Report for the year 1911 / Australian Institute of Tropical Medicine ; by Anton Breinl, in collaboration with Frank W. Taylor and T. Harvey Johnson.

Australian Institute of Tropical Medicine.

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BY

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DIRECTOR OF THE INSTITUTE

IN COLLABORATION WITH

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PREFACE.

THE Institute was founded in the year 1907-1908 as the result of a coalescence of the scheme of Professor Anderson Stuart, Dean of the Faculty of Medicine in the University of Sydney, with that of the Bishop of North Queensland, the Right Rev. Dr. Frodsham. Professor Anderson Stuart had proposed that there should be a Department of Tropical Medicine in connection with the Medical School of the University of Sydney, with clinical studies in the hospitals of Sydney, the immense amount of shipping visiting Port Jackson, affording ample clinical material, probably not inferior to that of the ports of Liverpool and London, which are so much more distant from tropical regions. Dr. Frodsham proposed that the Institute should be at Townsville, and thus nearer the tropical ports, and eventually Dr. Frodsham's was the scheme adopted. The University of Sydney offered to contribute £100 per annum in perpetuity, but this offer was afterwards withdrawn. The University of Sydney, however, donated the sum of £150, the University of Melbourne £100, and the University of Adelaide £50 towards the initial expenses of the Institute. The sum of £400 was also contributed for equipment from the Tropical Research Fund, administered by the Colonial Office, to which the Commonwealth had for some time contributed, and W. K. D'Arcy, Esq., gave the sum of £1000 also for the same purpose. The University of Sydney also originally offered accommodation, apparatus, and management. The Universities take part in the work by each nominating a member of the Committee of Management, and by each granting an Australian Diploma in Tropical Medicine after studies and examinations. The preliminary studies for the Diploma may be carried out at any of these Universities, and the final practical work is to be done at the Institute, and in the special ward of the Townsville Hospital. The Committee of Management meets at somewhat distant intervals, owing to the great distances between the capitals of the States, so that the immediate management of the Institute is, mainly for geographical reasons, left with the authorities of Sydney.

The members of the Committee are:—

Representing the University of Sydney: Professor Anderson Stuart, M.D., LL.D., D.Sc., Dean of the Faculty of Medicine.

Representing the University of Melbourne: Professor H. B. Allen, M.D., LL.D., Dean of the Faculty of Medicine.

Representing the University of Adelaide: Professor E. C. Stirling, M.A., M.D., F.R.C.S., F.R.S., C.M.G.

Representing the Queensland Government: Wilton W. Love, M.B.

Representing the Federal Government: Atlee Hunt, Esq., C.M.G., Secretary, Department External Affairs; W. P. Norris, M.D., D.P.H., Director of Quarantine; J. S. C. Elkington, M.D., D.P.H.

The income of the Institute is derived from the following sources:—Commonwealth Government, £4,000; Queensland Government, £250. The Queensland Government also pays the salary of the Entomologist, Mr. F. H. Taylor, in consideration of special services undertaken by the Institute in the investigation of certain diseases in cattle.

The expenditure of the Institute is, of course, mainly in salaries, and has been rendered possible only by the generosity of the Commonwealth Government, which has increased its grant to the sum of £4,000 per annum. Advantage has been taken of the presence of Professors Anderson Stuart and Allen in London when they were attending the Congress of Universities of the Empire, to secure the services of the additional members of the staff.

The staff consists of :—

Director..... Anton Breinl, M.D. (Prague).

Research Assistants and Demonstrators .. .. } W. Nicoll, M.D., D.Sc., D.P.H.
Henry Priestley, M.B., Ch.M. (Sydney), B.Sc.

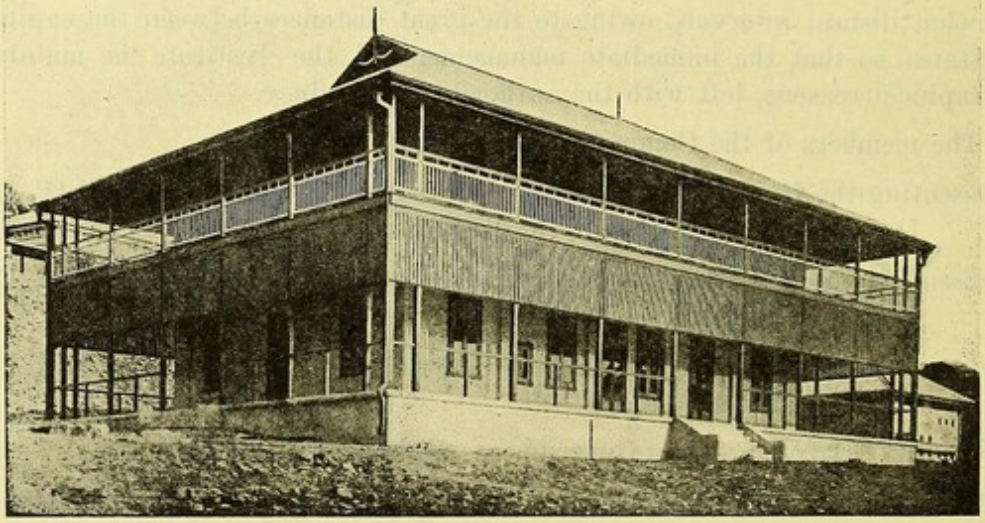
Bio-Chemist..... William John Young, M.Sc.(Manch.), D.Sc.(Lond.).

Entomologist.....Frank H. Taylor, F.E.S.

Laboratory Assistant..... J. W. Fielding.

Excellent Laboratory accommodation has now been provided for the Institute, including—

General and Research Laboratories.
Incubator Room.
General Library.
Rooms for Director and Assistants.
Photographic Dark Room.
Store Room, etc.



THE INSTITUTE AT TOWNSVILLE.

The Australasian Medical Congress met in Sydney in September, 1911, and resolved that "the permanent settlement of a working white race in tropical Australia be adopted as the principal subject for discussion at the Brisbane meeting." This meeting is due in 1917. The Congress further resolved, "That a report be made to the Federal Government with a view to securing for the Australian Institute of Tropical Medicine such increase of funds and staff as will enable an organised enquiry to be undertaken without delay into the various matters likely to affect the establishment of a working white race in tropical Australia." It is in response to these resolutions that the Federal Government has raised its contribution to £4,000 per annum, and it is hoped that meanwhile the Institute will justify its existence by important contributions of material towards the settlement of this important question.

INTRODUCTION.

The following pages contain an account of the work which has been done in the Australian Institute of Tropical Medicine during the period extending from April, 1911, to March, 1912.

The staff, during this period, consisted of the Director, an entomologist, Mr. Frank H. Taylor, and one laboratory assistant. Mr. F. H. Taylor was appointed entomologist in connection with the work on Onchocerciasis in cattle, and took up his duties at the beginning of April, 1911. His salary has been defrayed by the Queensland Government.

A qualified medical assistant, Dr. D. Steel had been appointed. He took up his duties by the middle of October, 1911. Unfortunately after a stay of only five weeks he contracted pneumonia, and died, after a short illness, on the 12th of December.

The energy of the staff of the Institute was directed towards the solution of the scientific problems connected with the occurrence of *Onchocerca Gibsoni* in Queensland cattle. It seemed firstly important to become thoroughly acquainted with the morphology of the adult parasite, and repeat the work already done by Gilruth and Sweet in Melbourne, and Johnston and Cleland in Sydney. It was found that in many instances two males and one female were present in one nodule.

After some preliminary unsuccessful attempts, we succeeded in dissecting out a complete female worm from one nodule.

Our findings as regards the detailed morphology of the worm, on the whole, agree with the results of previous workers, but in some details our results differ slightly from their statements.

The work on the life history of the parasite up to now has not led to a definite conclusion, but we have been able to exclude a number of possible intermediary hosts, as mosquitoes, *Stomoxys calcitrans*, and leeches. The finding of free filaria larvae on the shaved skin over nodules, which had been kept wet for a varying period, seems to offer some lines along which further researches should be conducted

Unfortunately in this work we have been handicapped through the late setting in of a very light wet season, as only a heavy wet season offers the best opportunity for a rich insect fauna.

