am informed that the forcing of a stick into the rectum is a not unknown form of native punishment for certain offences.

THE IMMEDIATE MICROSCOPICAL DIAGNOSIS OF TUMOURS DURING THE COURSE OF OPERATIONS.*

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IN June, 1904, I gave a lecture at St. Bartholomew's Hospital entitled, *The Early Microscopical Examination of Tumours*.¹ Perhaps this short title did not express my meaning as clearly as could be wished. It does not make clear that the early microscopical diagnosis is made whilst the patient is anaesthetized and ready for the operation to proceed, should that be necessary. Mr. Ernest Shaw is present to-night to demonstrate to you how easily and quickly a perfect section of a tumour can be placed under the microscope, and how certain that makes the diagnosis. A larger experience of the method has shown us how exceedingly valuable it is. Indeed, in my own surgical work it has become part of the organization of all operations in which any question of tumour diagnosis might possibly arise.

Many of the clinical rules laid down for the diagnosis of tumours are rules for the diagnosis of tumours which have grown until almost beyond the possibility of scientific surgery. By scientific I mean certain—absolutely certain. At first a cancer of the breast is a small, hard, painless, movable nodule, which no one can tell from a little fibroma, an adeno-fibroma, a little cyst, or an inflamed lobule. But left alone that little nodule soon—much sooner than is thought—spreads its cancer cells or juices far and wide into the lymphatic system.² An early microscopical examination—and no one can tell what that little tumour is without one—puts all doubt at rest. If the tumour be harmless the operation is quite trifling; but if it be malignant an efficient one can be done.

The diagnosis of tumours rests upon (a) clinical, (b) naked eye, and (c) microscopical characters. Even when based upon such solid foundations as these it may be profoundly modified by the ultimate fate of the patient. Of late several occurrences have shaken my belief in even the axioms of clinical surgery. What would any one think if he were told that an ossifying enchondroma had been removed from the front of the left thigh bone by sawing and chiselling through the bony pedicle? I venture to opine that few would think that the patient would come back in six years with a large growth of the upper third of the femur and enlarged glands in Scarpa's triangle, and for which I had to amputate at the hip-joint. Such a fact as this makes me wonder what will be the fate of a boy who had a similar ossifying enchondroma of the lower end of the thigh bone taken away by chiselling through its bony stalk, and then, after less than a year had elapsed, another from the same spot. Had nothing been known about what happened to these patients after the first operation, I myself, being, perhaps, still imbued with some of the "idols of the market and of the theatre," should have applied the term "innocent" to their tumours, and theorized that they would not grow again. Nay, some would have gone further and said that if they did grow again they would not have grown into the lymphatic glands. I suspect that in these cases the capsule is the source of the fresh growth. If this be a correct guess, its bearing upon the method of removal is obvious.

The truth seems to be that the time has come when most of us ought to pass in review and revise our notions about tumours. Should our ancient beliefs prove to be right no harm will be done; faith will be fortified. But should our beliefs prove to be wrong, then it is to be hoped that suffering humanity may ultimately benefit by their recantation.

Now, as regards the clinical diagnosis of tumours: It is difficult for a clinical and pathological sceptic to treat current beliefs with due reverence. My own faith has been shattered by many errors. A small, hard, movable nodule in the breast of a young woman has been diagnosed *secundum artem* to be a fibro-adenoma, and has proved to

be a carcinoma; and I am far from being the only one who has been deceived. A hard, solid mass in the full breast of a florid, middle-aged woman was surely a carcinoma, but was in reality chronically-inflamed breast with a cyst in its centre. A cyst in the mammary gland, when cut into, looked like a thick-walled cyst with walls of fibrous tissue. Its walls were cancer. A large adherent tumour of the breast, with retraction and ulceration of the nipple and enlargement of the axillary glands, was thought by many to be inoperable carcinoma. It was tuberculosis of the breast and easily taken away. An encapsulated tumour in the breast of a middle-aged woman ought to have been innocent, to use the current phrase, but it was cancerous.

