above the tip of the tail. Length $3\frac{1}{2}$ inches; breadth $\frac{1}{90}$ inch." The orifice of the vagina is $\frac{1}{20}$ inch from the head; and the vaginal pouch is $\frac{1}{100}$ inch in length, and separated from the two-horned uterus by a constriction. The uterine tubes extend nearly as far as the tail, and are filled with ova in various stages of development. The œsophagus, which is $\frac{1}{35}$ inch in length, shades off gradually into the intestine.

Our knowledge of the anatomy of the *male parasite* is limited to the description of a small portion, half an inch in length, discovered by Lewis, [2] and another portion, an inch and a quarter in length, discovered by Brigade-Surgeon C. Sibthorpe and described by Dr. A. G. Bourne [3] of Madras. It appears to be smaller than the female, measuring only $\frac{1}{180}$ inch in breadth. In addition to the alimentary canal, it contained another tube, thought to be the spermatic duct. The following is Dr. Bourne's description :—

"Testicular structures are visible in various places; it is difficult to be sure of the exact position of the anus; it appears to be subterminal. Immediately in front of the anus are a pair of spicula." The proximal extremity of each spicule "is broad, while the distal extremity is capillary, but while *in situ* the spicule is bent upon itself." In the figure, one of the spicula which has become detached is straightened out. "Whether the spicule ever becomes straightened out during life it is impossible to say—probably not; but the arrangement is peculiar, and, so far as I am able to tell from the literature at command, unlike that obtaining in the spicula of any other nematoid."

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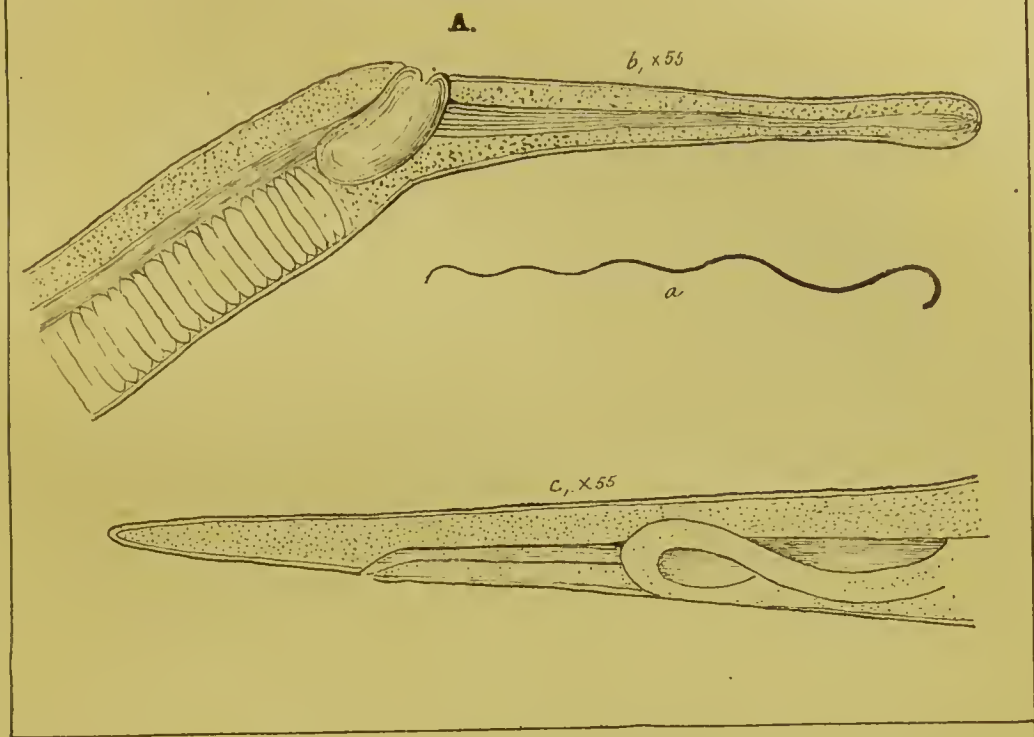
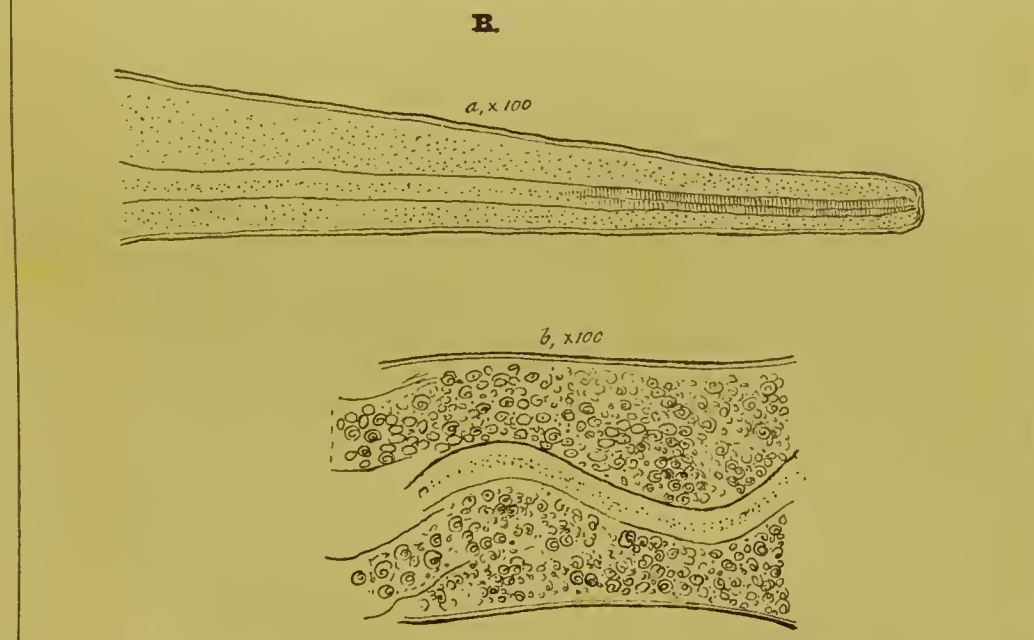
[1] "The Parasites of Man." T. Spencer Cobbold.

[2] "The Lancet," vol. II, 1877, pp. 495 and 452. Lewis and Cobbold.

[3] "Transactions of the South Indian Branch of the British Medical Association," vol. II, p. 398.

Plate I.





A. (after Cobbold) (*a*). female natural size. (*b*). head and neck, œsophagus and vagina, × 55 diameters. (*c*). tail, fold of uterine tube and end of intestine, × 55 diameters.

B (after Lewis) (*a*). anterior extremity × 100 diameters. (*b*). Portion of mature female; uterine tubes with ova in various stages of development and intestinal tube, × 100 diameters.

ALEY·PARREN; LITH: MADRAS, 1891

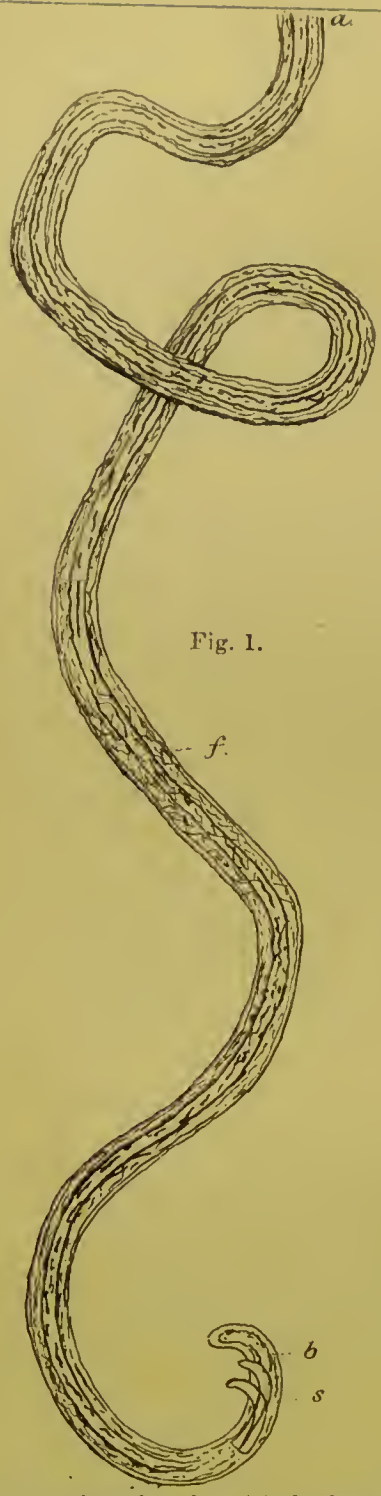


Fig. 1.

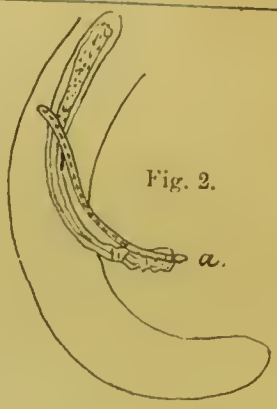


Fig. 2.

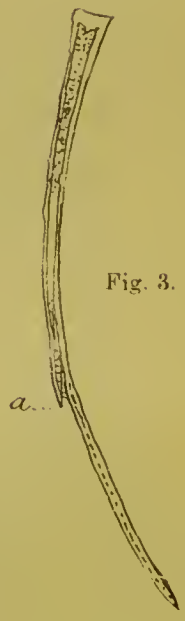


Fig. 3.

Fig. 1. Posterior portion of male; (*a*). broken extremity; (*f*). testicular products showing through the cuticle; (*b*). caudal extremity (? anus); (*s*), spicula.

Fig. 2. Caudal region of same specimen, one of the spicula *in situ*; (*a*). the free extremity.

Fig. 3. The other spicule detached; (*a*). the portion which becomes the free extremity when the spicule is *in situ*.
(after Bourne).

ALEX: BARREN, LITH. MADRAS, 1891.

The ova.—The diameter from pole to pole of the less advanced ova varies from $\frac{1}{650}$ inch to $\frac{1}{1300}$ inch, whereas the corresponding diameter of those more advanced ova, in which differentiation of the embryo has taken place, varies from $\frac{1}{500}$ inch to $\frac{1}{700}$ inch.

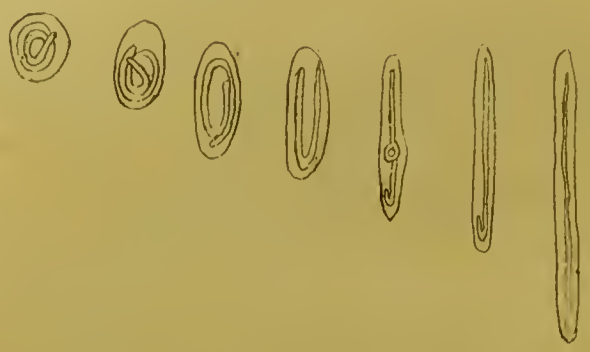
Each ovum is surrounded by a delicate pellicle, and, although naturally ovoid in shape, varies in contour as the result of pressure. In the smallest ova the outline of the embryo is not seen, but as they advance in size, and development progresses, the latter become distinctly visible.

The embryos average $\frac{1}{3500}$ inch in breadth by $\frac{1}{75}$ inch in length. Their breadth however may vary from $\frac{1}{3000}$ inch to $\frac{1}{7000}$ inch and their length from $\frac{1}{75}$ inch to $\frac{1}{200}$ inch. The cephalic end of the young worm is "blunt or slightly tapering," and occasionally contains a bright spot "suggestive of a mouth." The animal is enveloped in a hyaline envelope (the chorional sac), the whole area of which it does not quite fill, and this condition gives rise to considerable alterations in its appearance. "At one moment it may appear to possess a long tail, which follows it through the fluid like a string, whereas the very next moment not a trace of "tail" can be seen even with the highest powers. The same phenomenon takes place at the cephalic end. "Every now and then a fine point, like a fang, appears as if darted forwards out of its substance; the next instant the creature may jerk its head on one side and the 'fang' becomes bent and drawn after it like a ribbon." "Every now and then by movement the head or tail are forced into the empty portion of the tube, and the lash-like extremity disappears."[1] When first seen the embryos are in active movement, lashing about, wriggling, and "coiling and uncoiling" themselves, and their bodies appear to be translucent, although occasionally, with a high power, "a few granules may be seen at the junction of the middle and lower third" of the animal. As the activity of the embryo becomes less, it becomes granular; the bright spot at the cephalic end becomes more apparent; and immediately below the latter an "elongated vacuole" appears. From this point downwards to the junction of the middle and lower third "a more or less clearly differentiated œsophagus (?) becomes likewise discernible, and appears to have a cœcal termination." Beyond this point the digestive tract is less clearly defined. Under a high power very fine striæ may be seen on the body.

The conversion of the ovum into the fully-developed embryo is, under ordinary circumstances, accomplished within the uterus of the parent, and takes place, not by shedding of its envelope, but by the gradual straightening out of the embryo itself; as the result of which the shell of the ovum becomes the sheath of the embryo. Manson has pointed out that a similar phenomenon takes place in the development of the *filaria corvi torquata*

[1] Lewis, "On a Hæmatozoon."

and the accompanying illustration, taken from his work, shows very clearly the successive stage of this process [1]:—



It follows from what has been said that the worm is viviparous, and the embryos may be seen in the lower part of the uterine tubes of the parent, lying at full length, "outstretched as we see them in the blood."

A most important fact, in its bearing on the pathology of elephantiasis, is the great difference between the diameter of the embryo and that of the ovum. The diameter of the former being as small as that of a red blood corpuscle, it is able to pass through the smallest capillaries and lymphatics; whereas the mature ova cannot pass through any vessel having a diameter less than $\frac{1}{700}$ of an inch.