Some of the possible intermediary hosts, such as large biting flies, could not be obtained, except in small numbers. The great mortality amongst the captured Tabanids was a further hindrance to the carrying out of experiments successfully in this direction.

One of the two hospital wards, which were put at the disposal of the Institute, has been made mosquito proof and has been furnished. Since the beginning of March male patients suffering from tropical complaints have been admitted, and placed under the direct supervision and treatment of the Director of the Institute. Owing to accidental circumstances, part of the furniture for the female ward has not arrived yet.

In comparison with 1910 the clinical material in the hospital has not been so plentiful, which is in all probability due to the lack of a proper wet season. Nevertheless, since the opening of the new ward, 10 beds reserved for patients suffering from tropical complaints have been fully occupied. The facilities for careful clinical and scientific observations will certainly yield valuable results in the future.

A careful clinical study of *Typhoid Fever* has been begun. It has been observed that the clinical manifestations of typhoid fever in North Queensland are in many respects different from those occurring in the southern parts of Australia. And, furthermore, the Widal reaction and post mortem findings led us to the conclusion that some of the cases, which were clinically diagnosed as typhoid fever, were due to some other causative factor. Up to the present, however, our observations are too few to allow the publication of conclusive results.

A good number of cases suffering from *Agchylostomiasis* have been treated, mostly residents of the Innisfail and Ingham districts. The infections were mostly severe but yielded easily to treatment by Betanaphthol and Thymol. *Agchylostoma duodenale* has been found. In many instances *Necator americanus* was encountered at the same time.

A number of cases of *Filariasis* have been treated, and observations prove that the clinical manifestations of filariasis are more varied and protean than hitherto suspected. The work on the morphology of filaria larvae by means of new staining methods, led to interesting results, as regards the detailed morphology of *Microfilaria nocturna.*

The mosquito feeding experiments have been too small in number to enable us to follow the morphological details during the further development of *Microfilaria nocturna* in *Culex fatigans* by using improved fixing and staining methods, but will be resumed at the earliest opportunity.

The treatment of filarial infection has been followed up, but has not as yet been met by success.

A clinical and bacteriological study of "*Fevers*" of doubtful origin has been started, but the time at our disposal did not permit us of making full use of the clinical material in this respect.

A few cases of *Anaemia* of obscure origin were observed occurring in adults and children; all our attempts to find an etiological factor for the blood changes were fruitless. Further work may shed light on these, up to now, inexplicable cases.

Only a comparatively small number of cases of *Malaria* were treated in the hospital, who had contracted their "fever" in New Guinea or the Malay Straits.

An investigation has been started into the occurrence, prevalence and distribution of animal parasites, amongst the wild native animals—mammals, birds, and reptiles—and has yielded very interesting results. It was found that parasitism amongst the native animals is widely spread, and a number of new blood parasites and several entozoa new to science are being recorded.

The work on blood protozoa is very incomplete and disconnected owing to the unfavourable circumstances under which they were obtained Only under exceptional circumstances and in a few instances could the animals which harboured the parasites be obtained alive, and kept so for a sufficient time for careful observation. Most of the blood films were made during short outings when we could only make dry blood films and search through the intestines for entozoa. But the observations on the blood parasites are of a scientific value, as up to now very little work has been done on the blood parasites of North Queensland, and in consequence nothing has been known about the distribution and prevalence of parasitic protozoa.

Dr. Harvey Johnston, Lecturer in Biology in the University of Queensland, undertook the study of the cestodes which have been found, and his detailed description of eleven new species is embodied in this report.

We wish to express our indebtedness to the Department of Agriculture and Stock of Queensland, which gave us the permission to trap native birds and animals, protected by law; to the Town Council of Townsville, who permitted us to shoot on their reserves, the Townsville Town Common; and to Mr. J. Humphry in Ching Do, through whose kindness we obtained a number of native animals, not protected by law, from the Lower Burdekin district.

We hope that we will be able, in time, to make a complete survey of parasites occurring in tropical Australia. A careful study of a number of them will certainly throw a considerable light on the life history of human parasites, and facilitate the investigation of their life histories.

A journey was undertaken by the Director, who joined an expedition sent and financed by the Commonwealth Government to inquire into the health conditions and prevalence of disease in some parts of the Northern Territory. The results have been embodied in a report to the Department of External Affairs, which has already been published in the Bulletin of the Northern Territory.*

The Director took part in the Australian Medical Congress in Sydney in August, where he read a paper on "The Object and Scope of Tropical Medicine in Australia," and opened the discussion on Agchylostomiasis, with a short review of our present knowledge on this subject, and the prevalence and distribution of this

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*Report on Health and Disease in the Northern Territory. Bulletin No. 1, p. 32-68, March, 1912. Department of External Affairs, Melbourne.

complaint in North Queensland. Both papers will be published in the "Transactions of the Ninth Session of the Australian Medical Congress."

A Committee meeting took place in Sydney on September 22nd, on which occasion it was decided to approach the Commonwealth for a further increase of the subsidy to the Institute in order to widen the scope, and undertake investigations into the physiology and anthropology of the white population living under tropical conditions.

A considerable increase in the working grant has been voted, and in the near future the Institute will be able to extend its working sphere considerably. A new building for the housing of the Laboratory is being erected at present, and in all probability by August next the Institute will be able to move into its new home—a large two-storied ferro-concrete building.

The accompanying drawings have been made by Miss Gladys Roberts.

INVESTIGATION INTO THE MORPHOLOGY AND LIFE HISTORY OF ONCHOCERCA GIBSONI.

THE ETIOLOGY OF WORM NODULES IN CATTLE.

An investigation into the life history of *Onchocerca gibsoni*, which causes the so-called worm nodules in Australian cattle, has been undertaken at the instigation and with the financial aid of the Queensland Government.

A fairly complete account of the morphology and pathological significance of *Onchocerca gibsoni* has been given previously by Cleland and Johnston[1], by MacFadden and Leiper[2], and by Gilruth and Sweet[3]. These publications and especially Gilruth and Sweet's work, deal fully with the history of the occurrence, the geographical distribution and structure of the parasite; but it seemed advisable to repeat the work on the morphology of the parasite, *Onchocerca gibsoni*, with the hope of discovering new details, which might have been overlooked by previous observers, and might possibly offer a clue for the tracing of the life history of the parasite and the finding of the intermediary host.

THE OCCURRENCE OF WORM NODULES IN THE VICINITY OF TOWNSVILLE.

The conditions caused by *Onchocerca gibsoni* are very prevalent in the neighbourhood of Townsville. An examination of different herds of dairy cattle has proved that in the great majority of cows examined a small number of nodules of varying size could be felt in the subcutaneous tissue or between the muscular layers of the brisket; only on rare occasions a greater number of nodules—sometimes as many as 20 to 30—could be felt in the region of the brisket between the third and seventh rib. The fact that the majority of these animals had been born and bred on the Town Common, or in the near vicinity of Townsville and had never left the district, seemed to prove conclusively that the necessary conditions for a successful infection are provided on the Town Common, and it seemed therefore unnecessary to leave Townsville, and go further afield in order to carry on the investigations into the life history of *Onchocerca gibsoni*, where the great advantage of having a well-fitted up laboratory at the disposal would have been lacking.

Active work was started by the beginning of April 1911, at a time when the wet season had nearly abated; but the droughty conditions prevalent by the beginning of 1912 did not offer the best opportunities for finding the intermediary host by the thorough investigation into the flora and fauna of the waterholes

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[1] Agricultural Gaz. N.S.W., XXI., p. 173, 1910.
Report of the Gov. Bureau of Microbiology, Sydney, p. 91, 1910.

[2] MacFadden and Leiper Reports to the Local Government Board on Public Health and Medical Subjects. (New Series No. 45.) Food Reports No. 11, 1911.