A small indurated nodule in the epididymis was diagnosed by surgeons of great experience to be tuberculous. It was a small malignant adenoma. Five years afterwards a tumour grew in the other testicle. A similar nodule met with in the epididymis, and which was associated with hydrocele of the tunica vaginalis, proved forthwith to be inflammatory, not tuberculous. But on another occasion an inflamed testicle was punctured to find out the nature of some fluid. None was found, but a piece of tissue came away in the cannula. This was part of a malignant growth. To me this discovery was a complete surprise. The testicle was removed, and the diagnosis fully confirmed. I can adduce two other instances in which a swelling of the testicle was thought to be inflammatory, and treated as such, and ultimately found to be sarcomatous. Oddly enough, both occurred in cases in which the testicles had not undergone complete transition. In one, the left testicle had stopped just outside the external abdominal ring; and in the other both testicles were retained, the right in the abdomen and the left in the inguinal canal. The latter was the one which I removed, but some months afterwards an abdominal tumour appeared and carried off the patient. It was supposed to have originated in the right retained testicle. I could continue to give instances of erroneous clinical diagnosis of tumours, but surely enough have been mentioned to explain my own mental attitude towards the ordinary clinical diagnosis. It is, however, to be noted that all the examples that have been given are ones of recognized difficulty. Fortunately there are instances in which the clinical diagnosis is unerring; as, for example, when we find a hard nodule in the epididymis, together with similar ones in the prostate and vesiculæ seminales; and perhaps pus and tubercle bacilli in the urine. But I have been speaking of tumours in which corroborative evidence is lacking, and the tumour has to be considered alone, and upon its own merits or demerits. But how often there is no corroborative evidence!

Now as regards the naked-eye diagnosis of tumours after they have been cut into. Probably it is not wise to cut into tumours. Infective particles or juices may escape from them and bring about a further growth in the severed tissues. At all events the way in which nodules of cancer sometimes appear in the scar and in the stitch holes after a cancer has been cut into suggests that this is possible. Therefore it is better that whenever possible the suspicious tumour should be removed whole, and then cut into and examined. Inasmuch as tumours are now, I am glad to say, often examined before they have had time to grow big and dangerous, they can oftener be taken away whole with an abundant margin. And now as to the value of the naked-eye examination of the exterior of the tumour and of its cut surface. Some years ago I made an error which sank deeply into my mind. A large and rapidly-growing tumour of the testicle was cut into and then removed because it was thought to be malignant. Soon afterwards fresh growth appeared in the wound, and ulcerated in the manner characteristic of gumma. Iodide of potassium brought about a speedy cure; very likely it would have cured the original tumour. Again, a surgeon, who was a good pathologist, cut into a tumour growing in the subcutaneous tissue of the arm. To the naked eye it might have been a sarcoma or an inflammatory swelling. On the whole, it was most like a sarcoma. Excision of the tumour and even amputation of the arm were talked about, but the wound was closed pending a microscopical examination. Ultimately the tumour sloughed, and the slough was exactly like a piece of wet washleather. Obviously it, too, was a gumma.

* An address delivered to the Hampstead Division of the British Medical Association.

Many intra-abdominal tumours cannot be diagnosed with the naked eye. I have mentioned elsewhere a growth which implicated the intestine, and was thought to be malignant in spite of a microscopical section which had shown that it was inflammatory. Then I had a lingering confidence in my powers of making a naked-eye diagnosis of tumours. But the microscope was vindicated when the tumour departed and left no trace of its presence, for the patient ultimately died of septicaemia derived from a small abscess along the right ureter. On another occasion a large tumour of the great omentum had the naked-eye appearances of malignant growth, but the microscope revealed nothing but inflammatory deposit. The omentum was removed, otherwise the case might have got included amongst abdominal tumours, supposed to be malignant, but which disappear after laparotomy. The naked-eye diagnosis of such abdominal tumours unsupported by microscopical evidence is mere food for the credulous. Again, tumours which to the naked eye seem to be inflammatory are oftentimes malignant. Gall stones were removed from a very thick gall bladder. The thickening was assumed to be the result of inflammation, but a piece was cut off for microscopical examination. The thickening was, as is not by any means rare, caused by cancerous growth. A second operation was performed and the gall bladder excised. This brought to light a strange thing. At the first operation the cystic duct had been very thoroughly explored with the finger. Nevertheless, at the second operation it had a large gall stone in it. However, I have almost ceased to wonder at anything that occurs in this mysterious region, in spite of the infallibility with which its diseases are diagnosed, and the astounding certainty with which they are said to be cured.

