Fig. 2.—Tail of *filaria perstans* ♂ (slightly diagrammatic) $\times 525$.
a, p, anal papillae; tip of tail not seen.

on the research. The best method to adopt is to remove the whole of the mesentery from the intestines and the tissues at its base *en bloc*, and then to place them in 2 per cent. formalin. This is then dissected piecemeal at one's leisure, and with good eyes a lens is unnecessary. The worms when found may be placed in 2 per cent. formalin, and after measuring them, they should be mounted for permanent preparation with or without staining in glycerine jelly.

TABLE III.—Measurements of an Adult Female and Male *Filaria Perstans* from Uganda.

	♀	♂
Length...	50 mm.	34 mm.
Greatest thickness...	0.160 mm.	0.104 mm.
Diameter of head...	0.080 mm.	0.064 mm.
Diameter of neck...	0.072 mm.	0.054 mm.
Distance from head of vaginal orifice...	1.22 mm.	
Distance of commencement of uterus from head...	1.60 mm.	
Distance of end of uterus from tail...	0.600 mm.	0.120 mm.
Distance of anus from tail...	0.160 mm.	
Anal papillae...	None	Four pairs of pre-anal papillae, one pair of posterior
Termination of tail...	Cuticle thickened to form two triangular appendages	Cuticle thickened to form two triangular appendages

THE INTERMEDIATE HOST.

Analogy leads one to suppose that the embryo filariae must be sucked out of the blood by some insect in which they may undergo the metamorphosis necessary to enable them to become once more adult worms, and the peculiar distribution of the parasite and its association with dense tropical forests suggests some insect with a similar distribution. To determine the point a series of experiments were conducted with many different mosquitos and other insects, the procedure adopted being to catch the insects in infected huts or to rear them from larvae and then allow them to bite infected persons.

Subsequent dissections were then made, but with one exception all the results were entirely negative. In one isolated instance two forms, showing what has been described as a sausage shape, were seen in the thoracic muscle of *Taenio-rhynchus fuscopennatus* (Theobald), and this is interesting, because Vincent and myself when working in Trinidad at the intermediate host of *filaria Demarquaii* found in several instances sausage-stage forms in the thoracic muscles of *Stegomyia fasciata* reared from larvae and fed on infected cases. Those, however, never developed further, and in dissections at later dates entirely disappeared.

The fact, however, of finding forms of perstans and Demarquaii in the thoracic muscles showing this stage of development suggests at once that if one could find the proper efficient host the embryos would migrate to that same region, and undergo a similar development to that of *filaria nocturna* in *Culex fatigans*.

Some of the other insects experimented on, all of which,

however, gave negative results, were *Stethomyia nimbus*, of the subfamily of the *Anophelinae*, *Anopheles argyrotarsis*, *Culex fatigans*, *Culex atratus*, *Janthinomsoma musica*, *Culex viridis*, *Culex luteolateralis*, *Culex quasigildus*, *Anopheles costalis*, *Anopheles funestus*, *Panophites africanus vel uniformis*, *Uranotaenia caeruleocephala*, *Pulex irritans*, *Pulex penetrans* (chigger), *Pediculus capitis*, and *Pediculus vestimentorum*.

PATHOLOGY.

Filaria perstans, like *filaria Demarquaii*, gives rise to no pathological symptoms, the position of the worms in the connective tissues of the mesentery apparently causing no harm. A differential leucocyte count in a series of 8 cases showed that 5 had no eosinophilia, even though one of those had also bilharzial disease—a very common complaint in Uganda. The other 3—two children, one a young adult—showed an eosinophil percentage of 15, 16, and 19 respectively; but as their faeces exhibited the ova of ankylostomata, trichocephalus, and ascaris lumbricoides, it is difficult to decide to which of those the condition was due.

The idea that sleeping sickness was associated with *filaria perstans* is disproved by the fact that in British Guiana, where this parasite is common, there is no sleeping sickness, and vice versa in Kavirondo, where the latter disease is rife, there are no filariae.

SCREW-WORMS IN ST. LUCIA.

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THE screw-worm, which is the larval form of a small fly—*Chrysomya (comptosia) macellaria*, Fabr.—is one of the most important of all the insects that affect domestic animals in the New World. It does not confine its attentions, however, to the lower animals, for not infrequently it attacks man, and sometimes fatally. Its area of distribution is very wide, the species having been found in nearly all parts of America, from Patagonia to Canada, but it does the most damage within the tropical and subtropical belt.

I have seen numerous instances of its ravages in cattle, etc., chiefly in the navels of young calves and in barbed wire injuries. Not long ago I saw a goat with a cavity in its thigh caused by these worms into which I could have put my hand. Within the last few months I have seen several cases of screw-worm in man. These I shall briefly describe:

CASE I occurred in a young woman who was admitted to the Victoria Hospital, St. Lucia, with a sloughing ulcer on her upper lip. This spread rapidly, but was finally controlled by the application of pure formalin. Before the ulcer had healed, however, a large number of screw-worms were discovered in the nose. These were removed by injections of a dilute solution of izar, and the patient recovered with the loss of the greater part of the upper lip and of the septum nasi.