[3] Gilruth and Sweet : Publication, Commonwealth of Australia, Sydney, 1911.

on the Town Common. The impossibility of gaining a definite clue to the transmission of the parasite in question up to now is therefore not discouraging.

The dry and wet seasons in Northern Queensland are different from every point of view. The insect fauna, which, during the summer or wet season, is all pervading, is nearly completely absent during the winter months on account of the dryness and comparatively low temperature. It seems for that reason most likely that infection, as a rule, takes place during the summer months only, if an insect were to act as an intermediary host.

The geographical distribution of the disease, Onchocerciasis, in Australia generally speaking being confined to the northern parts of the Commonwealth, furnishes additional evidence that the infection is in some way dependant on climatic conditions, otherwise it would be equally prevalent throughout the whole of Australia.

The history of the occurrence of Onchocerciasis in Australia and its geographical distribution has been dealt with fully and completely in the previous publications on the subject.

No new observations can be added to the age incidence, and our experience gained on live dairy cattle and in the slaughter yards only confirms Gilruth and Sweet's and Cleland and Johnston's observations.

In no instance in live young calves of the yearling age could nodules be felt, but in the slaughter yards bull calves about one year old were usually found to be infected. Nodules in small numbers were encountered mostly situated in the subcutaneous tissue. In young cattle degenerated worms have only been found in rare instances, and these were mostly surface nodules, degenerated, in all probability, after injury. In older cattle (more than 7-8 years) some of the nodules showed distinct degeneration; the contents of the smaller nodules were often caseous, of a yellowish or brownish colour and partly calcified; in most instances fresh nodules containing live embryos could be found at the same time.

This finding made us assume that even in older cattle reinfection takes place periodically, and that it is not only early in the life of the beast that the infection becomes established to its full extent.

During our investigation nodules were only found in the situations pointed out by previous observers, but our limited experience tends to show that nodules could be observed more frequently behind the femoro-tibial joint if carefully looked for. On account of the small number and the small size they are, as a rule, overlooked.

Not in a single instance have we been able to find any evidence of nodules in any other part of the body. The careful examination of the internal organs, as spleen, liver, heart, etc., never revealed the presence of any parasite akin to *Onchocerca gibsoni.*

STRUCTURE OF THE NODULE.

On cross section the nodule consists of a fibrous capsule of varying thickness enclosing the worm, which lies in a system of tunnels formed of connective tissue,

in such a manner that the worm is altogether enclosed and surrounded by fibrous tissue. The small space left between the tunnel wall and the parasite is filled with a clear amber-coloured fluid, which usually contains larvae in a smaller or larger number. If the capsule of a nodule be taken off layer by layer it can usually be noticed that there is on one pole of the nodule a round area where the capsule is considerably thinner, and if dissection be started from this part the head of both male and female can usually be easily detected and dissected out.

In many of the nodules, especially in those situated under the subcutaneous tissue, extensive haemorrhagic infiltration has been noticed, in all probability due to injury. Often the whole nodule is permeated with fresh blood.

On microscopic sections the capsule consists of layers of dense fibrous tissue. The blood vessels, especially in the older nodules, show, as Gilruth and Sweet pointed out, extensive pathological changes. The walls are much thickened, which change is due to an endo- and peri-arteritis leading, in many instances, to complete obliteration of the lumen of the vessel.

In some instances free larvae are found in varying numbers between the layers of the connective tissue of the capsule; in other nodules, however, although the females were apparently sexually mature, their uterus being filled with numberless larvae, no larvae could be found between the capsular layers, although carefully looked for.

Serial sections were cut through the layers of fat and connective tissue, situated between the nodules and the skin. Only in one case could free filaria larvae be found embedded between the connective tissue fibres outside the capsule of the nodule.

It seemed of interest to ascertain the mechanism of the formation of the connective tissue capsule surrounding the parasite. Judging by analogy, it was thought to be due to a secretion of the worm setting up an inflammatory change in the surroundings, and causing an hypertrophy of the connective tissue. The contents of fresh nodules were ground up by means of powdered glass, and then sterilised with toluol. The extract was then injected subcutaneously into rabbits and guinea pigs. In no instance did the injections give rise to anything but a slight swelling, due to inflammation, which passed off in the course of a few days.

THE PARASITE.

It is impossible to dissect out an *Onchocerca gibsoni* from a fresh worm nodule on account of the fragility of the worm and the density with which the connective tissue is woven around the parasite, forming a complete tubular system. With the help of digestive ferments, mainly trypsin, one may succeed in dissecting out a female complete in favourable cases, or more often in from three to five pieces. This work naturally requires a great deal of patience, as the least move of the dissecting needle in a wrong direction may break the worm. Fig. 1, Pl. 1, shows a complete female worm (*a*) obtained out of one nodule, natural size, and the relative smallness of the male worm (*b*).

MALES.

TABLE I.

	3a	3b	4	1a	1b	5	6a	6b	7	17	19	20	21a	21b	25	26	Range	
	mm	mm	mm	mm	mm	mm	mm	mm	mm	mm	mm	mm	mm	mm	mm	mm	mm	mm
Diameter .014 mm from head ...	.013	.028	.031	.035	.028	.031	.028	.024	.031	.031	.031	.028	.031	.028	.031	.028	.028	.035
,, .07 mm ,, ,, ...	.035	.035	.045	.045	.052	.045	.038	.038	.045	.049	.049	.045	.052	.042	.045	.045	.035	.052
,, .175 mm ,, ,, ...	.049	.045	.052	.052	.063	.059	.042	.042	.052	.063	.063	.053	.066	.054	.054	.049	.042	.066
Largest Diameter	.178	.157	.143	.185	.175	.182	.154	.161	.164	.196	.182	.170	.178	.189	164	.171	.143	.196
Diameter level of anus	.042	.042	.045	.038	.045	.049	.035	.042	.056	.049	.075	.045	.049	.048	.045	.042	.035	.056
Anus from tip of tail	.059	.065	.052	.07	.073	.073	.052	.073	.077	.052	.087	.084	.052	.070	.077	.077	.052	.087
Excretory pore from head ...	.038	...	...	.280	...	...	...	...	..	...	...	...	...	...	...	...	.238	.280
Ganglionic ring from anterior end	.143	.157	.175	.175	.164	.168	.140	.157	.140	.175	.157	.158	.150	.154	.175	.164	.140	.175
Length of oesophagus	.598	.472	.567	.665	.589	.484	.913	.840	.927	.868	1.074	.976	.717	.714	.774	.753	.484	1.074
Diameter before joining chyle intestine	.031	.021	.021	.0157	.024	.035	.024	.021	.031	.021	.028	.075	.014	.021	.014	.017	.015	.075
Distance of testicular tube from anterior end	1.130	1.115	1.190	1.426	2.650	1.435	2.625	1.870	2.940	3.100	1.350	2.695	3.100	2.402	...	1.302	1.115	3.100
Spicule long { Length	.182	.168	.143	.171	.178	.185	.175	.175	...	.185	.210	.189	.210	.189	.220	.182	.143	.220
Spicule long { Diameter	.010	.010	.014	.007	.007	.008	.007	.009	...	.007	.007	.007	.007	.007	.007	.007	.007	.014
Spicule short { Length	.070	.084	.070	.077	.070	.084	.077	.077	...	.063	.063	.070	.087	.085	.077	.080	.063	.085
Spicule short { Diameter	.007	.008	.007	.007	.006	.007	.007	.007	...	.010	.008	.007	.007	.007	.007	.065	.006	.008
Total Length	4 cm	3 cm	4.9cm	4.8cm	4.1cm	5.5cm	3.75 cm	3.5cm	..	4.06 cm	4.88 cm	4.6cm	4.4cm	4.12 cm	4.1cm	3.316 cm	3.316	5.5cm

As may be expected, the treatment by digestive ferments altered, to a certain extent, the microscopic appearance of the parasite, making it unfit for detailed morphological examination. For that reason we attempted to obtain the necessary material—male and female head and tail end—out of nodules which had not been subjected to the action of trypsin.