Clearly the patient with the thick gall bladder might have been spared a second operation had I taken, as I do now, the precaution to have an immediate microscopical examination. In another instance this was done, and disclosed that a projecting piece of a curious mass near a slightly distended gall bladder was inflammatory; although the tumour itself was very hard and did not fluctuate, encouraged by the result of the microscopical examination, a further search was made, and a little pus was found in its interior. Two years afterwards the patient was well. Recently a gall bladder which looked malignant was forthwith shown to be quite innocent.

In other regions the naked-eye examination of a tumour may lead one to suppose that it is inflammatory when, as a matter of fact, it is not. For instance, a tumour at the inner side of the left nipple was cut into, and some cysts brought into view, and then a little pus. The pathologist, who was in attendance, looking at the cut surface of the tumour, and having also seen the pus, without hesitation said the tumour was inflammatory. It will be agreed that on ordinary clinical grounds he had ample justification. But the immediate microscopical examination brought to light a carcinoma—a so-called duct carcinoma.

Many enlargements of the lymphatic glands cannot be diagnosed by ordinary clinical methods. Fortunately, they are usually situated in accessible places, and can easily be removed for immediate microscopical examination. This method has brought to light things which to me have oftentimes been rather surprising. I know that the philosophical historian has said that we wonder because we are ignorant, but I also know that the recognition of ignorance is the beginning of knowledge.

A dustman had enlargement of the cervical glands which was thought to be tuberculous, but was removed and contained squamous-celled carcinoma. The glands had probably been infected from an ulcer in the pharynx. Another man was supposed to be suffering from lymphoma (I confess that that term conjures up no clear image in my mind), but the microscope showed that the enlargement was myxosarcoma. On the other hand, enlarged lymphatic glands in a child's neck which were thought sarcomatous proved to be tuberculous, and were removed on both sides with a reasonable prospect of success.

The naked-eye and also the microscopical diagnosis of enlarged glands is sometimes exceedingly difficult, perhaps impossible. A labourer had enlarged glands along both carotid sheaths. There was much difference of opinion when the microscopical sections were looked at as to whether the appearances were those of inflammation or of malignant disease. Acting upon my own opinion I removed the glands, for I thought they were

inflamed, which proved to be the case. The cause of the inflammation or the kind of inflammation was never known. But the case shows how important it is that the operator should himself be able to interpret for himself the appearances seen in microscopical sections, for otherwise the operation would, on this and other occasions, have been abandoned.

Another case illustrated very well the difficulties by which the clinical diagnosis of enlarged lymphatic glands is enmeshed. A man had a mass of enlarged and obviously inflamed lymphatic glands beneath the right sterno-cleido-mastoideus. One of the largest of the glands fluctuated and was presumably suppurating. When exposed they looked like inflamed glands and the fluid which escaped looked like pus; but the microscope brought to light squamous-celled carcinoma. A clean sweep was made of the growth, but it speedily grew again. Fortunately the efforts of surgery are not always so unavailing.

The immediate microscopical examination is applicable to dubious ulcerations of mucous membranes. An ulcer of the cervix uteri was shown to be carcinomatous, and a growth which appeared in the roof of the vagina after the whole uterus had been removed was also carcinoma, and singularly like the growth which was removed from the cervix in the other case. It had originated in the cervix, and it is to be inferred that, although the whole uterus had been removed, a particle of growth had been left behind and had gone on growing. Some might be contented to say that the growth had "recurred," whatever that may mean; but to me it seems better to face the fact that when the tumour grows again it has not been effectually removed. Ulcers of the tongue often present difficulties. A small hard circular ulcer of one of the foliate papillae was removed and found to be inflammatory; and yet another with similar characters was epithelioma. A papilloma of the penis was epitheliomatous, although no growth could be felt in its base. This microscopical diagnosis enabled amputation to be done at an early stage of the disease.