The usual and proper habitat of the mature parasite is a lymphatic vessel, a fact which has been established, not only by the discovery [2] of the worm *in situ*, but also by the fact that in cases of lymphorrhagia the exuded fluid contains, not only the embryo filariæ, but also the ova. "The ovum [3] being too large to pass from the outside to the inside of a lymphatic, and having no power to work its way, the parent that laid it" must have lodged within the lymphatics.

The parent worm being located in a lymphatic vessel, the young embryos when born are immediately carried away by the lymph stream, and passing successively through the lymphatic glands and vessels, find themselves eventually in the thoracic duct, from whence they issue directly into the blood. Their presence [4] in the blood may, provided proper methods be employed, be easily demonstrated. In some instances, however, more particularly when disease has arisen, the discovery of the embryos in the blood is not so easy, and both Manson and Lewis

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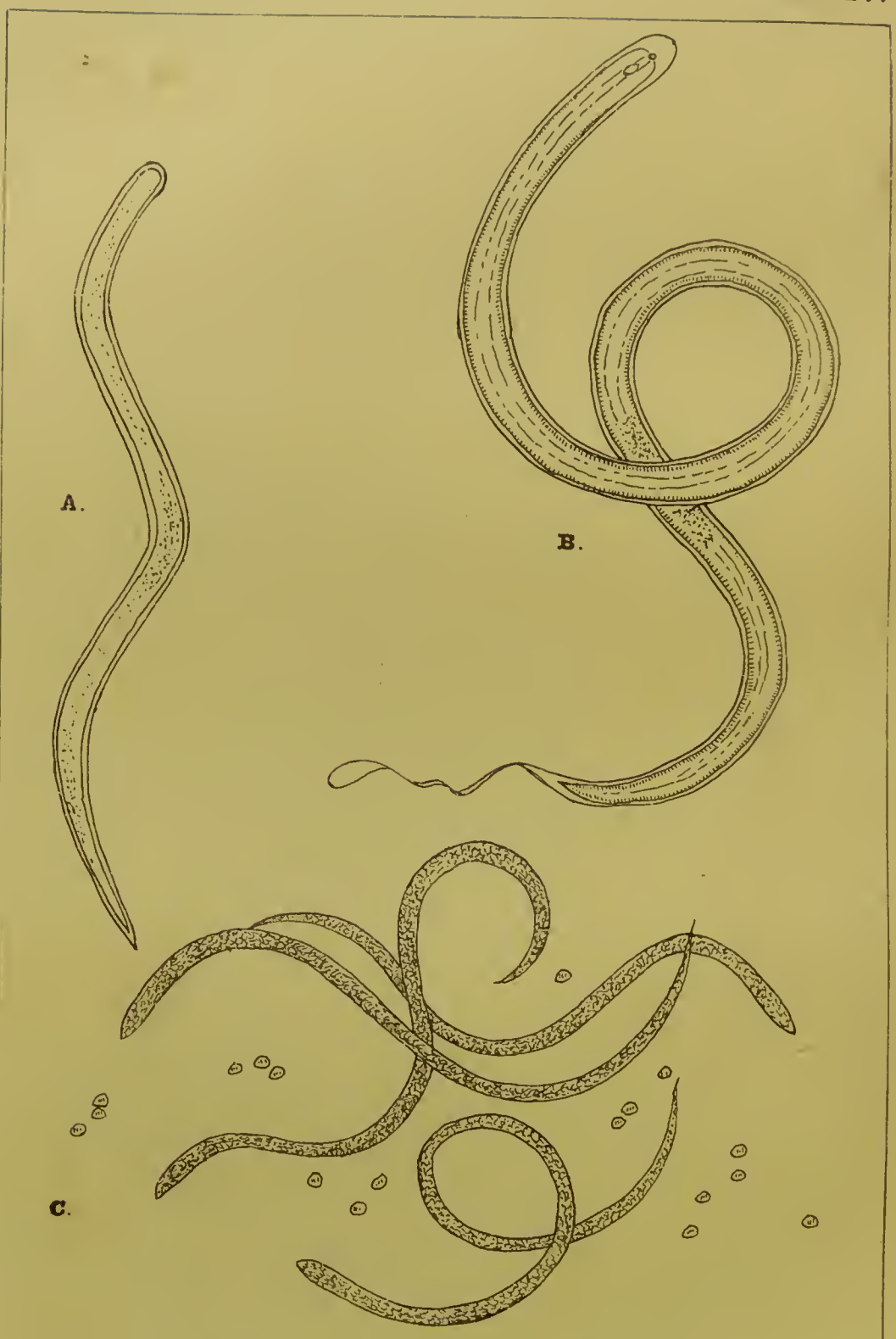
[1] "The Filaria Sanguinis Hominis," p. 25.
[2] "*Idem*" case XXII. [3] "Manson, *op. cit.*," p. 6.
[4] "Medical Times and Gazette," vol. II, 1877, p. 590.

A.

B. ×300

A. (after Cobbold). (*a*). Egg. (*b*). interchorional embryo.
B. (after Lewis). Ova in various stages of development.

ALEX: BARREN, LITH MADRAS, 1891



A. (after Cobbold). Embryo, × 400 diameters.
B. (after Lewis). Embryo.
C. Living embryos, in the blood.

ALEX: BARREN, LITH: MADRAS, 1891

repeatedly insist upon the great care and patience that must be exercised in such cases in searching for the embryos, whether in the blood, in the lymph, or in the urine. Manson, a most careful observer, says: "I would warn others against a hasty examination of the blood, and against concluding that whenever no filariæ are found, none exist. For several years I have been in the habit of occasionally examining the discharge in lymph scrotum and the blood also, but until lately never encountered the *filaria sanguinis hominis.*" The most important points to be observed in searching for the hæmatozoa are to make a free puncture in extracting the blood; to examine a number of slides, as well as every part of each slide; and to use a low power ($\frac{1}{2}$ inch), and not too strong a light.

It has been estimated that one individual may have as many as 2,000,000 embryos in his blood at one time.

In countries where elephantiasis is endemic the proportion of persons affected with filariæ appears to be very large. In Amoy,[1] Manson found the hæmatozoa in 10 per cent. of the population, and, making allowance for their temporary absence from the blood, he concluded that nearly 13 per cent. of persons in that city were affected with these parasites. Drs. Patterson and Hall[2] of Bahia made observations of a similar nature, and concluded that, without allowing for temporary absence of the filariæ from the blood, 8 or 9 per cent. of the inhabitants of that place were affected. Under ordinary circumstances, the presence of these parasites does not appear to have any injurious effect upon the individual.

To Dr. Manson[3] belongs the honor of having first demonstrated the phenomenon termed "filarial periodicity," of which the following is a brief description. Under ordinary circumstances the young filariæ are to be found in the circulation only during the hours of sleep. They begin to make their appearance towards sunset, and gradually increase in quantity up to midnight, after which the numbers gradually diminish, until about 9 o'clock in the morning, when they all disappear. Dr. Stephen Mackenzie[4] made the discovery that by changing the habits of the patient, and making him sleep during the day and remain awake during the night, periodicity was inverted; that is to say that the filariæ appeared in the blood during the day and absented themselves at night. It appears that it is not the sleeping state itself that affects periodicity, but something connected with it, and occurring every twenty-four hours. This is proved by the fact that the embryos commence their entry into the circulation some hours before sleep and begin to leave it some hours before the waking state. As Manson puts it "the conditions favourable to the ingress of the parasites become developed ordinarily during the last few hours of the

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[1] "China Customs Medical Reports," No. XIV.
[2] "The Veterinarian," June 1879.
[3] "The China Customs Medical Reports," No. XXIII.
[4] "Transactions of the Pathological Society," vol. XXXIII.

waking state, and they are slowly eliminated during the last few hours of sleep." The febrile condition also disturbs filarial periodicity. No clue to the cause of this remarkable phenomenon has hitherto been discovered.

Mortimer Granville [1] ascribed it to changes occurring in the blood, such as diminished rate of the blood current, increase of the amount of oxygen, and lowering of the temperature. But whatever the cause of this procedure on the part of the hæmatozoa may be, the purpose is evident; namely, the necessity of adapting themselves to the nocturnal habits of the mosquito. It remains a matter of speculation as to what becomes of the embryos during their temporary absence from the blood.

Manson found that the embryos of the *filaria immitis*, which affect dogs, although they do not observe the same regular periodicity as do those of the *filaria sanguinis hominis*, yet, at times, are almost entirely absent from the blood, and, during these periods, are collected, in great numbers, in the blood of the lungs. "How they manage to maintain their position there against the blood current," [2] he says, "I do not certainly know, but I suppose that they attach themselves to the inner surface of the vessels in some way, possibly using their oral extremity as a sucker. Occasionally I have seen an embryo thus attach itself to a slide while under examination with the microscope."

He was led to the conclusion that an analogous condition might obtain in regard to the *filaria sanguinis hominis*, and he believes that during the period that the embryo filaria is temporarily absent from the general circulation, "it lies resting and waiting for sunset in some of the thoracic or abdominal viscera."

What ultimately becomes of the enormous multitude of embryos to which the parent gives birth is another question which awaits solution. It has been proved, by the examination of the lymph discharged in cases of lymph scrotum and chyluria, that the production of embryos by the parent is not periodic, but nearly constant. We know, moreover, that the parasites are not shortlived in the blood, for they can be kept alive for several days on a slide. Manson [3] states that he has kept them alive on oiled slides for over 100 hours, and that they will live as long as the serum in which they are preserved remains fluid or viscid. But, although no dead filariæ have ever been discovered in the blood, yet Manson found" "[4] numbers of threads, about $\frac{1}{100}$ of an inch in length," whose appearance suggested "the idea that they were the collapsed sheath of the embryo, the body of which had disappeared by absorption or disintegration." Whatever may be the ultimate fate of the great mass of the hæmatozoa, or how long they may live in the blood, is to us only a matter of secondary interest. What is of more importance to know is that so long as the embryo filariæ remain in the blood, they

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[1] "Quekett Club Journal," vols. V and VI, p. 60.
[2] "Filaria Sanguinis Hominis," p. 46.
[3] "The Filaria Sanguinis Hominis," p. 63.
[4] "*Idem*" p. 104.

do not undergo any further development. For the completion of the next stage of their life-history, the intervention of an intermediary host is necessary.

Dr. Manson has recently published an account[1] of two other species of filaria sanguinis hominis, which he has named, respectively, *Filaria Sanguinis Hominis Major* and *Filaria Sanguinis Hominis Minor*.

The 'filaria sanguinis hominis major' appears to differ very slightly in appearance from the better known species, the only difference being that the former exhibits distinct oral movements while the latter does not, and that the granular looking aggregation about the centre of the body of the latter worm is not seen in the former. It is in their habits however that the main difference between the two is seen.

The filaria sanguinis hominis major is only found in the blood by day, whereas the better known species is only found by night.

Manson's observations were made in two cases only, and it may turn out this inversion of the periodicity may have been due to some peculiarity in the patients, producing a disturbance of the rhythm of their parasites. Until this discovery has been confirmed by further observations, it will remain doubtful whether the so-called 'filaria sanguinis hominis' major is in reality a new species or not.

The 'filaria sanguinis hominis minor' is without doubt a different species. It is much smaller than Lewis' filaria, measuring $\frac{1}{125}$ inch by $\frac{1}{3500}$ inch. It has no sheath and its caudal extremity is abruptly truncated. Its cephalic end varies in shape, being either conical or truncated, and a minute tongue-like organ is from time to time protruded from it. It also has powers of rapid locomotion which the larger embryo has not.

Both the large and small filariæ were found in the blood of a negro suffering from the "sleeping sickness of the Congo." The small worm was also found in the blood of a negro suffering from symptoms of insanity. Out of three other negroes examined, the blood of two contained filariæ. One contained specimens of 'filaria sanguinis hominis minor' only; the other showed specimens of both species.

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[1] "Lancet," 3rd January 1891.

CHAPTER IV.

THE INTERMEDIARY HOST.

The animal which performs the rôle of an intermediary host in the life-history of the *filaria sanguinis hominis* is the female of a particular species of mosquito. This insect is distinguished from other species of *culex* by her small size, brown colour, and the absence of markings on her abdomen, thorax and legs. She is about $\frac{3}{16}$ inch in length, and has a small dark head, and a proboscis about two-thirds the length of her body, with a bulbous extremity. When this animal by means of her proboscis pierces a blood vessel, a large number of the hæmatozoa, which are lashing about in the blood, become entangled by their so-called "tails" around the proboscis, and are from thence conveyed, along with the blood, to the insect's stomach. The blood which is found in the mosquito's stomach contains a much larger proportion of hæmatozoa than does an equal quantity of blood obtained by pricking the finger of the individual upon whom the mosquito has operated. Manson found that if pieces of cotton fibre were inserted into lymph which contained living filariæ, the former soon became covered with great numbers of the parasites, who, in wriggling about in the fluid, became attached by their tail or head lashes to the cotton fibres. It is probable the proboscis of the mosquito, when it enters a blood-vessel, becomes, in like manner, a means of entangling large numbers of young filariæ. The greater portion of the filariæ, which thus reach the stomach of the mosquito, are either digested or expelled along with the fœces. Only a few remain to undergo further development and to pass through a series of metamorphoses.

Metamorphoses of Filaria in the Mosquito.[1]—Soon after ingestion the filariæ pass out of the mosquito's stomach into the surrounding tissues and are found in largest numbers in the thorax.