After some preliminary attempts we succeeded in dissecting out of fresh nodules the female head end, about 4 to 5 cm. long, the complete males, and now and again the tail end of the female. The majority of nodules examined contained one complete female and one male; only in a small percentage no male could be found, although carefully looked for. Some nodules contained one complete female and two males, both sexually mature, but, as a rule, of slightly different length; of 34 nodules, 20 contained one male, 11 two males, and 3 no male at all.

Male and female heads were usually found in a definite relative position, both lying along side each other in the same channel. If two males were present they were usually situated parallel to each other. In our material we could not find the regularity noticed by Gilruth and Sweet, in the position of the further course of the anterior end of male and female. In the majority of cases, the males were wound around the female, about the middle of their length, forming a noose.

Fig. 4, Pl. 2, shows the relative position of two males and the female head end in a nodule partly digested by trypsin. It has been pointed out previously that the head ends, as a rule, point towards the thinner part of the capsule mentioned above.

ANATOMY.

The male (Fig. 2, Pl. 1) is fairly short, threadlike, measuring 3.316-5.5 cm. in length (comp. Tb. 1). The body tapers gradually in front. The posterior part is coiled up corkscrew-like, showing 1-2 turns. In one specimen, taken out of the nodule alive and fixed in hot alcohol glycerin, three distinct lips surrounding the mouth could be made out. In no instance could any papillae be seen, although carefully looked for.

The oesophagus (oe) is a straight tube from .487 to 1.074 mm. in length. In many specimens the transition between the oesophagus and the chyle intestine (i) can hardly be distinguished; in others the oesophagus becomes slightly narrower before leading into the bulb-like anterior end of the chyle intestine. No valvular arrangement could be observed. The chyle intestine is a narrow tube of approximately the same thickness opening out into the cloacal orifice.

The Reproductive System.

The testicular tube runs forward from the ano-genital orifice to a distance of 1.115 to 3.1 mm. from the anterior end. The testicular tube is of varying thickness, in the middle of the worm, filling the lumen of the parasite nearly completely. It becomes thinner towards the anterior end, ending in a knob-like swelling, or often turning back again, doubling up on itself and ending at a varying distance in the described manner. The two spicules (Fig. 3, sp. 1 and 2) are of unequal

FEMALES.

TABLE II.

	3	4	6	7	8	13*	23	24	28	29	30	31	32	33	Range.	
	mm	mm	mm	mm	mm	mm	mm	mm	mm	mm	mm	mm	mm	mm	mm	mm
Diameter near anterior end	.112	.0775	.042	.024	.035	.038	.049	.038	.049	.063	.042	.042	.052	.042	.024	.112
.18mm. from anterior end	.133	.108	.112	.070	.049	.108	.112	.084	.105	.143	.105	.105	.105	.119	.049	.143
Level of vulva	.175	.136	.080	.136	.119	.105	.129	.198	.140	.175	.115	.133	.122	.136	.080	.175
Vulva from anterior end	.809	.630	.402	.819	.675	.332	.542	.675	.700	1.176	.752	.805	.455	.539	.332	1.176
Length of oesophagus	1.193	.651	.705	1.424	.668	.885	.700	.959	.745	.710	.945	.595	coiled up	.714	.615	1.424
Largest diameter	.045	.045	.031	.042	.052	.028	.021	.025	.0175	.028	.021	.021	.021	.028	.0175	.052
Excretory pore from anterior end ...	.294	.175	...	...	...	...	...	...	...	...	...	...	...	...	.175	.294
Length of vagina and common uterus...	13.95	5.42	8.292	8.370	6.665	7.130	3.255	12.190	8.292	2.867	4.185	5.735	5.270	4.107	2.867	13.95
Diameter of vagina before bifurcation...	.054	.122	.077	.07	.063	...	.077	.087	.0665	.080	.077	.050	.129	.084	.050	.129
Ganglionic ring from anterior end ...	.170	.102	.175	.185	.175	.154	.175	.178	.175	.192	.182	.175	.178	.175	.102	.182
Distance of anus from tail	.290	.217	.175	.402	.315	..	.220	...	...	...	...	...	..	...	.175	.402
Diameter level of anus	.182	.147	.133	.245	.175	...	.175	...	...	...	...	..	...	...	.175	.245
Diameter of rectal ampulla	..	...	...	...	...	...	.056	...	...	...	...	...	...	...	...	...
Total length	89.5cm	85.5 cm	77 cm	127cm	129cm	...	133cm	...	...	...	...	...	...	...	77	133cm

* Nodule, showing a certain amount of degeneration.

length, the longer one from .173 to .220 mm. long and .007 to .014 wide. The proximal end shows a funnel-like opening. We could frequently observe in the middle of this spicule an opening passing obliquely into the lumen of the distal portion as described by Leiper. It ends in a fine straight tube. The smaller spicule is .063 to .083 mm. long and .007 to .008 broad; it shows about .015 mm. from the distal end a distinct constriction; the distal end beyond it is spoon-shaped.

The papillae (p) are fairly constant, but slight variations in number may be observed. As a rule, seven pairs could be distinctly made out. There is one pair of preanal papillae, fairly large and easily discernible, three pairs of adanal papillae somewhat smaller, nipple-like, but well separated, and three pairs of postanal papillae. Two pairs are larger, the third pair is smaller, usually situated on the extreme tip of the tail. Only in one case eight pairs of papillae could be seen; one additional pair was present in front of the adanal papillae (Fig. 8, Pl. iii), resembling somewhat the parasite figured by Gilruth and Sweet; in their case, however, there was only one additional papilla on one side.

The ganglionic ring (g.r.) is sometimes difficult to make out, at other times, however, distinctly visible, being situated .170 to .175 mm. from the anterior end; the excretory pore has the shape of a very small round opening in the middle line.

The Female Worm (comp. Tb. ii. and iii.) is from 77 to 157 cm. long, and .4 to .6 mm. broad in its largest diameter. About 1.4 mm. from the anterior end the

TABLE III.

Freshly dissected out Tails of Females.

	mm	mm
Diameter .07 mm. from posterior end	.107	.126
.14	.112	.150
.280	.120	.161
.350	.175	.210
.525	.304	.279
Distance of anal opening from posterior end ...	.294	.234
Diameter of rectal ampulla	.133	.2

worm tapers gradually to a blunt point (Comp. Fig. 5). Towards the posterior end the coils become narrower; the tail is slightly ventrally curved. The extreme tip of the tail is straight and cylindrical, expanding conically beyond the anal opening (Fig. 6, Pl. iii). The mouth opening is surrounded by three distinct lips, which can only be made out in well preserved specimens, each carrying a very small papilla.

Gilruth and Sweet describe the extreme tip of the head as being separated by a fold and depression of the cuticle and dermis. We could only observe this fold once, and then in a specimen which was dissected out of a nodule, which showed a certain amount of degeneration (the worm, after having been dissected out was of a yellowish colour). In none of the specimens which were freshly dissected out and fixed in hot 70 per cent. alcohol, nor in the female heads which were examined fresh and still alive, could we observe this fold alluded to by Gilruth and Sweet. The outer cuticle is smooth up to about .4 mm. from the anterior end and behind the anal aperture. In the succeeding parts the outer surface shows fine striation. About 4-5 cm. from the head end the cuticle is ornated with regular rows of cuticular knobs (Fig. 7, Pl. iii).

The posterior end is armed with three distinct and clearly visible papillae (Fig. 6, Pl. iii).

The oesophagus (oe) is a straight tube sometimes broader in front and narrowing backwards (Fig. 5, Pl. iii) or *vice versa*. In one specimen, however, the anterior part of the oesophagus only was coiled up. At the junction of the oesophagus and the chyle intestine there is often a bulb-like thickening of the latter. The chyle intestine (*i.*) extends throughout the length of the worm, being approximately of the same diameter, but widening out to a rectal ampulla (*r.a.*) about .133 in diameter in its broadest part. The vulva (*vu.*) is situated in the middle line, .332 to 1.176 mm. from the anterior end, and has the form of a longitudinal slit. The vagina (va.) is a strong muscular tube, leading without much change of structure into the common uterus, the length of which varies between 2.867 and 13.95 mm. It then bifurcates, and the double uterus extends in a straight line or slightly coiled, throughout most of the length of the worm, ending in a double ovary, which, as a rule, is much coiled. The uteri are filled with numerous larvae, which are the further developed the nearer to the vulva.