The immediate microscopical examination of tumours and of tissues has another very important use. It has fallen to my lot to operate for the removal of some very large connective-tissue tumours. A cartilaginous tumour of the scapula weighed more than 12 lb. after about a pint of fluid had run out of a cavity in its interior; but within nine months a second operation had to be done for growths in the remains of the scapular muscles and in the axillary glands. Now, these large chondromata of the scapula and pelvis usually contain sarcomatous elements, and we may surmise that these latter had grown along the muscles and fascial planes. Now, the extent of these prolongations cannot be seen with the naked eye. So, in another similar case, besides removing the suspected muscles very widely, as I went along, I gave a scrap of every doubtful tissue to Mr. Shaw, who at once reported upon it. Thus one had reasonable certainty at each step of this very extensive operation. In removing numerous and extensive epitheliomatous glands from the neck, too, it was of essential service to know what was being removed, because in addition to the growth there was much inflammatory thickening. What is the meaning of this association of inflammation with carcinoma? Or, again, the front half of both upper jaws had to be removed for epithelioma. This had grown for an indefinite distance into the upper lip. After the lip had been separated from the tumour, a piece of its deeper part was examined microscopically. It had some carcinoma in it, so a larger piece of lip was cut away. This case exemplified another point. The cancer had grown along the palate, and it was quite impossible to tell with the naked eye where it ended. Some tissue in the roof of the mouth looked exactly like growth, and most of the palate would undoubtedly have been removed had not Mr. Rose made an immediate microscopical section, and reported that we were looking at palatal glands.

Again, an immediate microscopical examination was useful when amputating at the hip-joint for a tumour of the upper third of the femur. In Scarpa's triangle, by the side of the tumour, some enlarged lymphatic glands were felt. Others could be felt along the crural arch and within the abdomen along the external iliac vessels. The question, therefore, arose as to whether at the time of the amputation or afterwards these intra-abdominal glands

ought or ought not to be removed. The microscope there and then showed that only the large glands upon the capsule of the tumour contained growth, and that those nearer the crural arch contained none, so that it was deemed unnecessary to open the abdomen.

Mr. Shaw will now demonstrate how quickly sections of growth can be cut with a freezing microtome, and how clear and good the sections are. In my opinion the apparatus he is using is an essential part of the equipment of an operating theatre.

DEMONSTRATION BY ERNEST H. SHAW.

Method of Cutting Frozen Sections of Fresh Tissues for Immediate Microscopic Diagnosis During Operations.

The method may be divided into two parts:

1. *The Arranging and Fixing-up of the Apparatus Required.*

The microtome must be fixed on a firm table, and all the instruments arranged in a convenient manner. A mental survey of the cutting, mounting, and staining of a section is then made, in order to make sure that everything is present and in its proper place. This ensures that no time will be wasted when once the process is begun.

2. *Preparation of the Microscopic Section.*

(a) The selected piece of tissue received from the surgeon is placed directly on to the brass disc of an ether-freezing microtome, and is surrounded by gum solution.

(b) The tissue and gum are frozen, and sections made by a razor on a carrier.

(c) The sections are transferred to a dish of cold water, and, after separating them with a glass rod, a suitable section is lifted out.

(d) It is dipped for a moment into pure methylated spirit, and

(e) Then placed in another larger dish of cold water; the currents set up by the spirit in the water cause the section to spread out flat.

(f) A glass slide is dipped in the water under the section, and the latter is lifted out as the slide is slowly drawn up out of the water again.

(g) The water is drained off the slide, and a drop or two of stain (Löffler's methylene blue) is allowed to fall directly on to the section.

(h) A thin cover-glass is placed on the stain and section after three to five seconds; it is lightly pressed down so as to drive out excess of stain; this is then blotted off, and the specimen is ready for examination under the microscope.

REFERENCES.

¹ BRITISH MEDICAL JOURNAL, July 2nd, 1904, p. 5. ² Carcinoma of the Breast and its Spread into the Lymphatics, by C. B. Lockwood, F.R.C.S., BRITISH MEDICAL JOURNAL, January 27th, 1906, p. 181.