The first change manifested by the filariæ is a tendency to become less active in their movements, and, at the same time, their bodies become striated in appearance and the sheath becomes separated from the body by a certain interval. After a time the sheath disappears as well as the striated appearance of the body, and the animal then enters into a sort of chrysalis stage. In this stage the body becomes much shorter and broader and filled with granular matter, the tail alters in shape, becoming filiform, and appears like "an appendage stuck on the sausage-shaped mass." The only movement exhibited is an occasional

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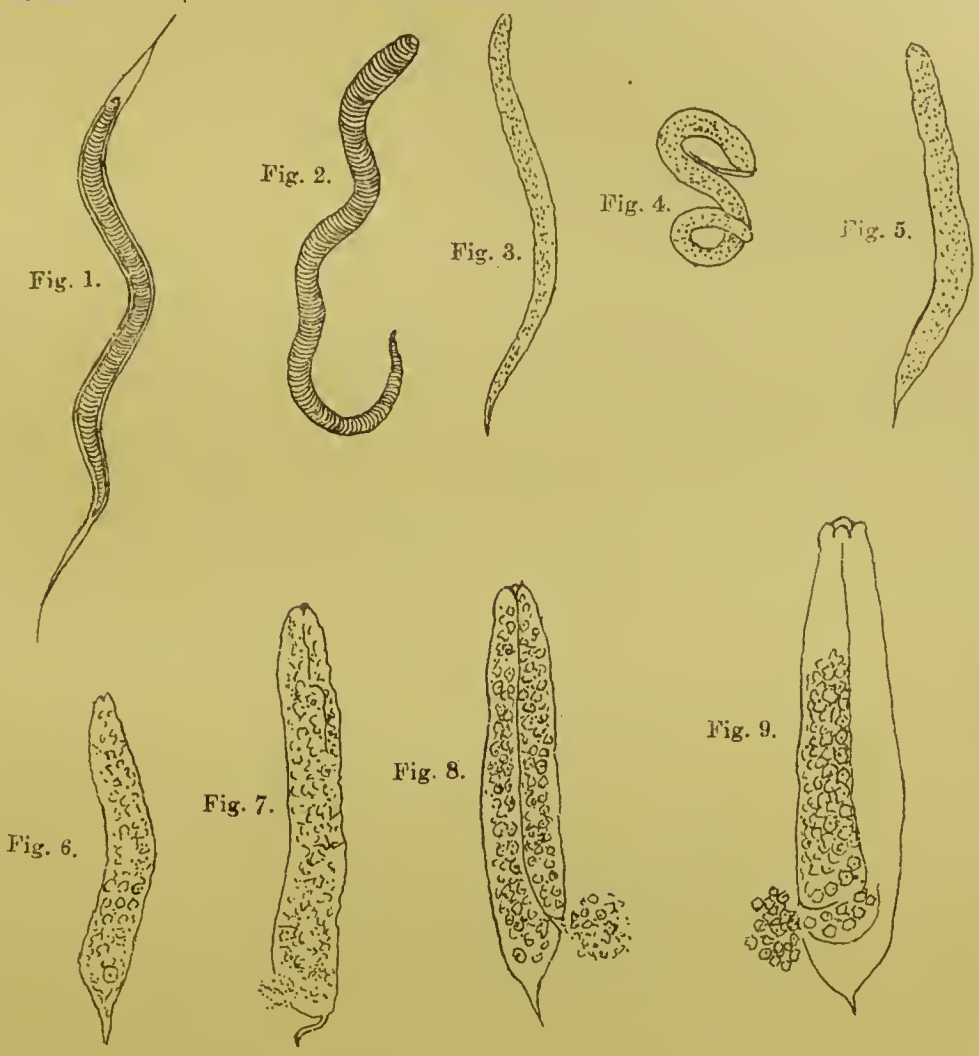
1 "Proceedings of the Linnæan Society," vol. XIV.—Manson. "Transactions of the Pathological Society," vol. XXXII.—Manson. "Report of the Sanitary Commissioner with the Government of India," No. XIV, 1877.—Lewis.



METAMORPHOSIS OF FILARIA IN THE MOSQUITO. (*Manson.*)

Fig. 1. (The filaria from 3 to 6 hours after ingestion); movements very languid; sheath separated by an interval from the body, which is striated.

Fig. 2. (8 hours); more languid; sheath has disappeared; tranverse striation and oral pouting very distinct.

Fig. 3. (25 hours); differentiation of tail commencing; $\frac{1}{100}'' \times \frac{1}{2500}''$.

Fig. 4. (36 hours); tail distinctly differentiated; breadth of body $\frac{1}{2000}''$.

Fig. 5. (46 hours); sausage like erysalis.

Fig. 6. (72 hours); no movement; obscure cellular arrangement; double outline; trace of anus and mouth; $\frac{1}{110}'' \times \frac{1}{700}''$.

Fig. 7. (80 hours); spasmodic jerks; head has double outline; mouth distinct; alimentary line runs backwards some distance becoming convoluted posteriorly and then gradually lost; anus distinct, open; tail distinct; cellulo-granular; $\frac{1}{100}'' \times \frac{1}{1000}''$.

Fig. 8. (96 honrs); alimentary line very distinct; body cellulo-granular; 4 lips rather pursed up. $\frac{1}{110}'' \times \frac{1}{715}''$.

Fig. 9. (128 hours) straight, extended, truncated; posterior end tipped with minute delicate tegumental tail; mouth distinctly 4 lipped; alimentary canal traceable from mouth to anus; nucleated cells round alimentary canal; $\frac{1}{90}'' \times \frac{1}{350}''$.

ALEX. BARREN, LITH MADRAS, 1891

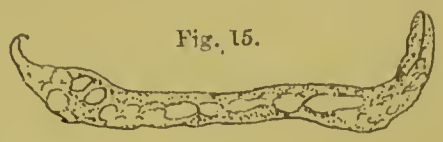


Fig. 15.

Fig. 13.

Fig. 10.

Fig. 11.

Fig. 12.

Fig. 14.

METAMORPHOSIS OF FILARIA IN THE MOSQUITO. (*Manson.*)

Fig. 10. (144 hours) slight movement; tail integumental and faint; anus a large bag; alimentary tube runs down two-thirds of the body but union with rectum not seen; mouth widely open; cellular structure obscure; $\frac{1}{60}'' \times \frac{1}{715}''$.

Fig. 11. Body cellulo-granular; mouth pursed up; bottle shaped; anterior part thinned down and lengthened; posterior part remaining full size; cephalic end very transparent, alimentary tube in it being visible; slow movement. $\frac{1}{85}'' \times \frac{1}{1250}''$.

Fig. 12. (144 hours) œsophagus a thick walled tube; mouth distinctly lipped; body cellulo-granular; $\frac{1}{60}'' \times \frac{1}{710}''$.

Fig. 13. (158 hours) great activity; viscera difficult to make out; one end tapered; papillæ at other end; no trace of organs of generation; at home in water.

Fig. 14. (156 hours) three papillæ on tail; motion most active in tail; $\frac{1}{20}'' \times \frac{1}{1000}''$.

Fig. 15. Probably a dead filaria with irregular bulgings and vacuoles and signs of degeneration.

ALEX. BARREN; LITH. MADRAS, 1891.

and vigorous movement of the tail. With this exception, the animal remains quite passive. After a time the body becomes cellular, an "alimentary line" becomes visible, the anus is distinct, and the mouth four-lipped; the animal is seen to have a double outline and the tail to be integumental. As development progresses, the alimentary canal becomes distinctly visible from mouth to anus, and is surrounded by rows of nucleated cells. During the whole of this stage the tissues of the animal appear to be exceedingly delicate, and when placed in water soon become disintegrated.

The commencement of the final stage is marked by disappearance of the tail, increase in length, and diminution in breadth of the body, and gradual swaying movements of the animal. The lengthening and narrowing of the body is at first limited to the cephalic portion of the body so as to produce a bottle-shaped appearance in the animal. The swaying movements are first manifested in the caudal extremity, and at this time three papillæ are developed on the posterior extremity of the animal. When the final metamorphosis has been completed, the animal attains a length of about $\frac{1}{15}$ inch and a breadth of about $\frac{1}{1000}$ inch. The anterior end is tapered, the posterior end marked by three papillæ. Owing to the increased opacity of the body, it is difficult to make out the viscera. Movements are very active and vigorous, and the animal quite at home when placed in the water. The accompanying illustrations are taken in part from Manson's work and in part from an article by the same author in the "Transactions of the Linnæan Society of London." [1]

During the progress of these changes, which extend over about six days, the mosquito remains in a torpid condition, slowly digesting the contents of its stomach and maturing its ova; after which it deposits the latter on the surface of the water and dies. Its body falling into the water soon becomes disintegrated, and the parasites escape. Whether the latter now pass directly with the water into the human stomach, or first enter the body of some other animal, and are thus transmitted is not certain. Manson [2] has suggested that "*Paludina*," a large fresh-water univalve, may act as a medium in carrying the parasite into the human stomach. This mollusc crawls along the surface of the water, eating everything it finds, including the decomposing bodies of mosquitoes. The Chinese are, it appears, in the habit of eating these molluscs. The intervention however of any other intermediary host than the mosquito appears quite unnecessary. As Manson says "there seems nothing wanting to fit it (the parasite) for an independent life and journey through the tissues of a human host. It possesses an alimentary canal; its head is armed with a boring apparatus, and it has sufficient strength and activity to wield this efficiently. It is also in the medium most likely to afford it an opportunity of gaining access to its final host." "Once in the human stomach, it soon bores its way into

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[1] "Transactions of the Linnæan Society, London," vol. II, part 10, April 1884, cap. 13, p. 367.

[2] "Medical Times and Gazette," vol. II, 1885, p. 237.

the thoracic duct, or some lymphatic vessel; and working up stream, in obedience to strange instinct, pierces the lymphatic glands and finally arrives at its permanent abode in some distinct lymphatic vessel. Here it is followed by one of the opposite sex obedient to sexual instinct. The couple grow and for years live together and breed, the progeny passing through the glands and into the blood, there to await their chance of a friendly mosquito to help them, as it had their parents, towards maturity." The faculty possessed by the *trichina spiralis*, and other human parasites of finding their way to a suitable lodging in the body of their host is well known; and there is no reason why the young filaria should not possess a similar instinct. The male filaria[1] probably also possesses the instinct, common to other parasites, of following up the track of the female.

[1] "Proceedings of the Linnæan Society," vol. XIV.

CHAPTER V.

PATHOLOGY OF THE DISEASE.

The fact that the presence of the *filaria sanguinis hominis* does not necessarily involve disease has already been noticed. The parent worms may live for an indefinite period discharging their embryos into the blood without inconveniencing their host. In many such cases however a time arrives when a hitch occurs, and circumstances arise which result in blocking of the lymphatic channels, and, as a consequence, serious disturbance of the nutrition of the tissues in the affected area. Our knowledge regarding the actual occurrences, which give rise to blocking of the lymph channels in these cases, we owe entirely to Manson. That able and zealous observer[1] was the first to discover and demonstrate the fact that obstruction of the lymphatics is the result, in most, if not in all, of these cases, of abortion of the parent worm, and plugging of the lymphatic channels by its ova. Attention has already been drawn to the fact that if the uterine tubes of the parent worm are examined, they will be found to contain, not only fully-stretched-out embryos, but also young worms which still remain coiled up within the chorional envelope. If the latter be prematurely expelled from the uterus of the parent and launched into the lymph stream before their time, they will be carried to the neighbouring lymphatic glands, and, being too large to pass through the minute lymph spaces, they will become impacted within the latter. Such are apparently the circumstances which give rise to elephantoid disease. The parent filaria, who has taken up her abode on the distal side of certain lymphatic glands, suddenly aborts, and the ova being carried to the glands, become impacted within the latter, and so give rise to obstruction. It is necessary at this point again, to draw attention to the facts which go to prove that the filaria frequently inhabits the lymphatic vessels on the distal side of the primary glands. Manson,[2] in one of his cases, actually found the filaria lying in one of the lymphatics of the scrotum, and he reports other cases,[3] in which embryos, as well as ova, were found in lymph taken from the inguinal glands, and also in lymph discharged from the surface of the scrotum. Cases have also been published by Manson,[4] Bancroft and Lewis in which the parasite was found in abscesses connected with enlarged and varicose inguinal glands. The cases in which the ova were found in lymph extracted from the inguinal glands, and also in

[1] "The Filaria Sanguinis Hominis," p. 122.
[2] "*Idem*," case XXII.
[3] "*Idem*," cases XVIII, XIX, XX, XXI, XXIV and XXV.
[4] "*Idem*," case XXIII.

lymph discharged from the skin, prove that the filaria may, and does, abort. Cobbold also discovered the ova in the urine, and, according to him,[1] they were also seen by Salisbury. "If we reflect on the long life of the parasite; the activity of its generative functions; the exposed position it often occupies in the legs or scrotum; its liability to injury therefore from mechanical violence; of the sicknesses of the host, his fevers and blood poisonings; the miscellaneous food he consumes, some of which may act on the uterus of the worm, as they act on that of the human subject; we can readily understand how abortion is brought about. We know the mature parasite sometimes dies; what kills her, applied in a less degree, may readily cause her to abort." It is not improbable that some drugs, such as quinine and mercury, may cause the worm to abort. It is not uncommon to find that the onset of the disease has been coincident with an attack of syphilis, and, indeed, many of the older writers ascribed the disease to syphilis. May not the syphilitic poison, or the remedies used for its cure, have caused the filaria to abort. The worm may also, like the human being, acquire the habit to aborting.