CASE II.—A man had his left hand and forearm amputated for malignant disease, which reappeared later in the axillary lymphatics. The affected glands broke down, leaving a large abscess cavity which was soon found to be swarming with screw-worms. As in the first case, these were removed by the dilute izar injections. But the patient succumbed to his original disease, dying of exhaustion several weeks later.

CASE III.—A young woman suffering from phthisis with diarrhoea. This patient used to throw off the bed clothes when sleeping, and one morning she found a worm in her bed. I examined her, and removed forty-six screw worms from her vagina and rectum. There was no wound and the patient seemed none the worse for her experience, but she is now more careful to keep herself covered while sleeping. This patient has since died of phthisis.

CASE IV was a woman with advanced phthisis. There was an offensive discharge from the nose, which afterwards became bloody, and then numerous screw-worms crawled out of the nostrils and mouth. I put five of these into a bottle with some earth, and twelve days later bred out five large flies similar to the flies which I had found attacking cattle, but many times larger. Dilute creolin injections soon removed the worms, and the patient improved somewhat, but her case was hopeless from the beginning, and she died just ten days after the last worm had been removed.

CASE V.—A man, about 50 years of age, received some slight injury to his left great toe. This was treated with *remède Crôle*, which probably consisted of a mixture of various herbs, leaves, etc., boiled down with tallow, whale oil, and perhaps a little cow dung, and other ingredients. The result was a fetid ulcer, which soon became infested with screw-worms. On my first visit to him I removed twenty-two of the worms. I did not see him again for five days—he lived several miles in the country—and then found that my directions had not been carried out. The creolin lotion had simply been applied on a piece of rag without any attempt at cleaning the sore, which had now become a large suppurating cavity, in which I could still see a few worms moving. The end of the toe was gangrenous, and when I cut through a small bridge of skin in order to get at the worms at the bottom of the cavity, the ungual phalanx almost dropped

off, the last joint of the toe being attached by a strip of skin only. I cut through this, and removed the gangrenous part at once, and brought the patient to hospital, where I removed the other phalanx and scraped out the cavity with a sharp spoon. At the time of my second visit I took away all the worms that remained. In all sixty-seven worms were removed from this man's toe. The phalanges of the toe were completely destroyed, the bones being so rotten that they crumbled away when I attempted to seize them with forceps. This man is still under treatment and doing well, but, owing to the septic nature of the case and the great destruction of tissue his progress towards recovery is necessarily slow.

The fly which causes all this mischief is a small species, less than $\frac{1}{2}$ in. in length, although it varies considerably in size. The body is of a bluish-green (see below) colour, with metallic reflections, and covered with stiff black hairs. It is distinguished from other flies which are related to it by the presence of three longitudinal black stripes on the thorax. The head and eyes are of a brick-red or yellowish colour during life, but after death the eyes become darker.

In depositing its eggs it selects some wound or decaying matter, and lays a mass of eggs at once. I find them a great nuisance when I have to make a necropsy in the country, especially if the body is at all offensive, as it frequently is in the tropics. It is said¹ that at least three or four hundred eggs may be deposited by a single female within a very few moments, and that the same fly may oviposit at different times and in different places hundreds or even thousands of eggs. I think this an exaggeration. I have never seen as many as one hundred larvae in any one case.

The eggs are cylindrical like those of other flies, about one millimetre in length, and white. "Under the microscope the eggs show a prominent ridge on one side" (Weed). They hatch within from one to nine hours.

The larvae are whitish, footless, rather slender maggots, and quite active. They are composed of twelve segments, each with a ring of minute spines or bristles, giving the worm the appearance of a screw. They burrow into the tissues of the affected animal, or into the mass of putrid flesh or decaying matter that furnishes them food, devouring everything that comes in the way, even the bones (Case v), and, when they attack the head (nose, ear, or scalp), may penetrate to the cranial cavity and cause death. They grow rapidly, and mature in a week or less. When mature they escape from the wound or decaying mass in which they have developed, and bury themselves in the ground, or hide in crevices, bedding, etc., to transform.

The pupae are brown in colour, cylindrical, and rounded at the ends. The length of time passed in the pupa stage varies from nine to twelve days.

When freshly hatched the flies are brown, but after a very short exposure to the air they become blue or green. (See above.) All of those that I bred from larvae were blue, and all of those that I caught in the open were green. I killed and pinned all my flies without giving them a meal, so it is possible that the blue ones would have changed to green had they been fed.