THE ETIOLOGY AND PROPHYLAXIS OF DRACONTIASIS.

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DRACONTIASIS is very common and widely disseminated throughout the native races of our West African possessions. During the last five years it has twice assumed epidemic proportions amongst the black troops stationed there, and on the more recent occasion severely hampered military operations in Nigeria.¹ These outbreaks indicate how, by aggravating the difficulty of maintaining the necessary supplies of labour, the disease may materially retard the commercial development of these colonies in the future. The authorities are at present deterred from initiating any active prophylactic measures by the varied and conflicting nature of the theories now in vogue as to the life-history of the parasite, and the manner in which it gains access to the human body.

In order to investigate these points in more detail, and, if possible, to determine the means by which the disease might be mitigated or controlled, I was sent to West Africa in August, 1905, by the Committee of the London School of Tropical Medicine.

The aim of the present paper is, first, to record the

results of experiments undertaken to test the truth of previous theories; secondly, to define the conditions essential to the complete development of the parasite; and, thirdly, to base upon the facts ascertained some suggestions for the prevention of the spread of the disease.

The hypotheses of infection that have been advocated from time to time may be classified as follows:

I. Those in which the development of the embryo is supposed to occur without the intervention of any intermediate host, human infection being caused by:

a. The embryo, as discharged from the parent worm; or

b. The mature larva, evolved from the embryo in water or marshy soil; or

c. The young adult, the product of the continued growth of the larva in water.

II. Those in which an intermediate host is considered essential for the development of the larva in order that it may become fitted to reinfect man:

d. The only, and in itself sufficient, host being cyclops.

e. A second, and at present unknown, intermediate host being necessary to continue and complete the changes begun in cyclops.

Further, there remains to be considered under each heading a still more controversial and important question: By what route does the parasite enter the human body? Does it do so passively with the ingestion of fluid or actively by penetrating the skin?

The theories comprised in Section I have been strongly advocated by many writers on dracontiasis in the past. They are still to be found in some of our modern textbooks of pathology, though they have become discredited. Plehn² is the most recent investigator to support the theory (a) of direct infection by the embryo. In a tumour of the right thigh of a monkey which had been fed eight months previously on bananas containing freshly discharged embryos he found a filaria "indistinguishable from the Medina-worm." This experiment I repeated in Accra, but though the monkey swallowed thousands of living embryos, not a sign of infection could be discovered *post mortem* six months afterwards. Busk³ has maintained on clinical evidence that the embryos directly penetrate the skin, but I am unable to support this view. The application of living embryos in water to the dorsum of my own hand always failed to produce the erythema and itching noted by Looss to accompany skin infection by nematode larvae, and there have as yet been no other indications of infection.

The remaining hypotheses (b and c) of this section may be rejected from a critical examination of their literature. It is obvious both from the descriptions and illustrations that the larvae and adults of certain free-living nematodes have been very generally mistaken for the developing Guinea-worm. The same explanation disposes of the statement (Carter) that *Urolabes palustris* is the free form of the *Filaria medinensis*.⁴

It has frequently been shown that the embryos discharged from the parent can only live in water for quite a short time, and that they undergo no metamorphosis. In my observations on the vitality of these embryos in water the vast majority died on the third day, though some survived until the sixth. In mud they lived a day or two longer, probably because in this they move more slowly, and are consequently less quickly exhausted. Although provided with a mouth and digestive tract they are still unable to obtain food for themselves.

This inability on the part of the embryo to infect man by the skin or by the mouth, to undergo any further development, or even to remain alive in water, points to an intermediate host as an essential factor in its life-cycle.

This conclusion brings us to the consideration of the theories in Section II. The conditions under which the embryo becomes a larva were discovered by Fedschenko about 1870.⁵ He observed that the embryo made its way into the body cavity of a small crustacean of the genus Cyclops, and there, after a period of twelve days, underwent metamorphosis. Having followed the growth of the larva until the fourth week, he then endeavoured to complete the life-cycle of the parasite by feeding cats and dogs upon the infected cyclops. These experiments were unsuccessful. Nevertheless, Fedachenko concluded that