The smaller lymph channels having become plugged by the aborted ova, what is the sequence of events which follow on the primary lesion? The ova-laden lymph regurgitating from the obstructed channels is carried onwards by anastomosing vessels, which, in their turn, become blocked in a manner similar to the first. In this way, if there be a large number of ova, the whole set of primary glands may be rendered impassable. The most frequent habitat of the parasite being the distal lymphatics of the lower extremities and scrotum, embolism most frequently occurs in the inguinal and femoral glands. If the inguinal glands on one side of the body become completely blocked, the lymph may be carried, by anastomosing vessels, to the scrotal lymphatics, and from thence to the glands in the opposite groin; and the latter, in their turn, may be rendered impassable. Thus it will be seen that the amount of obstruction will vary in different cases, and will depend, to a certain extent, upon the number of extruded ova. *The area affected by elephantoid disease depends primarily upon the extent and location of the obstruction of the lymph passages, and upon the sufficiency, or otherwise, of the anastomosing circulation.*

It has been asserted by Prospero Sonsino[2] and others that obstruction may be caused by the parent worm itself. That this does occur in some cases is certain, but, the obstruction being limited to the vessel in which the worm is lying, does not cause any extensive disturbance of the circulation of the lymph. Mere[3] obstruction of a lymphatic vessel does not produce œdema, because of free anastomosis. The cases in which Manson, Bancroft, and Lewis found the parent worm in the contents of

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[1] "Parasites of Man." T. Spencer Cobbold.
[2] "Lancet," vol. I, 1882, p. 825.
[3] "British Medical Journal," vol. II, 1884, p. 354. Phillipson.

abscesses were instances in which the parent worm had caused obstruction and set up irritation. Lewis[1] appeared to be of opinion that obstruction might be caused by the embryos themselves, and Cobbold[2] thought that, as in the case of the *trichina spiralis*, evil effects would not be manifested until very large numbers had been produced; thereby implying his belief that the embryos themselves might be the cause of the disease. No evidence, however, has as yet been adduced to show that the embryos of the *filaria sanguinis hominis* ever cause obstruction of the lymphatics. We know, on the other hand, that many individuals live for years, with enormous numbers of these embryo parasites in their blood, without their health being in any way interfered with. Many of the lower animals also possess their own particular variety of filarial worm, which gives birth to swarms of hæmatozoa, without the latter affecting the health of their host. In China, according to Manson, half the dogs, all the magpies, and one-third of the crows harbour filariæ.

Elephantiasis.—We proceed now to discuss the nature of the lesions which result from obstruction of the lymphatic glands, and why in one case true elephantiasis is produced, and in another lymphatic varix. Dr. Curnow[3] states that, when obstruction to the onward flow of lymph occurs, "the lymphatics may dilate and rupture, or local œdema of the connective tissue may take place, *according to the degree of obstruction.*" These words serve as a key to the whole matter. If obstruction be complete, elephantiasis results; if incomplete, lymphatic varix is produced. If all the channels which normally drain the affected area are obstructed, and the anastomosing channels either fail to afford relief, or become themselves obstructed, then complete stasis results, and is followed by lymphatic œdema and lymphangitis. When accumulation of lymph occurs within the tissues, whether it be due to increased inflow from the blood-vessels, as in inflammation, or to diminished outflow through the lymphatics, as in elephantoid disease, the result is the same; namely, stagnation of lymph, or lymphatic œdema. That this should be so is easily understood when we consider the functions of the lymphatics as "regulators of turgesence." (Hermann). "The condition[4] in which there is increased pressure of the parenchymatous fluids, and which is removed by increased activity of the absorbents is called œdema. We may say that a system of drainage is continually in operation in the tissues, in which fluids are poured out of the blood-vessels by transudation, percolate the surrounding cellular tissues, and finally flow away through the lymphatics." If the outflow becomes impeded or obstructed, overflow and stagnation of the fluids take place. So far the effects are such as might be caused by any transient obstruction of the lymphatic system, and all surgeons are familiar with cases of lymphatic œdema and inflammation resulting from

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[1] "On a Hæmatozoon."
[2] "Transactions of the Epidemiological Society," 1881-82, p. 116.
[3] "Gulstonian Lectures," "Lancet," vol. I, 1879, p. 361.
[4] "Elements of Human Physiology," 2nd edition, p. 168. L. Hermann.

pressure on the lymphatics by splints or bandages. In the latter cases however as soon as pressure is removed the lymphatics resume their normal function, the swelling is removed, and inflammation disappears. In elephantoid disease it is also possible that the obstruction may be removed, either wholly or partially, before any permanent damage has been effected. If wholly removed, the patient's troubles are, for the time being, at an end; but if only partially removed, lymphatic varix will, as we shall see, be developed. In the majority of cases however the damage to the lymphatic channels is irretrievable, obstruction continues, and stagnation of lymph within the tissues occurs.

"Œdema [1] from lymphatic obstruction soon becomes solid, from the formation of an immature connective tissue (the so-called mucous-tissue) and leads to "local hypertrophy or giant growth." This hypertrophy results from the passive outflow of lymph, "the mere presence [2] of this lymph, exuded under pressure (lymph rich in cells) directly leading to increase of the connective tissue." Although the rapidity of the growth of new connective tissue may and does vary, yet it is generally progressive, and the ultimate size of the resulting tumours is usually determined only by the age to which the patient lives. In addition to this slow yet progressive hypertrophy, the result of obstructed outflow of lymph, there are also occasional active additions to the new growth, the result of periodic attacks of inflammation to which the deceased tissues are liable.

Periodic Attacks of Inflammation.—When once any portion of the lymphatic system has become permanently damaged, the tissues drained by the affected part become susceptible to periodic attacks of lymphatic œdema and lymphangitis. Any unusual exertion on the part of the individual, giving rise to increased functional activity of the absorbents, or any injury, or a chill resulting in congestion, are liable to be followed by lymphatic œdema and erysipelatous inflammation. "In cases [3] of lymphatic œdema dependant on obstruction in the lymphatic capillaries, it will be found, with few exceptions, that the patients are subject to recurrent, although it may be ephemeral attacks of dermic inflammation, erethema, or perhaps erysipelas." Mr. Hutchinson [4] noticed the connection between frequently recurring erysipelas and elephantiasis, but he apparently considered that the former was the starting point of the disease. In true elephantiasis the attacks of erysipelas are secondary to, and the result of, an obstructed and damaged lymphatic system. These facts serve to explain the cause of the recurrent attacks of inflammation, to which the subjects of elephantoid disease are liable.

Some authorities are, I believe, of opinion that there is one form of elephantiasis which is the result of vaso-motor disturbance, but I am unaware whether any evidence has yet been

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[1] *Op. cit.* Curnow.
[2] "Medical Times and Gazette," vol. I, 1880, p. 660. Bradley.
[3] *Op. cit.* Bradley.
[4] "Medical Times and Gazette," vol. I, 1883.

brought forward to prove this theory, or not. On the other hand it has been stated by Lewaschew [1] that the vaso-motor nerves do not exert any direct influence on the lymphatics.

To sum up the foregoing remarks on the processes involved in the production of elephantiasis, it may be said that the sequence of events is as follows:—Embolism and complete obstruction of the lymphatic glands; passive outflow of lymph; progressive increase of connective tissue elements; and recurrent attacks of lymphangitis, resulting in periodic additions to the bulk of the tumour.

Lymphatic Varix.—Having thus far traced the pathological processes which are involved in the production of elephantiasis, we have now to follow out the processes which result in the development of lymphatic varix. It has been seen that in elephantiasis, in spite of anastomosis, all the glands which can give passage to the lymph becoming successively plugged, the fluid comes to a complete stand-still. In some cases however one or more of the outlets for the lymph remain patent, and the current, although much diverted from its original course, and much impeded, still continues to flow onwards. The impediment to the circulation results, not only in diminished rapidity of the current, but also in increased tension of the lymphatics, and the latter causes, in its turn, dilatation and varicosity of the lymphatics. If the pressure becomes sufficiently great, the superficial lymphatics give way and "lymphorrhagia" results. It is moreover probable that, in many cases, although all the glands have become obstructed, yet the discharge of lymph from the surface, by relieving tension, prevents complete stagnation and the establishment of true elephantiasis. I have already alluded to the fact that many cases of elephantiasis in the early stage of their history suffer from lymphatic varix and lymphorrhœa, but, after a time, the discharge gradually diminishes and finally ceases, and elephantiasis is established. The removal, by operation, of the tissue which permits the escape of lymph, may produce elephantiasis in some other part of the body. Manson relates a case in which the removal of a lymph-scrotum was followed by elephantiasis of the leg, and another in which elephantiasis developed in the cicatrix, after removal of a lymph-scrotum.

The nature of the tissues involved in the disease influences, to a certain extent, the result as to which variety of elephantoid affection will develop. In the scrotum, the lymphatics are not only more numerous than in other parts of the body, but are also, according to Curnow,[2] remarkable for their varicosity. These peculiarities, combined with the laxity of the tissue in which the vessels are situated, render the scrotum more liable to be affected with lymph varix and lymphorrhagia than any other part of the body. Manson[3] points out that when there is a powerful dartos and thick skin, lymph-scrotum is not so likely

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[1] "Lancet," vol. II, 1886, p. 263 (Union Medicale, No. 86).
[2] *Op. cit.*
[3] "Transactions of the Pathological Society," vol. XXXII.

to develop, as when the tissues are lax. In the limbs, on the other hand, the tissues being less lax and the lymphatics less numerous, complete obstruction and œdema are the usual result; dilatation of the lymphatics and lymphorrhagia are uncommon. Curnow is of opinion that inefficiency of the valves, and degeneration of the muscular tissue in the glands and in the walls of the lymphatic vessels, are also factors in determining the production of lymphatic varix. Obstruction of the lymphatics of the lower limbs may be relieved by discharge from the scrotum, and if the latter be removed in such cases, elephantiasis will develop in the former.

It must be borne in mind that elephantiasis and lymphatic varix may not only be found side by side in the same part of the body, but the one may pass almost insensibly into the other.

Why this should be so is easily understood if we bear in mind the cardinal fact that, *one is the expression of lesions which result in stagnation of lymph*, whilst *the other is the expression merely of impeded flow of lymph and increased tension of the lymphatics*. In lymphatic varix, as in elephantiasis, there is some passive exudation of lymph, but of a much slighter degree. There is, moreover, a similar susceptibility to recurrent attacks of inflammation.

ELEPHANTIASIS OF SCROTUM.
Transactions of South Indian Branch, British Medical Association, June 1887.
(Surgeon Major W. R. Browne's case)

CHAPTER VI.

MORBID ANATOMY OF THE DISEASE.

Elephantiasis.—When the disease is seen in its initial stage, before any permanent thickening has taken place, we find œdematous swelling and redness of the surface. This lymphatic œdema is distinguished from venous œdema by the greater firmness and the brawny condition of the part. The redness is due to inflammation of the superficial lymphatic capillaries, the larger lymphatic vessels being only affected in a minor degree.

When the deep trunks[1] are involved, there are indurations of variable extent, but fixed, and giving the idea of œdema rather than inflammation.

When elephantiasis has existed for any length of time and the disease is fully established, the most evident alteration in the appearance of the part is hypertrophy, but the enlargement not being uniform, there is also deformity. When the limbs are affected, deformity is particularly manifest, those members becoming huge, shapeless, and unwieldy. When the scrotum is affected, the enlargement is more uniform, but attains a greater size, than in the limbs, and the penis soon becomes embedded and lost to view. The enlargement usually continues to progress throughout the life of the patient, and its ultimate size is determined by the longevity of the patient. The skin covering these tumours is often thrown into large folds, and, in places where the corium is firmly blended with the deep inelastic fascia, as in the palms of the hands, soles of the feet, groins, sides of the perinœum, ankles and wrists, there is no swelling. The skin generally looses its smoothness and assumes a somewhat warty appearance from unequal hypertrophy of the papillæ, and there is sometimes a tendency to desquamation, and occasionally an icthyotic condition. Cracks, fissures, and ulcers often form, especially between the folds of skin. The consistence of the tumour is generally hard, but elastic and india-rubber like. In some places however it is less dense, and more resembles the condition found in cases of lymphatic varix. If examined during an inflammatory attack, the usual appearances will be modified by the evidences of erysipelatous action, such as have already been described. Sometimes the surface of the tumour presents an eczematous-looking condition, developing raw patches, which pour forth a watery discharge.

On section the tumour is found to consist of an outer rind or shell of variable thickness, but dense structure, and an inner portion, which is soft, succulent, and "blubber-like," and which

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[1] *Op. cit.* Curnow.

gives exit to a large quantity of fluid. The outer portion is of dense consistence, white or yellowish in colour, and consists of bands of fibrous tissue which interlace in every direction, and its structure corresponds in appearance with that of fibroid tumours. The inner portion, although soft and gelatinous in appearance, is, in reality, of a tough consistence; and like the outer portion is composed of fibrous tissue; but it is less compact, and its meshes are permeated by a large quantity of fluid. Paget [1] describes these elephantoid tumours as consisting "mainly of over-growing fibro-cellular tissue, which, mingled with elastic tissue and with more or less fat, imitates, in general structure, the outer compact layer of the cutis. Their tissue is always closely woven, and very tough and elastic. In some cases, it is compressible and succulent, as if anasarcous, and it yields on section a large quantity of serous-looking fluid. In others, it is much denser, interlaced with strong shining bands, like those of a fascia."

In extreme cases, the intermuscular connective tissue becomes affected and the muscles undergo fatty degeneration. The bones also, it is said, become thickened.