The ganglionic ring (gr.), more or less clearly discernible, is .102 to .182 mm. distant from the anterior end. The excretory pore is a small opening only, rarely visible, situated .175 to .294 mm. from the head.

DEVELOPMENT.

The different developmental stages of the larvae were studied on films made of the contents of the uterus of female *Onchocerca gibsoni*. With the help of our new fixing and staining method, fully described on page 20, we have been able to make out structural details similar to those observed in the larvae of other species of filariae.

The one-cell stage (Fig. 9, Pl. iv), which is comparatively rarely met with, represents a cell of somewhat irregular oblong shape, broadest in the centre, and is drawn out on both ends to a point. The nucleus contains a distinct nucleolus. On both drawn-out ends there is often a small collection of granules. This egg cell divides into two cells (Fig. 10) ; the nuclei often contain, in addition to the distinct nucleolus, particles of chromatic staining material. Unfortunately the preservation was not quite good enough to differentiate and count the

number of chromosomes. Further division takes place, and the 4, 8, 16 and 32 cell stage (Fig. 11-14) are fairly common. As the division progresses the nuclei become smaller and smaller, and finally a morula-like stage results (Fig. 15), which seems to have a smooth outline. At this stage numerous mitotic divisions can be distinctly made out. At a further stage a small opening appears in the middle of this cell bladder, becoming more and more marked, resulting in the formation of a ring-shaped body of cells, one half of it broader and thicker, the other half narrower (Fig. 16). The connecting bridge on one side becomes narrower, and eventually breaks (Fig. 17); the parasite subsequently straightens out, and assumes a tadpole-like shape (Fig. 18). This body elongates more and more (Fig. 19-20), and becomes narrower, finally forming the fully developed larva (Fig. 21), which may leave the vulva. In the fully developed larva a light staining area is visible some distance from the anterior end (Fig. 20, 22 n.), representing the rudiment of the nervous system. In well preserved specimens, some distance further back, one cell can be made out (Fig. 22), larger and distinct from the epidermoidal cells (e), corresponding to the excretory cell, as seen in other Filaria larvae.

Now and again, in suitable specimens, one cell is prominent in the posterior third of the parasite (Fig. 21g.), representing the rudiment of the genital system.

THE LIFE HISTORY OF ONCHOCERCA GIBSONI.

Gilruth and Sweet's statement that the life history of *Onchocerca gibsoni* is an extremely difficult and probably complex one on account of the enormous number of eggs produced by one adult female in comparison with the few adults found in the most severely affected animal, is borne out by our further experiences in this direction.

Gilruth and Sweet point out that the necessity of an intermediary host can be taken as granted, and our own experiences and those of the other experimenters bring forward additional proof. This conclusion, moreover, can be arrived at judging by analogy. The larvae of nearly every species of filaria living in the human or animal organism have to undergo definite changes before growing up to the adult stage, and these maturation changes take place in an intermediary host after the larva has left the definite host. Mosquitoes may act as intermediary hosts for several species, e.g., *Filaria bancrofti* and *immitis*, or *Cyclops* for *Filaria medinensis;* the intermediary host for numerous filariae is not known up to the present.

Blood of a dog containing numerous microfilariae has been repeatedly inoculated into a normal dog, the microfilariae could be seen for some time in the blood of the animal, but finally disappeared without giving rise to a new infection. Similar experiments have been carried out by Gilruth and Sweet, with the larvae of *Onchocerca gibsoni.* They injected, on several occasions, large numbers of living larvae into the subcutaneous and muscular tissue of young cattle without being able to detect at the post mortem examination, one to four months later, any indication of a worm nodule. We repeated the same experiments with analogous results.

One calf was inoculated with living larvae obtained from a series of nodules, but up to now, after a lapse of nearly seven months, no infection has followed.

POSSIBLE INTERMEDIARY HOST.

In analogy with other filariae, of which the life history is known, either a blood sucking ecto-parasite may act as transmitter or water-living animals, as crustacea or such like, which swallow the microfilariae after they have obtained access to water; after a lapse of time the infected crustaceans may be taken up by the beasts with the drinking water, and give rise to a new infection.

It is a curious fact which must be regarded as more than a coincidence that the nodules occur only in those parts of the animal, which come in contact with the ground when the beast is resting, or with water, when the cattle enter it for drinking or cooling purposes *i.e.*, in the brisket and behind the femoro-tibial joint. It was, therefore, considered a possibility that Onchocerca larvae may be able to penetrate the unbroken skin, obtain access to the water, where they may be swallowed up by some water-living animal to undergo further development and

maturation, before entering the definite host. An additional proof for this conception seemed to be the finding of filaria larvae by Gilruth and Sweet, in the thick wall of the worm nodule which surrounds the adult parasite. It has been pointed out previously that we have been able to confirm this observation repeatedly.

Experiments were undertaken to prove, firstly, whether the larvae can penetrate the outer skin of the cattle. For this purpose cotton wool pads wetted in water were applied to the shaved skin in places where nodules could be felt and kept wet continually. Scrapings were then taken of the skin, and microscopically examined; but in no instance could free microfilariae be detected in the scrapings, although 26 experiments had been carried out. The experiments were, therefore, somewhat modified; the cotton wool pads were replaced by flat dishes, containing rain or tap water, or water obtained from different water-holes on the Town Common. The water usually was heated to 80-90 degrees F. before being applied. The temperature of the air was varying from 70 degrees F. to 93 degrees F. The time of exposing the skin over the nodule to the water varied from 45 minutes to two hours.

The water was then removed, the skin over the infected region scraped, and the scrapings subjected to microscopic examination.

The water was centrifugalised, and the centrifugalate examined for the presence or absence of Onchocerca larvae.

Nearly one hundred experiments were carried out, and only in five experiments were larvae encountered, which were morphologically identical with the larvae of *Onchocerca gibsoni,* as found in the uterus of the adult worm.

In one experiment three larvae were found in the scrapings taken from the skin above the nodule; in the second positive experiment two larvae were found in the centrifugalate. In the third experiment numerous microfilariae were found in the scrapings, and the fourth and fifth only one larva was found in the centrifugalate.

The microfilariae of the second experiment were actively motile, moving slowly in a similar way as the larvae taken out of the uterus of the adult female worm. In the four other experiments the microfilariae were motionless.

In every instance the microfilariae were first examined unstained, and afterwards a diluted solution of polychrome methylenblue was added to the cover slip preparation to study the morphological details after *intra vitam* staining, but in no instance could any further development be found by comparison with the fully-developed larvae taken from a nodule.

It is noteworthy that the days on which the experiments gave positive results were dull, rainy and hot days.

It is necessary to add that all reasonable precautions had been taken to prevent accidental contamination of the water by means of the instruments and vessels used for the experiments. All the water which was used, had been sterilised and filtered, all the vessels were completely dried and heated before use, so that

the only source from which the Onchocerca larvae could have been derived, was the skin over the nodule of the cow.

The results detailed above prove that the larvae of Onchocerca gibsoni may penetrate the thick capsule which surrounds the nodule, and also the skin of the beast in small numbers.

It seems remarkable that only in a few, out of numerous experiments carried out under somewhat similar conditions, positive results should have been obtained. It is probable, however, that in our experiments we have not yet been able to obtain the exact conditions under which microfilariae penetrate the skin in nature.

Previous experiences of transmission of parasites by means of intermediary hosts have taught us repeatedly that even a small and apparently negligible detail may greatly influence the success of an experiment.