I venture to suggest that the size of the adult fly depends upon the stage of growth that the larva has reached within the wound or sore before passing to the pupa stage. In Case iv the existence of screw-worms was not suspected until the full-grown larvae began to drop out of the patient's nose and mouth. These were quite large and fat, and the flies which were bred from them were nearly if not quite half an inch long. In Case v, on the contrary, the worms were discovered and removed when only half grown, and the flies bred from them were hardly, if at all, larger than ordinary house flies.

Owing to the immense area of its distribution (about half the New World) and to the nature of its ravages, it would be Utopian to expect that any remedial measures that could be devised would be successful in stamping out this pest; but much could be done to lessen the damage caused by it. Attention should be paid to the destruction of all kinds of filth, carcasses, etc., particularly in the country, and to the prevention of wounds, barbed wire scratches, and especially the punctures of tick, which, according to Weed and Francis, furnish the greatest number of cases in cattle.

The fatal cases in man are due to the deposition of eggs, mainly in the nostrils, sometimes in the mouth, and such deposition is most liable to occur to persons sleeping in the open air or to those suffering from catarrh. The evident precaution is to avoid these sources of danger by the use of mosquito netting or wire gauze for sleeping rooms, and of a protection for the nostrils when exposed in places where the flies are common.²

All wounds, ulcers, etc., should be covered with a suitable dressing, and care should be taken that flies do not have access to the sore while the dressing is being changed.

As a direct application for the sores infested with worms a

wash of carbolic acid³ or creolin is advised. After the worms have been killed and removed the sore may be dressed in whatever manner the medical attendant may think necessary. For cattle a final dressing of pine tar, or in deep sores a packing with oakum and coating with tar is recommended.

REFERENCES.

¹ Bulletin. No. 5, New Series, U.S. Department of Agriculture, Division of Entomology, p. 131. ² Loc. cit., p. 132. ³ Loc. cit., p. 133.

THE DIAGNOSTIC VALUE OF BLOOD COUNTS IN MALARIAL AND OTHER FEVERS.

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In the following notes I desire to publish the results of blood examinations I have made in the Medical College and Eden Hospitals, Calcutta, during the last nine months, with special reference to the diagnosis of malaria.

Technique Adopted.

I employ the usual method with the Thoma-Zeiss haemocytometer for enumerating the red blood corpuscles. In counting the white cells, however, I use the same pipette (namely, a 1 in 100 dilution) as for the red corpuscles, but I count whole "fields" of the microscope ($\frac{1}{2}$ lens), having previously ascertained the area of the field, and from this and the known depth of the space between the cover-glass and slide, ascertained the cubic contents of the space beneath the "field."

I usually count 100 squares on the marked slide supplied with the haemocytometer for the red corpuscles, and 100 "fields" for the white corpuscles. For the differential count of the white corpuscles I stain a large film on a slide with Ehrlich's haematoxylin solution and eosin, and count 500 in all. I place them under the headings polynuclears, lymphocytes, large mononuclears, eosinophiles, and myelocytes. I always place "transitional" forms under the heading "polynuclears."

The differentiation of lymphocytes from large mononuclears is the most difficult part of the work, and for this I adopt the standard adopted by Captain Leonard Rogers, I.M.S.—namely, to place every single unlobed nucleated corpuscle which is as large or larger than a polynuclear under the heading "large mononuclears."

This portion of the blood diagnosis requires an amount of skill which will only be attained by a beginner when he has examined many normal bloods. Another difficulty to contend with is, that in severe malaria cachexia cases a number of nucleated red blood corpuscles are to be found in the blood. These will, if not recognized, cause one to give a too high total white blood corpuscle count, and a too high percentage count of lymphocytes in the differential count.

Again, in cachexia cases it may be quite impossible to find 500 white corpuscles on a slide, as they are sometimes very much diminished in number; but the fact that this difficulty occurs in any given case stamps it at once as a malaria cachexia case.

The method I refer to above for counting the white cells considerably shortens the time spent over each blood examination. Ehrlich's haematoxylin is a rapid stain for the nuclei of white cells, and the film can readily be stained while the white and red cells are being enumerated by the haemocytometer. The more the process of blood examination is shortened and facilitated the more likely it is to be universally adopted; but such as it is at present it is very tiring work, and three bloods at a sitting of three to four hours is the most any one can hope to do.

Skill acquired by frequent examinations alone will enable one to overcome the difficulties of blood examination. I find I have examined 197 bloods in nine months since I came to Calcutta.

Tabulation of Cases.

For the purposes of this paper I divide the 66 cases I am now publishing into three heads under Tables I, II, and III.

Table I shows cases recognized as malaria from the beginning and subsequently proved to be such by the clinical, quinine, and examination for parasites test. This table then is a sort of control and as such enhances, I consider, the diagnostic values of the blood counts exemplified in Tables II and III.

Table II includes cases not appearing at first by clinical methods to be malaria cases, in which the blood examination