The microscopical appearances show that the growth consists, in various proportions [2] of "the usual textures of the cutis, and subcutaneous tissue." The epidermis may be very little modified, but usually there is some increase [3] in the granular and horny layers. The dermis is enormously thickened, and consists of bundles of fibrous tissue perpendicular to, as well as parallel with, the surface. The ducts of the sweat glands are elongated in proportion to the increase in depth of the cutis, but the glands themselves and the hair follicles, are not modified to any appreciable extent. The capillaries are dilated and thin-walled; the blood-vessels numerous and enlarged; and the lymphatics occasionally dilated. When the scrotum is affected, there is a large amount of unstriped muscle found in narrow bands throughout the tissue, being the hypertrophied fibres of the dartos. After an elephantoid scrotum has been removed from the body, during life, alternate contractions and relaxations of the dartos cause corresponding contraction and expansion of the tumour; and these movements continue for a considerable period after the mass has been removed.

Lymphatic Varix.—In lymphatic varix the thickening of the skin and subcutaneous tissue is very slight, but the tissues of the affected part become remarkably soft and easily compressible, and the skin, which is corrugated, imparts a characteristic sensation of silkiness to the fingers. The surface is covered with vesicular-like elevations, which vary in size from that of a pin's head to that of a pea; but these elevations differ from true vesicles in having thicker walls, and in having less clearly defined margins. Besides these vesicular elevations, bunches of varicose and turgid lymphatic vessels are often seen projecting the skin

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[1] "Surgical Pathology." Paget.
[2] "*Idem.*"
[3] "Lancet," vol. II, 1883. Cornil.

at various points. Where there are a number of enlarged trunks aggregated together, as over the inguinal canal and in the upper part of the scrotum, they may be felt between the fingers, but slight pressure emptying them of their contents, they speedily collapse. When one of the vesicles or an enlarged lymphatic vessel is punctured, a stream of lymph is ejected with considerable force and continues to flow for some time; after which it gradually slackens, and finally ceases spontaneously. Examination of the diseased tissue shows it to consist of numberless lymph channels ramifying in every direction throughout the slightly hypertrophied subcutaneous connective tissue. These lymph channels vary in diameter, from that of a probe, to dilatations $\frac{3}{4}$ of an inch in diameter; and the smaller ones terminate in the vesicular elevations already described.

Microscopical examination shows changes in the dermis and subdermic tissue, similar to those found in elephantiasis, but very much less in degree.

The fluid which is poured out from the punctured lymphatics, is at first quite limpid, but gradually becomes less clear, and often tinged with red. It resembles in all respects the fluid which exudes spontaneously from the skin in cases of lymphorrhagia, and like the latter coagulates rapidly on exposure to the air. In the course of twelve hours or so, the coagulum resolves into a fluid portion, and a floculent sediment. In many cases although the fluid which is at first poured out is quite clear and of a faint straw colour, yet the later portion is opalescent, milky, or sanguineous. In one of Manson's cases,[1] the first portion of the spontaneously exuded fluid was quite white, and the last portion dark-red; and "an incision into one of the varices gave vent to a large stream of dark-brown blood-like lymph." The opalescence and pinkish hue of the fluid may be accounted for, to a certain extent, by admixture with the products of inflammation. "In all cases [2] of wounds of the normal peripheral lymphatics, the fluid which exudes is generally limpid," but "it may occasionally be yellow or even pink, that is to say it is either pure or mixed with the ordinary products of inflammation." Some authors believe that the red colour when present indicates the existence of some communication between the blood-vessels and the lymphatics, but Manson has pointed out that any such communication is not only exceedingly improbable (none exists in the healthy state), but that the red colour of the lymph can be accounted for in another manner. According to him the changes in the appearance of the lymph are brought about by its regurgitation through the lymphatic glands, and are a proof that the obstruction is situated high up in the lymphatic system. The higher up in the lymphatic system the seat of obstruction, the more opaque will be the fluid discharged, and the more often will it be of a red colour.

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[1] "The Filaria Sanguinis Hominis," p. 95.
[2] *Op. cit.* Curnow.

Vandyke Carter [1] in treating of chyluria appears to support this opinion, and believes that the seat of obstruction determines the nature of the discharge. Both of these authors consider that the changes which take place in the lymph are the result of its progress through succesive series of lymphatic glands, and are evidence of its natural development and elaboration. If the obstruction be situated in the first series of glands, these changes do not take place, and the lymph remains colourless, or straw-coloured. "Curnow [2] believes that the presence of fat globules is due to degeneration of lymph cells crowded together," and "of cells produced by proliferation of the living endothelium of the spaces and vessels." Letulle,[3] in treating of chyliform ascites, thinks that all such cases are primarily inflammatory, and are due to granulo-fatty degneration of inflammatory products. I have already stated my belief that the slight changes in the nature of the fluid, which are so common, may be explained by admixture with the products of inflammation. There can be no doubt however that when the fluid is quite white and milky, and afterwards becomes sanguineous, its nature is dependant upon an obstruction seated high up in the lymphatic system, in the neighbourhood of the recepteculum chyli, or in the thoracic duct itself. In such cases the milkiness is not due to fatty degeneration of lymph cells, but to development and elaboration of the lymph, in its passage through the lymphatic glands. It is quite possible however that, in the cases of so-called "galactocele," there has been fatty degeneration of the corpuscular element of the pent up fluid.

The Lymphatic Glands, in cases of elephantiasis, are not only enlarged, but of firm consistence, whereas in cases of lymphatic varix, they form an exceedingly soft and collapsable mass, which, when situated in the inguinal region, has sometimes been mistaken for a hernia.[4 & 5] The sensation however which they impart to the fingers is quite characteristic, and could not be mistaken by any one who had previously examined such cases. The large soft mass consists not only of enlarged and collapsable glands, but also of a number of dilated and varicose lymphatic vessels surrounding the former. According to Vandyke Carter,[6] the enlarged glands are liable to changes of dimensions, and particularly to an increase in size after meals. Were it possible to obtain an examination of the glands during the initial attack of the disease, we should probably find them to be swollen and congested; and on microscopical examination we should find the lymph spaces, impacted with ova, and filled with the products of

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[1] "Transactions of the Medical and Physical Society of Bombay," 1861. Vandyke Carter.

[2] *Op. cit.* Curnow.

[3] "Revue de Medecine," September 1884.

[4] "Transactions of the Medical and Physical Society, Bombay," 1861. Amussat, quoted by Vandyke Carter.

[5] "Transactions of the South Indian Branch of the British Medical Association," 1889. The Author.

[6] *Op. cit.* Vandyke Carter.

catarrhal inflammation. These products, according to Cornil,[1] consist of round and granular lymph cells, and large cells containing many nuclei, the latter proceeding from the flat cells which line the reticulum. When the disease is fully established the glands become, not only enlarged, but hard; the hardness being due to increase of connective tissue elements. The enlargement of the glands in cases of lymphatic varix is due chiefly to dilatation of the lymph spaces. The author has related several interesting cases of lymphatic varix of the glands in the "Transactions of the South Indian Branch of the British Medical Association for 1889."

When the disease affects the scrotum, the *testicles* may become diseased. In a great number of cases one or both organs are affected with hydrocele, often of very large size. Sometimes the testicles are atrophied, and sometimes they undergo calcareous changes; and they are often surrounded by a layer of dense fibrous tissue, the product of old attacks of inflammation. This layer of dense tissue is insensibly blended, on the one hand, with the tunica vaginalis, and, on the other, with the softer tissue outside itself; so that it becomes difficult in such cases to shell out the testicles. When we consider how liable to inflammation the scrotum is, in the early stages of the disease, it is easy to understand the origin of this layer of dense tissue. Macnamara[2] describes a case in which atrophy of the testicles followed compression of the "vas deferens" by the growth of dense tissue round the organ.

The testicles are sometimes enlarged, but in these cases the diseased condition is probably due to causes other than elephantiasis.

Diseases associated with Elephantoid Affections.—The association of *chyluria* with elephantoid disease has already been discussed. It is now necessary to notice briefly some other disorders which are frequently associated with elephantoid affections. There is little doubt that the presence of the *filaria sanguinis hominis* often gives rise to *abscesses*, and both Bancroft and Manson found the mature worm in the contents of such abscesses.

Many patients give a history of having had abscesses in the parts affected with elephantoid disease, and it is quite common to find the evidences of such in the form of cicatrices.

The very frequent association of *hydrocele* with elephantiasis of the scrotum has already been noticed, the proportion of such cases, according to McLeod,[3] being 56 per cent. Hydrocele, independent of scrotal disease, is not uncommon among filaria-infected persons.

Attacks of *acute orchitis* and *hydrocele* preceded by rigors and fever are not uncommon in India, and such cases are, in the author's opinion, filarial in origin.

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[1] "Journal de l'Anatomie."—Cornil. "Lancet," vol. II, 1878, p. 547.
[2] "Indian Annals of Medical Science," vol. II.
[3] "Operative Surgery."

Acute synovitis of the knee-joint, preceded by rigors, is also common in this country, and is probably often due to a similar cause. A patient once came under the author's care suffering from synovitis which had commenced four months previously with rigors. He gave a history of once having suffered from an attack of chyluria and subsequent to his admission into hospital, chyluria re-appeared, and the patient ultimately died from the effect of that disease. According to Lewis,[1] diarrhœa, dysentery, and ulceration of the intestines are sometimes associated with the presence of filariæ; but the cases met with by him have been too few to establish any definite connection between these diseases and elephantiasis.

Dr. O'Neil[2] gives an account of an affection termed "*craw-craw*," which is prevalent on the west coast of Africa, and which, he thinks, is filarial in origin, because he found embryo filariæ in the papules which occur in the course of the disease. His description of the disease however so closely resembles that of "itch," that it is difficult to believe that these were not cases of the latter disease, occurring in persons whose blood contained filariæ. He obtained the filariæ by slicing off a portion of the papules, and no doubt the filariæ thus obtained came from the blood.

Manson met with cases in which rheumatism, stricture of the œsophagus, heart disease, cateract, hœmatemesis and ulceration of the cornea were associated with the presence of filariæ in the blood, but there is no reason to suppose that these were anything but accidental complications.

Some recent observation of Manson[3] appear to show that the "sleeping sickness of the Congo" is due to the presence of filaria.

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[1] "On a Hæmatozoon in the Human Blood."
[2] "Lancet," vol. I, 1875, p. 265.
[3] "Lancet" 3rd January 1891.

CHAPTER VII.

GEOGRAPHICAL DISTRIBUTION OF THE DISEASE, AND THE INFLUENCE OF RACE, SEX, AGE, AND OCCUPATION.

A CORRECT appreciation of the facts concerning the geographical distribution of elephantoid disease cannot be obtained without a knowledge of the causes which lead to its production. The discussion of this branch of the subject has therefore been postponed up to this point. The area in which elephantoid disease is endemic embraces a large part of the tropical and sub-tropical portions of the globe. It is met with in Arabia, Hindustan, Burmah, the Malay Peninsula, China, Mauritius, Queensland, the Society Islands and other islands of the Eastern Archipelago, Egypt, Cape Colony, Brazil and other parts of South America, and in Barbadoes and other of the West Indian Islands.

But, although the disease is endemic in so large a number of countries, the actual endemic area in each country is limited to a narrow strip of land near the coast. According to Day, the disease is limited to the district within ten miles of the sea. It is not endemic in any inland districts. The area of distribution of the disease is probably determined by the presence or absence of the particular species of mosquito which acts as the intermediary host in the development of the *filaria sanguinis hominis*. The manner in which the young filaria undergoes development in the stomach of this particular species of mosquito has already been described. It is known that other species of mosquito are incapable of performing the rôle of intermediary host. Dr. Wickham Myers,[1] of South Formosa, has demonstrated the fact that, when other species of mosquito take up the filaria-infected blood, the embryo parasites are all destroyed and digested, and never live to undergo further development. He[2] observed that, although many persons affected with filarial disease came over to the island of South Formosa from the mainland of China, yet the disease never spread to the inhabitants of the island itself. This fact he explains by the absence from that island of the proper filaria-breeding mosquito. He states that, although for a number of years he has caused a careful search to be made in the island for this mosquito, he has never succeeded in obtaining a specimen.

These observations serve to show that two factors are absolutely essential to the introduction of filarial disease into any country ; viz., a filaria-infected person, and filaria-breeding mosquitoes.

There is reason to believe that the disease has been introduced comparatively recently into certain countries. In the

[1] "China Customs Medical Reports," No. 21.
[2] "Lancet," vol. I, 1887, p. 733.

Influence of Sex.—Drs. Tilbury Fox and Farquhar,[1] in reviewing their inquiries into this subject, came to the conclusion that both sexes were equally liable to the disease, and Manson's [2] observations in China inclined him to a similar opinion. In Brazil, according to Drs. Patterson and Hall,[3] 1 out of $11\frac{1}{4}$ males are affected with filariæ, and 1 out of 13 females. On the other hand, Sir Joseph Fayrer and Dr. Richards, as well as others, state that in India the female sex is less liable than the male. Males are affected to females, as 3 to 1 according to Fayrer, and as 3 to 2 according to Richards. It must be remembered however that, throughout the East, women are much less ready than men to seek medical aid, more especially, as is so frequently the case in this disease, when the genital organs are affected. These facts render it impossible to estimate, with any accuracy, the relative liability of the sexes in India. We know that women in India are frequently affected with elephantiasis of the legs, or of the labia.

Influence of Age.—Elephantiasis is most frequent between the ages of 20 and 50. It is rare below the age of 15, but cases have been reported as occurring at the age of 10 and under.

The following table, given by Waring,[4] corresponds very closely with those prepared by other observers, such as Richards,[5] Mohideen Sheriff,[6] and Patterson and Hall [7]:—

Age table of 945 cases of Elephantiasis (Waring).