It seemed to be of interest to decide how long Onchocerca larvae, taken out of a nodule, could be kept alive in water; in this respect our results coincide with the findings of previous experimenters. Sometimes larvae taken out of a fresh nodule still showed slight movements after having been kept for 28-30 hours in water at a temperature of 15-18 degrees C. At room temperature all movements of the parasites had ceased after about 10-12 hours.

EXPERIMENTS
USING BLOOD-SUCKING INSECTS FOR TRANSMISSION.

1. The common stable fly, *Stomoxys calcitrans,* a fly which occurs frequently in many parts of Northern Queensland, has been fed on infected cows over nodules. About sixty flies were used for these experiments on different occasions, and the intestinal content examined after short varying intervals of one to two days, but in no instance could anything be found even resembling a larva.

2. Similar experiments were carried out using mosquitoes for feeding experiments, as *Culex fatigans, Culicelsa vigilax,* and *Mansonia uniformis,* with entirely negative results.

3. Leeches collected in the waterholes of the Townsville Town Common belonging to the species *Hirudo medicinalis,* were made to suck blood after having attached themselves to the skin of a cow over a surface nodule, or over the brisket. They were dissected afterwards; the gut contents mixed with saline solution and centrifugalised. Forty-three leeches were examined in this way, but in none of them could anything be found resembling an Onchocerca larva.

Unfortunately we have not been able to use Biting Flies, *Tabanids,* commonly called March Flies, for transmission experiments, as we have not been able to collect them in numbers. Moreover, the few flies experimented with, did not live for any length of time or breed in captivity, but, as a rule, refused to feed, and died shortly after having been put into fly cages.

Thanks to the courtesy of Mr. J. Marshall, Manager of the Bowen Meat Works, we obtained about 60 tabanids, collected from a locality where nodules were of frequent occurrence. The careful examination of the intestinal contents, however, did not reveal the presence of microfilariae.

Experiments with Cyclops.

During our search through the waterholes on the Town Common for possible intermediary hosts, we encountered frequently a small crustacean belonging to the genus of Cyclops.*. As it has been proved that some species of cyclops may act as intermediary host of the *Filaria medinensis* it seemed advisable to carry out experiments to determine whether *Microfilaria gibsoni* can undergo further development after having been swallowed by cyclops.

We added onchocerca larvae from fresh nodules to water containing cyclops, and examined the crustaceans after varying intervals. Although it was repeatedly observed that the larvae were taken up by the cyclops, we were never able to observe any further development of these larvae. After an interval of 3-4 days the larvae had been digested. Up to the present our experiments point to the conclusion that cyclops is to be excluded from the number of intermediary hosts.

Significance of the Foregoing Experiments.

Up to the present our experiments have not led to any conclusive results as to the intermediary host of *Onchocerca gibsoni*. The finding of Onchocerca larvae on the outer skin over nodules is of too rare occurrence to be taken into consideration, and may only represent a pathological curiosity, especially as the larvae belong morphologically to the group which seem to require an insect as intermediary host, similar to *Filaria bancrofti*, and not to the group of *Filaria medinensis*, which are able to live and move in water.

The experiments have so far failed with biting insects, but the systematic collecting of biting flies and experiments with them on infected beasts may in future lead to success.

Description of Cyclops Used for the Foregoing Experiments.

Cyclops occurs in most of the swamps in the vicinity of Townsville. They are to be commonly found, during the wet season, in waterholes, just below the surface at the stems of water-grass, especially where any decaying vegetable matter has collected; they are to be found both in clear and muddy water, though much more numerous in the latter. They have not been observed on water-weed stems above the surface. Males are very numerous during the early part of the year.

Cyclops pallidus, n.sp.

Male.—Colour, transparent pale yellow. Antennule colourless, composed of 17 segments reaching to the posterior margin of the second thoracic segment; both branches of the first four pairs of legs five-jointed, fifth pair consisting of a single joint with two terminal setae.

Female.—Colour, transparent very pale greenish yellow. Antennule the same as in the male, reaching to the middle of the second thoracic segment. Length to the end of the furca 1.5 mm. Cephalothorax and thorax 1 mm. Furca the length of the two preceding segments. Egg sacs carried wide apart.

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* For description of the Cyclops see below.

ON HUMAN FILARIASIS IN QUEENSLAND AND THE MORPHOLOGY OF MICROFILARIA BANCROFTI.

It is a well-known fact that filarial infections in men have been existent and prevalent in Queensland for a considerable time. It was in Queensland where Joseph Bancroft discovered the first adult worm, which has been named by Cobbold in 1877, *Filaria bancrofti.*

According to our short experience filarial infection in man is not uncommonly met with in Northern Queensland, but is apparently not as prevalent as in and around Brisbane. A systematic examination of the patients who entered the Townsville Hospital during three months showed that out of 164 men examined five harboured microfilariae in their blood. The blood of 60 female patients was examined in the same way, and two were found to be infected. Thus, 3.13 per cent. of the total admissions to the Townsville Hospital harboured *Microfilaria nocturna* in their blood.

A proportion of patients harbouring *Microfilaria bancrofti* in their blood did not show any clinical symptoms whatsoever. In other cases, however, the infections gave rise to well-marked and more or less severe clinical manifestations.

The symptom mostly met with is the "soft, glandular swelling" in the groin. Either on one or both sides there is a swelling in Scarpa's triangle, extending upwards as far as Poupart's ligament, which swelling is of an oedematous character, and embedded in it, enlarged lymph glands can often distinctly be felt.

Most of the other symptoms typical of filariasis have been met with as orchitis and hydrocele, lymphangitis and abscess formation in the skin of the legs, arms and abdomen, chyluria and chylocele.

Two cases of filariasis were of special clinical interest. One case occurred in a man of 34 years of age. He complained of passing at the end of micturition a few drops of blood. The examination of the urethra showed normal conditions. This symptom could, therefore only be attributed to filariasis, as numerous microfilariae could be detected in his blood when examined at night time.

The other case was a girl eighteen years of age. One labium minus was swollen to about twice its normal size, the skin was thickened, the veins and capillaries were distended, and this congestion gave rise to a small capillary haemorrhage of the affected parts. Numerous microfilariae could be found in the peripheral blood at night time.

Four cases of elephantiasis, two of the leg, one of the arm and one of the scrotum, have come under our observation, but in neither case could we find microfilariae in the blood.

Periodicity of Microfilaria Bancrofti.

Ashburn and Craig[1] found microfilariae occurring in the Philippine Islands, which did not show any periodicity, and regarded them as a new species, *Filaria philippinensis.*

Bahr[2] working in Fiji could not observe any marked periodicity in his cases, although the adults and larvae found, corresponded in all details with *Filaria bancrofti.*

The microfilariae occurring in Northern Queensland show a well-marked periodicity, being absent from the peripheral blood in the day time; they appear again about 6 p.m., and increase in number until about 3 a.m., and afterwards disappear, as a rule, from the peripheral circulation between 6 and 8 a.m. Only in two cases out of 17 could microfilariae be observed in the day time as well; both being cases of acute filarial abscesses, the number of microfilariae found in the day time was comparatively small, the parasites increased towards midnight and decreased again towards the morning.

The following table gives the result of examination of a fresh ¾in. coverslip preparation extending over 24 hours:—

Case 1.		Case 2.	
12 midday	1 microfilariae	12 midday	2 microfilariae in 1 film.
2.30	1 „	2.30	3 „ „
4	5 „	4	5 „ „
5	5 „	5	5 „ „
6	5 „	6	3 „ „
8 p.m.	10 „	8 p.m.	5 „ „
9	24 „	9	13 „ „
10	29 „	10	15 „ „
11.30	48 „	11.30	18 „ „
1 a.m.	18 „	1 a.m.	3 „ „
2	21 „	2	20 „ „
3	23 „	3	8 „ „
4.30	13 „	4.30	8 „ „
6	2 „	6	2 „ „
9	neg.	9	neg.
11 a.m.	2 „	11 a.m.	1 „ „

On more than one occasion we were struck by the absence of microfilariae in the blood of patients, who were suffering from clinical symptoms of filariasis.