Age.	Number of cases.	Percentage.
From 5 to 10 years	2	·21
From 11 to 15 „	12	1·27
From 16 to 20 „	54	5·71
From 21 to 25 „	71	7·61
From 26 to 30 „	117	12·38
From 31 to 35 „	98	10·37
From 36 to 40 „	156	16·49
From 41 to 45 „	110	11·55
From 46 to 50 „	112	11·76
From 51 to 55 „	70	7·35
From 56 to 60 „	66	6·98
From 61 to 65 „	22	2·32
From 66 to 70 „	10	1·05
Above 70 years	10	1·05
Doubtful age	35	3·67
Total ...	945	100

[1] "On certain Endemic Skin and other Diseases of India, &c." Tilbury Fox and Farquhar.
[2] "China Customs Medical Reports," No. XIV.
[3] "Patterson and Hall, *op. cit.*
[4] "Indian Annals of Medical Science," vol. V.
[5] "On certain Endemic Skin and other Diseases of India, &c." Tilbury Fox and Farquhar.
[6] "*Idem*," Tilbury Fox and Farquhar.
[7] *Op. cit.*

It would appear, according to Manson, that the liability to *filariæ* gradually increases with age. This he explains by the fact that the parent filaria lives for a long time, "so that old age not only has its own liability to fresh infection, but possibly inherits the worms of youth and middle age." [1] The following is Manson's table showing the progressive liability to filariæ :—

Decennial period.	Number examined.	Filariæ found in	Percentage of total cases of filaria.	Proportion affected.
10 to 20 ...	35	2	3·22	1 in 17·5
20 to 30 ...	219	17	27·42	1 in 12·9
30 to 40 ...	177	16	25·81	1 in 11·1
40 to 50 ...	133	12	19·35	1 in 11·1
50 to 60 ...	70	8	12·91	1 in 8·8
60 to 70 ...	25	4	6·45	1 in 6·25
Over 70 ..	9	3	4·84	1 in 3
Not ascertained ...	2	...	...	...
Total ...	670	62	100 ·	...

Influence of Occupation.—The occupation of the individual does not appear to have any manifest influence as regards liability to the disease. It is true that Waring, [2] Richards, and others were of opinion that agriculturists and coolies were more liable than other classes, but their conclusions were based upon fallacy, as they did not calculate the proportion affected of each class separately. Manson's observations led him to conclude that the occupation of the individual did not influence the liability to the disease, except, perhaps, that boatmen, fishermen, and sailors were less liable to the disease than other classes. The above-mentioned Indian writers share Manson's opinion regarding the lesser liability of fishermen and boatmen. Out of 17 individuals operated upon by the author for elephantiasis of the scrotum, 3 were merchants, 3 were shopmen, 1 was a goldsmith, 1 a clerk, 1 a priest, 1 a draughtsman, 1 a coachman, 1 a cook, 1 a baker, 1 a schoolboy, 1 a barber, 1 a magician, and 1 a cooly.

[1] "The Filaria Sanguinis Hominis," p. 74.
[2] *Op. cit.*

CHAPTER VIII.

SYMPTOMS AND DIAGNOSIS.

ELEPHANTIASIS.—The disease is ushered in by swelling and pain or uneasiness in the lymphatic glands, either of the groin or axilla, and these symptoms are followed in a few hours by violent fever. The lymphatic disturbance is not always well marked, and may be overlooked. Some observers go so far as to say that fever is the primary symptom. Careful examination however will always detect symptoms of glandular disturbance, and even Richards, who wrote before the true pathology of the disease was understood, stated that "so commonly does the lymphatic disturbance precede the paroxysms of fever that many patients regard the swelling of the glands of the axilla or groin as a premonitory symptom of an attack."[1]

The febrile symptoms, which are usully of a violent nature, are ushered in by headache, nausea or vomiting, and often by rigors; and, in cases where the obstruction is situated high up in the lymphatic system, there is pain in the loins. The constitutional disturbance is symptomatic of the glandular inflammation which precedes it. Coincident with the advent of fever, inflammation of the tissues, drained by the affected glands, sets in. There is pain, redness, and œdematous swelling, the nature of which has alrcady been described. The fever is continuous, and, together with the other symptoms of constitutional disturbance, lasts for three or four days. Cessation of fever is followed by gradual abatement of the local disturbance, and after a time the tissues appear to recover their normal condition. Immediately after recovery from the primary attack, there is often no manifest sign of the damage which has been done to the lymphatics, excepting some enlargement of the glands. After an interval of variable extent, the patient is again attacked with a train of similar symptoms, followed perhaps by apparent recovery of health. Such attacks however continue to repeat themselves at intervals of variable extent, and although at first they appear to be followed by recovery, yet after a time it is noticed that the subsidence of the local swelling is only partial, and that each successive attack involves a slight increase in the bulk of the affected tissues. In other cases attacks of fever and inflammation are not repeated for long periods; but in all cases, whether the attacks are frequent or not, there is gradual enlargement of the affected part. According to Richards,[2] 3½ per cent. of cases of elephantiasis do not suffer from recurrent attacks

[1] "On certain Endemic Skin and other Diseases of India, &c." Tilbury Fox and Farquhar.

[2] "*Idem*," Tilbury Fox and Farquhar.

of fever, and Wong [1] of Canton met with many cases in which there was no history of febrile attacks.

We have already seen that the condition of mal-nutrition of the tissues, which results from the damage to the lymphatics, renders the part extremely liable to inflammation; and hence we can easily understand how chills, over-exertion, or injuries may, and do, so frequently result in such attacks. In the author's opinion attacks of ague are frequently the exciting cause of attacks of lymphangitis, and this serves to explain the apparent periodicity of the disease in some cases, and the belief of many of the older writers in the malarial origin of the disease. Inaccuracy of statements, belief in the periodicity of all fevers, and ideas of lunar influence on the body no doubt also account, in a measure, for the old ideas of the periodicity of the attacks.

During the intervals the patients enjoy good health, and their only complaint is of the inconvenience arising from the presence of the tumour, when the latter becomes of large size. Where the lower limbs are affected, and grow large and unwieldy, walking becomes proportionately difficult and labourious, and extensive hypertrophy of the scrotum interferes to a still greater extent with the power of locomotion.

Occasionally the parts affected with elephantiasis are attacked by a sloughing process or gangrene threatening the life of the patient and necessitating immediate interference.

Cases of acute inflammation, followed by sloughing of the scrotum, threatening the life of patients otherwise strong and healthy, are not infrequent in India; and such cases are, in my opinion, frequently due to filarial obstruction of the lymphatics.

Lymphatic Varix.—The symptoms and progress of cases of lymphatic varix resemble in most respects those of elephantiasis. They differ only in the nature of the permanent changes which take place in the tissues of the part, and in the fact that in cases of lymphatic varix, each attack of fever and local disturbance is accompanied by discharge of lymph from the surface. The fluid, which is poured out is, as we have seen, either clear, milky, or sanguineous, and the discharge continues in most cases for three or four days. In some cases however the discharge becomes so profuse and continuous as to exhaust the patient, and endanger life, and in such cases it becomes necessary to operate at once.

In some cases of elephantoid disease the febrile attacks become so frequent as to exhaust the patient and necessitate surgical interference.

According to Richards [2] and Day,[3] when women are affected with elephantoid disease the uterine functions are interfered with, and abortion becomes frequent. The same authors further

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[1] "On certain Endemic Skin and other Diseases of India, &c." Tilbury Fox and Farquhar.

[2] *Op. cit.*

[3] *Op. cit.*

state that when males are affected, the procreative powers become diminished or annulled. Sir Joseph Fayrer [1] however does not share their opinion regarding the effect upon males.

Part of the Body affected with Elephantoid Diseases.—Elephantiasis most usually affects either the limbs or the scrotum. There is great discrepancy of opinion regarding the relative frequency of elephantiasis of the scrotum and elephantiasis of the limbs. Waring [2] states that the lower extremities are affected in 98 per cent. of cases, and that in only 4 out of 945 cases, collected by himself, was the scrotum affected. According to Richards [3] the lower extremities are affected in the ratio of 85 per cent., and the scrotum in the ratio of 4½ per cent. Day [4] gives similar figures. Mohideen Sheriff [5] states that the lower extremities are affected in the ratio of 71 per cent. and the scrotum in the ratio of 28 per cent.

In considering these figures it must be borne in mind that a certain amount of shame is attached to the fact of being affected with scrotal disease, and that there is an idea, among the natives of India, that the latter is connected with venereal disease. The experience of the Presidency Hospitals in India is quite opposed to that of some of the observers whom I have quoted, and Palmer of the Calcutta Hospital states that 80 per cent. of the cases he met with were affected with scrotal disease. These figures however do not represent any more than the others the true proportions, because most of the patients who resort to the Presidency Hospitals do so for the express purpose of undergoing amputation of the scrotum. In my own practice in the General Hospital of Madras, the majority of cases of the disease which came under my notice were cases in which the scrotum was affected, the patients having come to hospital for the purpose of having the scrotum removed. Such patients, suffering from elephantiasis of the limbs, as do resort to the hospital, usually come on account of some other disease or on account of injuries.

The figures given by Mohideen Sheriff are probably nearer the truth than any of the others, but even in his case, I think, the relative frequency of elephantiasis of the limbs is overestimated.

In women the labia are sometimes affected, and the Museum of the Madras Medical College contains a specimen of such, weighing 37 lbs. This tumour was removed from a Burmese woman by Surgeon E. P. Frenchman. Disease of the labia however does not appear very common. Surgeon-Major Branfoot, who has had long experience in the Hospital for Women and Children in Madras, writes: "I have for years been on the look out for cases of elephantiasis with disease of the lymphatics and filaria in the blood, but have not come across such cases, although

[1] "Tropical Dysentery," p. 258. [2] *Op. cit.* [3] *Op. cit.*
[4] "Madras Quarterly Journal of Medical Science," vol. I, p. 37.
[5] "On certain Endemic Skin and other Diseases, of India, &c." Tilbury Fox and Farquhar.

I have met with several cases of chyluria in women with presence of filaria in the urine and in the blood."

All observers are agreed as to the comparative infrequency with which the disease affects the upper extremities.

When the lower limbs are affected, the disease is usually limited to the foot and leg, and in like manner when the disease affects the upper extremity, it is usually limited to the hand and forearm. This is probably due to the fact that some of the lymphatics of the thigh do not enter the inguinal glands,[1] but accompany the obturator, ischial and gluteal vessels into the pelvis. A similar distribution of lymphatics probably exists in the upper limb.

It is rare to meet with elephantiasis of the skin of the trunk. The author has met with two such cases. In one of these [2] the disease implicated the skin covering a large fatty tumour of the back. The patient was subject to periodical and characteristic attacks of inflammation of the tumour, and filariæ were found in the blood. In another case the disease affected the skin of the buttock. In this case, however, the blood was not examined for the presence of filariæ, and therefore its filarial origin is not certain.

Lymphatic varix is much less frequent than elephantiasis proper. According to McLeod,[3] only 3 per cent. of cases of scrotal disease suffer from "lymph-scrotum."

The size to which scrotal tumours attain is sometimes enormous. Sir Joseph Fayrer removed a tumour weighing 110 lbs., and Mr. Partridge [4] of Calcutta removed one weighing 111 lbs. Mr. Cooper [5] is said to have removed a tumour weighing 224 lbs. Surgeon-Major W. R. Browne removed a scrotal tumour weighing 124¾ lbs. from a patient in the General Hospital, Madras. The weighment was made in this case after all the fluids had drained out of the tumour. The total weight was estimated as being about 140 lbs.

Diagnosis.—The initial attack of the disease may easily be mistaken for one of glandular inflammation and erysipelas, such as might result from a poisoned wound. In a case occurring in a country where elephantoid disease is endemic, and where there has not been any wound, filarial disease may be suspected, and if the embryo filariæ are found in the blood, there is still less doubt as to the nature of the case. The absence of filariæ from the blood does not, on the other hand, exclude the diagnosis of elephantoid disease, because the embryos may escape observation, or may be temporarily absent from the blood.

It has already been stated that the examination of the blood in such cases must not only be conducted at night, but also that

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[1] *Op. cit.* Curnow.

[2] "Transactions of the South Indian Branch of the British Medical Association," April 1889.

[3] "Operative Surgery."

[4] "Medical Times and Gazette," vol. I, 1880, p. 660.

[5] "Medical Times and Gazette," vol. I, 1884, p. 177. Norman Chevers.

it must be systematic and prolonged. It must moreover be remembered that the febrile state interferes with filarial periodicity, and lessens the number of filariæ in the blood at any one time.

The disease may be distinguished from malarial fever by the symptoms of primary lymphatic disturbance, and by the absence of intermissions or remissions, anœmia, dropsy, enlarged spleen or cachexia (Richards).

When once the disease is fully established, there is no difficulty about the diagnosis, either of elephantiasis or lymph scrotum. The differential diagnosis between varicose groin glands and herniæ has already been discussed.

Prognosis.—Excepting the liability to attacks of fever and inflammation, the subjects of elephantoid disease enjoy good health as a rule.

The following table, prepared by Waring,[1] serves to show how long such patients may live :—

Duration of disease.	Number of cases.	Percentage.
Under 1 year	44	4·66
From 1 to 5 years	197	20·85
From 6 to 10 ,, ...	196	20·74
From 11 to 15 ,, ...	136	14·39
From 16 to 20 ,, ...	126	13·33
From 21 to 25 ,, ...	79	8·36
From 26 to 30 ,, ...	71	7·52
From 31 to 35 ,, ...	30	3·17
From 36 to 40 ,, ...	23	2·43
From 41 to 45 ,, ...	11	1·16
From 46 to 50 ,, ...	2	·20
From 51 to 55 ,, ...	2	·20
Doubtful	28	2·96
Total ...	945	100

The dangers to which the patients are liable have already been recounted, when treating of the symptoms of the disease. Inguinal hernia, which sometimes exists in cases of elephantiasis of the scrotum, is a serious complication, and as will be seen affects the question of operation.