The blood of a patient suffering from orchitis on the right side and chylocele on the left, accompanied by fever, was examined at different hours of the day and night for eight days in succession, but no microfilariae could be detected. The centrifugalate of the chylocele fluid (about 60 ccm.) contained *Microfilariae nocturnae* in scanty numbers.

In the blood of a second case who suffered from attacks of fever and lymphan-

[1] Ashburn and Craig, "The Philippine Journal of Science," Vol. II., No. 1, p. 1.

[2] P. H. Bahr, "Filariasis in Fiji. Transactions of the Soc. of Trop. Med." Vol. V., No. 4.

gitis at irregular intervals, microfilariae could never be found, although about 2 ccm. of blood were centrifugalised, and the centrifugalate repeatedly examined. Numerous microfilariae had been detected in his blood about five years previously, but had disappeared after an acute attack of filarial fever.

Morphology of Microfilaria Bancrofti.

To work out the finer morphology of *Microfilaria bancrofti* is, on the whole, difficult, as the larvae occur only in comparatively small numbers in the blood. Even when one or two larvae are seen in one microscopic field of a fresh cover-slip preparation, a small number only can be observed in the stained specimen; many of them are found near the edge of the films, covered and surrounded by blood corpuscles, which obscure the finer morphological details.

If wet films are used the number of larvae is still smaller, since through the immersion into the fixing fluid, part of the blood film always floats off the slide and is lost.

In the blood of one of our cases of filariasis who suffered from orchitis and hydrocele, microfilariae occurred in extremely scanty numbers, only two larvae were found in eight films of blood collected from different parts of the body. The centrifulgalate of the hydrocele fluid obtained late in the evening, contained innumerable larvae, so that a cover-slip preparation of the sediment appeared to be a seething mass of microfilariae.

A number of specimens were made, and after wet fixation stained in different ways. Most of the fixation methods which gave satisfactory results, if used for blood parasites, as Flemming, Hermann and Zenker's solution and alcohol, gave unsatisfactory results. The sheaths and cuticle took the stain so deeply and diffusely that the larvae appeared as a dark and uniformly staining band in which no details could be made out. All attempts at differentiation failed, as the whole parasite became decolourised. Hofer's fluid, consisting of 48 parts of a saturated solution of picric acid, 50 parts of distilled water and two parts of glacial acetic acid, proved an excellent fixing method for microfilariae. A slight increase of the amount of acetic acid (5-7 per cent.) improved the results greatly. Of the different stains, alkaline (polychrome) methylenblue (1 per cent. solution of methylenblue Hoechst, with the addition of ½gr. sodium carbonate ripened in the sun for a few weeks) was found superior to any other chromatin stain. As a mordant before staining we used iodine in potassium iodide solution.

In short our technique was as follows:—

Wet films were made on a slide prepared with a thin layer of Mayer's egg albumin, and immersed in a slightly modified Hofer's fluid (5 ccm. of glacial acetic acid to 100 ccm. of half saturated solution of picric acid). The films were fixed for 5-10 minutes washed in water, and taken through the alcohols to harden from 10 per cent. to 70 per cent., rising by 10 per cent., and left in 80 per cent. alcohol, to which a solution of iodine in potassium iodide was added until the alcohol was of a dark brown colour. The specimen was then taken back into water, and stained for 2-3 hours in polychrome methylenblue. The stain was

washed off with water, and Unna's orange tannin was used for differentiation, until the blood film was of a slight orange colour, the thick parts still showing a distinct bluish coloration. The films were taken up quickly through the alcohols into absolute alcohol, aniline oil, xylol and preserved in Canada balsam.

If the specimen was successfully stained, the protoplasm of the parasites was stained orange, the nuclei of the matrix cells being of a brilliant violet colour.

On the whole, the technique is very simple, but care has to be taken not to over differentiate with orange tannin as the differentiation may easily be carried too far.

Previous to Rodenwaldt and Fülleborn's publication filaria larvae were examined fresh or after having been dried on a slide, and stained with haematoxylin, or any of the methylenblue eosin combinations. The only morphological details observed consisted in the presence of unstained or lightly staining areas, distributed over the length of the parasite and occurring fairly constantly in different parts of the microfilaria.

Following Annett, Dutton and Elliott's description the following spot occurred regularly in *Microfilaria bancrofti*:—

1. An irregular transverse break at about 21.5 per cent. of the length of the body, which is constant.

2. A V-shaped spot or transverse irregular break at a distance of about 30 per cent. of the whole length from the anterior end. This is nearly always present (Manson's V spot).

3. An area of varying length in which the cells are loosely arranged.

4. A median line (the inner body of Manson) distant 63 per cent. constant.

5. An irregular, sometimes oval spot often present at a distance of 85 per cent. (Manson's tail spot).

6. A small central bright spot, only occasionally present at a distance of 91.5 per cent.

Rodenwaldt and Fülleborn in their excellent and painstaking work on human and dog filariasis were the first to shed further light on the meaning and significance of the "spots" described previously.

Rodenwaldt's observations on the morphological details were based on specimens after intra-vitam staining. A solution of Azur. ii., 1-3000 was mixed on the microscopic slide with a drop of blood containing filarial larvae and living parasites could be observed up to 27 hours, gradually taking up the stain. An addition of eosin permitted further differentiation of morphological details of the living object.

Figure 1, plate vi., gives a scheme of the structure of a microfilaria, reproduced from Rodenwaldt's publication.*

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* Rodenwalt. Die Vertheilung der Mikrofilarien im Körper und die Ursache des Turnus bei Mikrofilaria nocturna und diurna. Studien zur Morphologie der Filarien. Arch f. Schiffs und Tropenhyg. Beiheft 10, 1908.

In the microfilaria stained according to our above described method the nuclei of the matrix cells are seen clearly, the cytoplasm of the cells can only be made out if highly magnified.

The so-called first spot (n) (fig. 2, pl. vi.), which in our specimens is from 38 to 54 μ. distant from the anterior end, is always distinct, appearing as a break in the column of the nuclei of the matrix cells of the subcuticle, and represents the rudiment of the nervous system of the adult worm.

The excretory cells (e.c.) (Figs. 2, 3, Pl. vi.), is situated from 70-82 μ. from the anterior end; only in a few instances the distance was less. The smallest measurement obtained was 50 μ. The nucleus of this cell is oval and oblong, and possesses a very distinct nucleolus. The excretory cell is often connected by a fine strand of bluish staining protoplasm with a sac-like organ, situated anteriorly, corresponding to the excretory pore (e.p.). This sac is usually oblong, rarely round, often empty, sometimes filled with a lightly staining granular substance. The opening of the excretory pore, as described by Rodenwaldt, could be observed in a few stained specimens.

In a few parasites the nucleus of the excretory cell is absent, and only the excretory pore can be seen. Now and again this organ is pointed and connected with a regular row of fine granules extending some distance backwards (Fig. 4, Pl. vi.).

In some parasites there is from 90-120 μ. from the posterior end, a fairly large oval organ, which is filled with small metachromatically staining granules (Figs. 5, 6, Pl. vi.). This organ is about 6 μ. long and 3 μ. broad.

In other larvae a fairly broad, and 12-17 μ. long tube-like arrangement can be made out (fig. 6, pl. vi.).

In other microfilariae in place of this oblong tube-like structure, a double row of small darkly staining granules can be seen extending over 20-30 μ. in length (fig. 7, pl. vi.).

These structures just described, correspond in all probability to Manson's "innerbody."*

The rudiment of the genital system has been described by Rodenwaldt for microfilaria diurna and imitis. In a similar way the genital rudiment of *Microfilaria nocturna* consists of four cells, the main genital cell, which is quite distinct and well marked in most parasites, and three small cells situated close to each other (Figs. 2 and 8, Pl. vi.). The nucleus of the main genital cell is large, taking up nearly the whole width of the parasite, round, and possesses one or two nucleoli. A small amount of chromatin is collected around the periphery. This main genital cell is situated 60-80 μ. from the last epidermoidal cell. Some distance behind there are from two to three additional genital cells, which are, however, much smaller than the main genital cell, round, and lie close to each other. They resemble the cells of the matrix, but are larger, more lightly stained, and have well pronounced

* Manson Tropical Diseases, 1909.

and large nucleoli. In a few of the parasites the genital cells could not be made out.