[1] "Indian Annals of Medical Science," vol. V, p. 1.

CHAPTER IX.

GENERAL TREATMENT.

PREVENTIVE TREATMENT.—Elephantoid disease is one of those affections which it is theoretically possible to stamp out. Were it possible to secure a water-supply, either originally free from immature filariæ, or so purified by filtration or boiling as to insure the destruction of these parasites, the disease would perforce disappear. Putting aside such possibilities as utopian, we have to admit that the ignorance, as well as the poverty, of the natives must prevent any such happy consummation in eastern countries for a long time to come. Much however may and has been done in this direction in the larger towns of India. In Madras, for instance, since the introduction in 1873 of a new water-supply brought from a distant reservoir, there has been a very marked diminution of "guinea-worm." There is every reason to hope that the *filaria sanguinis hominis*, like the *filaria medianensis*, may become rare in that city; and there is a general impression that already elephantiasis is becoming less frequent.

When once an individual has become the victim of the parasite, it is questionable whether it is possible to do anything to relieve him of his unwelcome guest. It is possible that the animal might be destroyed by means of drugs administered to the host, but the first effect would more than probably be to produce abortion in the worm, and embolism of the lymphatic glands; and thus bring about the very catastrophe which we wish to avoid. Whenever this catastrophe has occurred and the lymphatics have become damaged, we cannot hope to do more than to relieve symptoms as they arise, and remove, when necessary, such out-growths as result from the disease.

CURATIVE TREATMENT.—The subjects of elephantoid disease must as far as possible avoid all those contingencies which are liable to produce inflammatory attacks; such as over-exertion, exposure to extremes of temperature, and chills. Whenever attacks of inflammation arise the treatment must be conducted on general principles. The patient must rest in bed, and the inflamed part must as far as possible be elevated, and cold or hot applications used in accordance with circumstances. After inflammation has commenced to subside, the part must be carefully bandaged and kept in an elevated position, and the longer the patient can be induced to continue this treatment, the less rapid will be the progress of the hypertrophic changes. The nature of the treatment of the disease in its later stages, depends upon the particular part of the body which is affected, and hence it is necessary to discuss separately the treatment of elephantiasis of the limbs, and that of the scrotum and labia.

ELEPHANTIASIS OF THE LIMBS.—It is expedient to deal first with the question of the propriety of ligaturing the main artery of

the limb in these cases. This operation is still countenanced by some surgical authorities, is still treated of in some text books as a legitimate one, and is still, I regret to say, occasionally put in practice. It is an operation which is totally unjustifiable. It was first proposed and practiced by Carnochan[1] of New York in 1851, and has since that period been performed by a great number of surgeons, notably by Butcher, Bryant, Fayrer, Richards, Bochard, Baum and Simon.

The following are the more important reasons which have led to its condemnation, and they demonstrate, so unmistakeably, the impropriety of undertaking the operation, that it is a matter for wonder that any surgeons can still be found to countenance it :—

(1) The disease, under ordinary circumstances not being one which threatens the life of the patient, nor materially affects his health, the undertaking of any operation which seriously endangers the former is not justifiable. In treating of the prognosis of the disease, it was pointed out that patients affected with elephantiasis might live to an indefinite age, and that their general health does not usually suffer. In those exceptional instances, when life is threatened by severe inflammation or gangrene of the limb, amputation is the only operation likely to save the patient's life.

(2) To ligature the main artery of an elephantoid limb—a limb which is liable to attacks of violent inflammation and serious disturbances of nutrition, as the result of even trivial causes,—is to perform an operation fraught with very considerable danger to the life of the patient. When we consider the condition of the tissues in these cases, the great and constant disturbance of nutrition, and the fact that slight injuries are liable to produce violent inflammation, it is difficult to believe that the operation is not fraught with great danger. Most of the statistics of the operation that have been published are, unfortunately, very unsatisfactory and vague regarding the mortality. Erichsen however quotes Eppner to the effect that 49 cases were followed by 5 deaths—a mortality of 10 per cent. Bryant operated four times with 1 death. Sir Joseph Fayrer[2] three times with 1 death ; and Jamieson[3] records a fatal case. These figures serve to show that the operation is frequently followed by a fatal result.

(3) The operation in a great number of cases fails to afford any relief. Jamieson collected reports of 28 cases, in the majority[4] of which the result was negative. In a few there was marked diminution of the swelling, and in only one or two cases apparent cure. Buchanan[5] collected 12 cases, 4 of whom were not benefited by the operation. Fischer[6] reports 21 cases, 10 of

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[1] "Medical Times and Gazette," vol. II, 1877, p. 470. Jamieson.
[2] "*Idem*," vol. I, 1870, p. 577.
[3] "*Idem*," vol. II, 1877, p. 470.
[4] "*Idem*."
[5] "Biennial Retrospect of Medicine and Surgery," vols. 67-68.
[6] "Rankin's Abstract," vol. I, 1870, p. 117.

whom were not benefited; and Wernher[1] 32 cases, 16 of whom were unsuccessful. According to the best of these statistics (Buchanan's), 4 out of 12 cases were not in any way benefited.

(4) When the operation does result in relief of the symptoms, or in apparent cure of the disease, the beneficial effects are only temporary, and the swelling sooner or later recurs. In most of the records that have been published there is no attempt to show whether the cure was permanent or not, and there is every reason to believe that in many, if not in all, cases of apparent cure, the disease sooner or later re-appears. Of the 31 cures reported by Eppner,[2] 9 were known to have relapsed; and out of 32 cases reported by Wernher, permanent relief was obtained in only 3. Buchanan[3] operated upon a case the result of which led him to speak warmly of the advantages of operation and to recommend its adoption, in spite of the unfavourable criticisms of Syme and others. At the same time, he pointed out the imperfection of our information as to the permanence of such cures. Shortly afterwards, his own patient, whom he thought he had cured, was seized with fresh attacks of inflammation, and the limb returned to its former size. He concludes, "in this case therefore the success obtained was only temporary, and a knowledge of this fact must necessarily induce us to look, with some suspicion, upon other published cases, in which we have no information as to the state of the patient, long after the operation."

(5) The beneficial effects attributed to the operation are in reality the result of the associated treatment, such as rest and bandaging of the limb; and can be brought about equally well by the latter means alone. A case,[4] related by a medical man in south Australia, illustrates very clearly the fact that the beneficial effects attributed to the operation are the result of the associated treatment, rather than of the operation itself. In this case the patient suffered from elephantiasis of both lower limbs, on one of which the operation of ligature was performed. Seven weeks after operation, the limb which had been operated upon had diminished in circumference, at the calf by 4 inches, and at the ankle by $5\frac{1}{4}$ inches; whereas the limb which had not been operated upon, had diminished in girth, at the calf by $3\frac{1}{2}$ inches, and at the ankle by 7 inches. The limb therefore which had not been operated upon, improved to a greater extent than the other—a proof that the operation at any rate was not the cause of the beneficial result. The surgeon who narrates the case believes that digitalis and ergot, both of which were administered to the patient, were the cause of the improvement. Whether these drugs had any share in producing the beneficial results, it is impossible to say; but on the other hand all surgeons who have had much experience in the treatment of the disease, are aware that similar benefit can be obtained by keeping the patient at complete rest, and elevating and bandaging the limb.

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[1] "Ashurst's Encyclopædia of Surgery." [2] *Op. cit.* [3] *Op. cit.*
[4] "Lancet," vol. I, 1879, p. 44.

(6) Our knowledge of the pathology of the disease does not lead us to expect any permanent benefit from such an operation. The failure of the operation to afford any permanent relief is only what we should expect considering the nature and pathology of the disease. Neither this operation nor any other can restore the damaged lymphatics, nor re-establish the normal circulation of the lymph.

An unbiassed consideration of all the facts which have been enumerated, cannot but convince every surgeon of the impropriety of attempting this operation, and therefore it is very necessary that these facts should be widely known, and that the practice should be decisively condemned by all surgical authorities.

All that we can hope to do in elephantiasis of the limbs is to prevent, as far as possible, the outflow of lymph into the tissues, and to promote absorption by means of rest, elevation of the limb, and bandaging. The longer the patient can be induced to undergo this method of treatment, the greater the benefit that will result. As soon as the treatment is left off, there will be a gradual return of swelling, which will be aggravated by further attacks of inflammation. Aranjo[1] of Brazil treated a case of elephantiasis with electricity, obtaining a satisfactory result; but states that the treatment was *rendered more efficacious by elevating and bandaging the limb.* Dr. Dowse[2] used a simlar method of treatment with benefit. It is quite possible that electricity may aid in removing the hypertrophy for the time being, but it cannot possibly cure the disease.

Mercury[3] has been used extensively, both externally and internally, with varying success. When benefit has resulted, the treatment has usually been associated with rest and bandaging. A very interesting case was published by Mr. Bentley,[4] in which the limb was elevated, fomented, and rubbed with strong mercurial ointment; and iodide of potassium and chlorate of potash were administered internally. The treatment lasted three months and resulted in complete disappearance of the swelling, and the patient is said to have remained well for three years afterwards.

It is right to mention here that several Indian authorities believe that the disease is cured by change of climate, but, so far as I know, no cases have been published in proof of these statements. When the health of the patient is harassed by constantly recurring attacks of inflammation and fever, the limb must be amputated.

Elephantiasis of the Scrotum and "Lymph-Scrotum."—The remarks which have been made regarding the treatment of elephantiasis of the limbs apply, in a great measure, to the treatment of scrotal disease. Complete rest, combined with elevation of the part, and equable pressure applied by means of

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[1] "London Medical Record," vol. VIII, p. 185.
[2] "Lancet," vol. II, 1880, p. 619.
[3] "Clinical and Pathological Observations in India."—Fayrer. "Madras Quarterly Journal."—Day.
[4] "Lancet," vol. I, 1878, p. 784.

bandages, will reduce the swelling for a time, but will not effect a permanent cure. When once the tumour has reached such a size as to interfere with the power of locomotion, or to be a great deformity, it is better that the diseased mass should be removed, and a permanent cure thus established. In those cases in which attacks of inflammation and fever are constantly recurring and thereby seriously affecting the patient's health, amputation of the scrotum must be carried out without delay. Similar principles must guide our treatment of "lymph-scrotum." When the discharge of lymph is so copious or so constant as to seriously affect the patient's health, there must be no delay in removing the scrotum.

CHAPTER X.

OPERATIVE TREATMENT.

The operation for removal of elephantiasis of the scrotum or "lymph-scrotum" was, it is believed, first attempted by Mr. Key[1] of Guy's Hospital, but his patient succumbed to hæmorrhage. The first successful operation was performed in 1831 by Brett[2] of Calcutta, who removed the scrotal tumour, and, at the same time, preserved the genital organs intact. Brett operated by means of flaps, and a similar method was employed by Bascombe,[3] but it was soon found that flaps were not only unnecessary, but also disadvantageous; for the disease always reappeared in the tissues that were not removed. The danger of hæmorrhage, which was the great difficulty in these early operations, was first overcome by Sir Joseph Fayrer, who employed a cord to compress the neck of the tumour during the operation. A still further advance was made in 1874, when Mr. Partridge[4] of Calcutta first introduced elastic compression, as a means of controlling hæmorrhage.

The first statistics[5] published regarding the operation were those of the General Hospital of Calcutta from 1859 to 1871 recorded by Sir Joseph Fayrer. This report included 193 operations with 35 deaths, giving a mortality of 18·2 per cent. Of the fatal cases 15 died from septic poisoning; 6 from tetanus; 1 from gangrene; 7 from exhaustion; and 4 from other causes, such as embolism and diarrhœa.

A later report of the cases occurring in the Calcutta Hospital is given by McLeod,[6] and consists of 129 operations with 23 deaths showing a mortality of 17·7 per cent. Of the fatal cases, 6 died from septic poisoning; 9 from tetanus; 1 from gangrene; 4 from exhaustion; and 3 from other causes. The records of the General Hospital of Madras, for the years 1870 to 1884, show a series of 115 operations with 17 deaths, giving a mortality of 14·78 per cent.

The records of the same hospital for the nine years ending 1886, published by Sibthorpe,[7] show a series of 68 cases with 5 deaths, giving a mortality of only 7·37 per cent.

The comparatively high mortality in the Calcutta Hospital appears to have been chiefly the result of septicœmia and tetanus.

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[1] "Medical Times and Gazette," vol. I, 1884, p. 177. Norman Chevers.
[2] "*Idem*," and "Lancet," vol. I, 1846, p. 241; and "Lancet," vol. II, 1846, p. 36.
[3] "Lancet," vol. I, 1846. Bascombe.
[4] "Medical Times and Gazette," 1880, p. 660.
[5] "Transactions of the Pathological Society," vol. XXX. Sir J. Fayrer.
[6] "Operative Surgery." McLeod.
[7] "Transactions of the South Indian Branch of the British Medical Association," vol. II, 1888, p. 145.

The first series of cases occurred in the days before antiseptics had come into general use, and the high mortality cannot be wondered at when we read that "the fœtor of the discharges which, during the hot weather, with the thermometer at 91° in the shade, decompose very rapidly, cause the patient and his neighbours much annoyance."[1] If we exclude the deaths from septicœmia and tetanus, the mortality, in the first series of operations, would be reduced to 7·2 per cent., and, in the second series, to 6·1 per cent.

The author's own cases in the General Hospital of Madras have been 17, all of whom recovered with the exception of one man, who was removed from hospital by his friends, and died from diarrhœa a month after the operation. Assuming that the death of this patient was the result of the operation, the mortality of this series of cases was 5·8 per cent.

The experience gathered from these cases, joined to a consideration of the above statistics, lead me to believe that the mortality of this operation will, in course of time, be reduced to a much smaller figure. Under favourable circumstances septicœmia should be very rare indeed, even in Indian hospitals; and, although tetanus is very common in this country, it seldom, if ever, follows wounds or operations as long as the latter remain in an aseptic condition. Such at least is my experience.

In deciding upon the advisability of operating in cases of elephantiasis of the scrotum or lymph-scrotum, the surgeon is guided by those general rules which are applicable to all operations of a major degree. Visceral disease, more especially disease of the kidneys, of necessity forbids operation, as do also enfeebled conditions of the system generally, unless arising from the disease itself. The presence of an inguinal hernia does not necessarily forbid the operation. In cases in which the hernia is large, and of old standing, the operation should not be undertaken, excepting as a matter of expediency. In other cases the hernia should be dealt with by a preliminary operation. The danger of shock is proportioned to the size of the tumour, and is only serious in cases of extremely large growths. The operation in itself is quite devoid of danger, and, if such cases as I have mentioned be excluded, a favourable issue may be confidently anticipated.

In the measures adopted preparatory to the operation, the most important are those which refer to the cleansing of the parts to be operated upon. At least twenty-four hours previous to the operation the parts must be very carefully shaved, well scrubbed with soap and warm water, and then enveloped in cloths saturated with an antiseptic lotion. Immediately before the operation, these cloths are removed and the parts scrubbed with spirits of turpentine.

Means adopted for preventing Hæmorrhage.—Some surgeons are in the habit of completely emptying the tumour of

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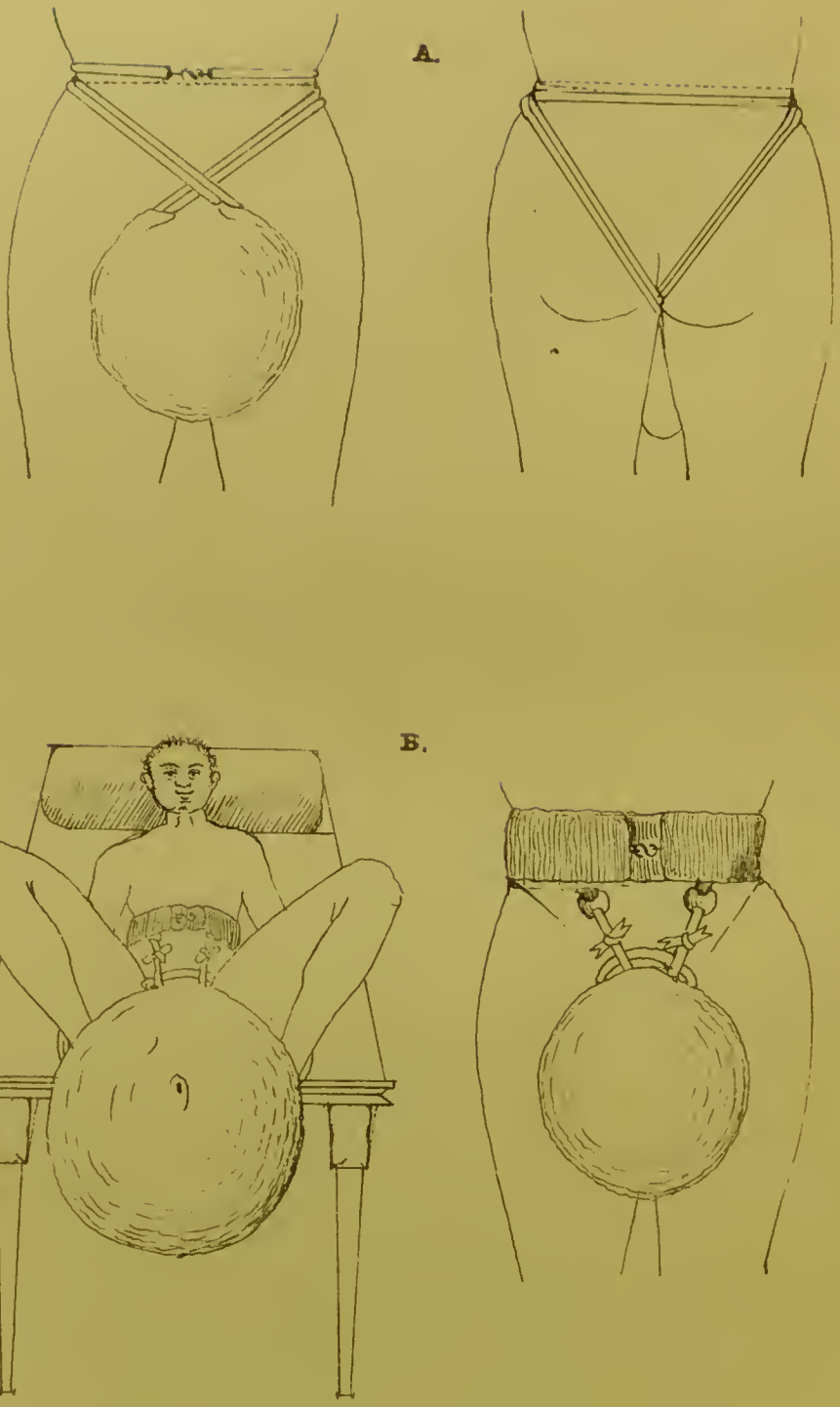
[1] "Clinical Surgery," p. 310. Fayrer.



A. McLeod's method of controlling Lumorrhage.
B. Partridge's method of controlling Lumorrhage.

blood by means of Esmarch's bandages. For my own part I cannot believe that the sudden addition of such a large quantity of blood to the general circulation, and the corresponding increase of blood pressure are conditions devoid of danger, and I always content myself with applying only such an amount of pressure as is sufficient to empty the large veins of the tumour. Whether the tumour be completely drained of blood or not, it is necessary to restrain active hæmorrhage during the operation, by constricting the neck of the tumour by means of an elastic cord. This may be done in accordance with the plan adopted by Mr. Partridge, or by a method employed by Dr. McLeod.

The former method[1] consists in encircling the neck of the tumour by means of an elastic cord. Beneath this elastic cord are passed four tapes, two in front and two behind; and these in their turn are attached to the four rings of a belt which encircles the patient's waist. By drawing on these tapes and securing them tightly the elastic cord is prevented from slipping down and off the neck of the tumour. Dr. McLeod objects to this method that the belt is apt to impede breathing, and that the elastic cord is apt to slip off the neck of the tumour, after the latter has been removed. The first of these objections is certainly of importance, as, although, under ordinary circumstances, it does not give rise to any inconvenience, particular instances might occur in which it might prove a source of danger, and necessitate the removal of the belt during the operation. On the other hand, Dr. McLeod's own method is open to a similar objection, although in a less degree, because considerable pressure upon the abdomen is caused by the elastic cord. As regards the second of these objections, there is little fear of the cord slipping, if the apparatus be properly applied. The accompanying drawings serve to illustrate Partridge's method of controlling hæmorrhage.

McLeod's[2] method, which is undoubtedly the most satisfactory of the two, is described in his own words as follows:— It is commenced "by placing the middle of the cord over the lumbar region. This gives two ends. I take the right end and pass it round the left side of the neck of the tumour, crossing the pubis. Having encircled the neck on the left side, the loop crosses in front of the anus to the right, lodges in the cleft of the nates, and is brought round a second time over the crest of the ilium, and again carried round the neck of the tumour, and above the crest of the ilium. The same manœuvre is carried out on the opposite side with the other end of the cord, and the two ends are finally looped over the abdomen. The neck of the tumour is thus clasped by four tight cords of india-rubber crossing each other over the pubis, and in front of the anus. It is compressed by an oval elastic loop which presses vertically as well as laterally, and has therefore less tendency to slip than a single ring or loop. The main pressure of the

[1] "Medical Times and Gazette," vol. I, 1880, p. 660.
[2] "Operative Surgery." McLeod.

stretched cord is brought to bear on the crests of the iliac bones, and there is no pressure on the abdomen except that which results from the final loop." The accompanying drawings, illustrating this method, are taken from McLeod's work.

The circulation having been controlled by either of these methods, the patient is placed in the lithotomy position, and the operation commenced by introducing a director into the orifice of the prepuce, slitting up the latter with a sharp-pointed bistoury, seizing the glans, and by continuing the primary incision upwards towards the pubis, shelling out the penis. Two parallel vertical incisions are then made into the tumour, one on each side over the line of the cords and testicles, and are deepened until the latter are reached. The testicles are then seized and shelled out along with the cords. If the testicles are affected with hydrocele, care should be taken not to open the sac at this stage of the operation, as, otherwise, it will not be so easy to isolate the cord and testicle. The upper ends of the two vertical incisions are now joined to the primary incision by means of two horizontal cuts. The penis, testicles, and spermatic cords now being held up over the abdomen by an assistant, the whole mass of diseased tissue is removed by a sweeping incision carried within half an inch of the elastic compressor.

If hydroceles are present, they should now be dealt with by opening the sac, and, after all the fluid has escaped, cutting off the whole of the parietal portion of the tunica vaginalis, with the exception of a small margin, a quarter of an inch in breadth.

The next procedure is to take up and tie, or twist, all such arteries as can easily be seen. These will chiefly be found in the centre of the perinæum, and between the root of the penis and the pubis (internal pudic branches); and also at the upper margin of the wound (external pudic branches). After these vessels have been secured, the elastic cord may be removed, and the surface of the wound compressed with sponges, by assistants, until all the remaining vessels have been seized by means of forceps. The vessels may then be tied at leisure, or twisted.

If any scrotal tissue remain at the edges of the wound, it should now be pared away by means of scissors, and care must be taken to remove the whole of the mucous membrane of the prepuce, as, if any portion be left behind, it will ultimately become hypertrophied, and necessitate another operation.

The final stage of the operation consists in fixing the testicles in position. In the early days of this operation, surgeons were in the habit of retaining flaps of, what appeared to be, healthy scrotal tissue and by means of those covering in the testicles. It was soon found, however, that such flaps of skin became subsequently diseased, and the operation by means of flaps was abandoned. In spite of these facts, this method of operating has from time to time been revived, showing that the uselessness of such attempts is not as fully recognized as it should be. The impropriety of any attempt to retain flaps from the sides of the scrotum cannot be too firmly insisted upon, for, as long as any of the skin or subdermic tissue which is drained by the damaged

lymphatic glands is left behind, such tissue must subsequently become diseased. Any attempt to use any of the scrotum to cover in the testicles must end in failure. The method of fixing the testicles, which I have been led to adopt, consists in uniting the fringe of the tunica vaginalis of each organ to the edges of the wound by means of silk sutures. The two testicles are united to one another in the median line, in a similar manner, by means of sutures passed through the fringe of the tunica vaginalis.

Dr. McLeod's method of fixing the testicles consists in dissecting up the deep layer of the superficial fascia of the perinæum and thus making "pockets," within which the testicles are placed. This procedure, however, appears to prolong and complicate the operation, without producing any compensating advantages over the simpler method which has been described.

As regards the dressing of the wound, there is one point of very great importance, and that is that a piece, either of Lister's "protective," or of ordinary oil-silk should be placed in immediate contact with the wound. Unless this precaution be adopted, the dressings become so incorporated with the surface of the wound, as to render the subsequent changing of the former, not only extremely painful, but also, by tearing up the granulations, to cause hæmorrhage, and subject the patient to increased risk of septicœmia. If either of these substances be placed next the wound, the dressings are removed easily, and without causing pain or hæmorrhage. It may seem unnecessary, in these days, to draw attention to such a point, but I believe the necessity for such precautions is not as widely recognised as it should be, and it certainly was the practise, only a few years ago, of some surgeons to dress these wounds without the interposition of any protective medium. In such cases, in order to avoid the difficulties to which I have alluded, the dressings were not changed for three or four days, until suppuration had been established. It is almost needless to add that, with a temperature bordering upon the nineties, the smell from these wounds became intolerable, and that septic disease or tetanus were not unfrequently the result.

The nature of the dressings employed, provided they be antiseptic, absorbent, and sufficiently often changed, is immaterial.

A considerable time elapses before the whole wound is covered with granulations, but as soon as this process is satisfactorily established skin-grafting must be resorted to. Owing to the movements involved in the acts of micturition and defœcation, and the consequent liability to disturbance of the dressings, skin-grafting is carried on under considerable difficulties.

One of the most important points at this stage of the treatment is the necessity of counteracting, as far as possible, the tendency to retraction of the penis. The sulcus at the root of the penis must, as far as possible, be kept open by means of strips of lint, and the two granulating surfaces prevented from adhering to one another.

It is at the root of the penis that skin-grafting is most essential and, at the same time, most difficult of fruition.

The latter part of the healing process is extremely tedious, and twelve weeks or more may elapse before the wound has quite healed.

Result of the Operation.—When the parasite is situated in the distal lymphatics of the scrotum, the success of the operation is complete; and the patient is not only freed from what is at one and the same time a hideous deformity, and a source of very great inconvenience, but he moreover loses entirely the liability to attacks of inflammation and fever. When however the disease is the result of obstruction situated high up in the lymphatic system, or is secondary to obstruction of the lymphatics of either or both the lower limbs, the operation does not affect the original source of the disease; and, although the scrotum remains free from further disorder, the damage to other portions of the lymphatic system will continue to embarass the well-being of the patient.

Elephantiasis of the Labia.—The treatment of elephantiasis of the labia is conducted on the same principles as that of the scrotum. When the tumour reaches such a size as to necessitate its removal, it may be cut away by means of the knife, although some surgeons prefer to use the ecraseur.

INDEX.

A

B

C

D

E

F

G

H

I

J

K

L

M

N

O

P

Q

R

S

T

V

W

Y