If fixed in Hofer's fluid and stained by the above described method, the filariae measured from 212 to 300 μ. in length, and were from 4.65 to 6.25 μ. broad.

In the hydrocele fluid only one single earlier developmental stage of microfilaria could be found (Fig. 9. Pl. vi.). Ova could not be detected, although carefully looked for.

Our attempts to study the further development of microfilaria nocturna in the mosquito by using the wet film method have failed up to now. About 200 *Culex fatigans,* bred in the laboratory, have been fed on a patient with a fairly large number of microfilariae in the blood, but after the third day no larvae could be found in the specimens made from the intestinal contents and organs of infected *Culex fatigans.*

HISTOLOGY OF FILARIAL SWELLING.

In three cases of filarial swelling, the varicose groin glands and the hyperplastic lymph vessels were removed and histologically examined. Only in one case could live adult female *Filariae bancrofti* be found in one of the enlarged spermatic lymph vessels. The adult females agreed in every respect with the measurements and previous descriptions of *Filaria bancrofti.*

The histological examination of the enlarged lymph glands did not show any marked pathological changes. The tissue, which caused the "soft swelling," consisted, on the whole, of loose, richly vasculated fibrous tissue containing lymphocytic infiltration. Here and there in parts which showed a greater amount of small celled infiltration, lymphocytes had collected in round or irregular follicle-like patches from 200 to 800 μ. in diameter. These lymph follicles occurred in varying numbers, were well defined from the surrounding tissue, and richly vasculated. As a rule, two areas could be distinguished, a peripheral one, consisting of lymphocytes, and a central one, consisting of more lightly staining cells, resembling the epitheloid cells of a tubercle. In all sections, especially in those of the lymph tissue surrounding the spermatic cord, numerous larger and smaller lymph vessels could be seen. The larger ones had a very thick wall and a wide lumen. Many of the larger lymph vessels, however, showed thrombus formation, the lumen of the vessel being filled by a fine loose meshwork of newly-formed connective tissue, and often nearly obliterated.

Throughout the connective tissue haemorrhagic infiltration to a varying extent could be noticed. In some parts haemorrhage had taken place, the blood was being resorbed, becoming organised by connective tissue fibres growing in from the surrounding parts.

Only in one case one dead adult *Filaria bancrofti* was met with on cross sections, surrounded by a thick layer of dense fibrous tissue.

PREVALENCE OF KERATOSIS FOLLOWED BY EPITHELIOMA OF THE SKIN IN NORTH-WESTERN QUEENSLAND.

Our attention was drawn by Dr. W. B. Nisbet to the prevalence of Keratosis in North Queensland.

This skin lesion, which occurs also in temperate climates, has been frequently met with on the face and arms of people, who had spent a considerable time in the western parts of North Queensland.

Generally speaking, the climate of the dry western parts seems to affect the skin of fair-haired and light-skinned individuals, who, in the pursuance of their work are exposed for long periods to the influence of the sun. The skin of the face and arms becomes freckled, and large pigmentary spots appear; the derma becomes thinner, and in consequence the skin of the face is of a smooth and shiny appearance. Later on, small round ulcers are formed on the face and on the forearms, the site of predilection being the nose, the skin behind the ears and the extensor surface of the arms. At first, the skin shows here and there a thickening of the horny layer of the epidermis. Afterwards the patch becomes slightly raised and has an uneven scaly surface of dirty yellowish colour. The scales may be rubbed off, and the skin underneath is of an atrophic appearance. After a lapse of time the thin skin breaks, and slight abrasions on the surface are noticed. At this stage the crust becomes thicker, and if removed a discharging and bleeding uneven ulcerated surface is seen. These ulcers have no tendency to spontaneous healing, but remain stationary sometimes for a number of years. Now and again, if treated with caustic applications they heal up, but only to break out again and again.

This skin lesion corresponds to the senile Keratosis as described in the text books of Diseases of the Skin. It is, however, noteworthy that the complaint is not only confined to old people, but very often attacks the middle-aged persons, and mostly men who are a great deal exposed to the hot and dry climate of the western parts of North Queensland.

The patients usually relate the history of their complaint in a similar way; they state that they have been suffering for years from a "skinning" of the affected parts that some time afterwards a hard scab formed which, when removed, left a small, superficial, bleeding ulceration, which did not show any tendency to spontaneous healing.

Some of the patients show only one, or a small number of these ulcers; in others, quite a number of them can be observed.

Now and again these ulcerations suddenly begin to spread gradually and slowly, after having remained stationary for years, and give rise to larger ulcerations, which on outward appearance similate typical epithelioma of the skin. The edges of the ulcer are slightly raised, the ulcerated surface is uneven, showing protuberances and exudes a small amount of whitish or yellowish fluid.

HISTOLOGICAL DESCRIPTION OF LESION.

Skin ulcers at the different stages of development were excised and sections made. In the earliest stages at a time when the affected parts were small (about 3-4 mm. in diameter), the skin bordering on the ulcer showed slight changes; the epithelial layer has become thinner than usual, being represented by three or four layers of cells. The papillae have become flattened, so that the line of demarcation between the epithelium and the corium forms a fairly straight line. The horny surface layer is much increased in thickness if compared with a normal skin, being twice to three times as thick as the epithelial layer. The corium is hyperaemic, and the blood vessels distended. Within the region of the ulcer the epithelial layer is separated from the corium by the *membrana propria*. Numerous mitotic divisions can be noticed in the deeper layers. About three layers down from the surface the epithelial cells are filled with keratohyalin granules. The thick horny surface layer forms, in the lower portion, a dense structureless striated substance, which becomes, nearer to the surface, an open mesh work of honeycomb-shaped horny mass.

The corium contains small foci of small-celled infiltrations, especially well marked around the larger blood vessels, which, on the whole, are distended, and filled with blood. Only here and there free blood corpuscles can be seen between the layers of connective tissue.

In a further stage the papillae are seen to grow downwards into the deeper layers, and form an epithelial meshwork, the meshes being filled by loose connective tissue, containing a few leucocytes and capillary blood vessels. Most of the surface layer of the epithelium has disappeared, the cells have undergone degeneration, have become flattened, and possess indistinct outlines. If viewed with a low magnifying power, one can see above the much hypertrophied papillae a thin layer of homogenous substance interspersed with a few flattened degenerated nuclei. The area is covered with a network of coagulated fibrin, leuco- and lymphocytes and erythrocytes in different stages of disintegration. Of the papillae, which have grown deeply into the corium, many of the epithelial cells are undergoing mitotic division, the cells more centrally situated, are in different stages of horny degeneration. At this stage of the "ulcer" the epithelial cells forming the papillae can, in rare instances, be seen breaking through the *membrana propria*, and are noticed here and there in small numbers scattered between the inflammatory cells of the corium, this being the first sign that the ulcer has become of an epitheliomatous character. The corium shows signs of inflammation, the loose connective tissue is filled with leuco and lymphocytes and red blood corpuscles, the blood vessels, especially the veins have increased in size and number, and are congested. The inflammation usually extends deeper into the subcutaneous tissue, and small celled infiltration is often present around the sweat glands.

In a further advanced stage the surface epithelial layer has completely disappeared, the corium consist of a mesh work of epithelial cells, which penetrate deeply into the subcutaneous tissue. The horny degeneration of growing

papillae has progressed, so that a number of them, on cross section, appear as "cancroid pearls." Further growth takes place, both in the depth, penetrating the subcutaneous layer, and also on the surface, showing the classical microscopic picture of the epithelioma of the skin.

The microscopic examination of tissue from four cases suffering from keratosis and epithelioma of the skin proves that the keratosis occurring in middle-aged people may develop into an epithelioma in the same way as a senile keratosis can give rise to skin cancer. We have been able to find, microscopically, all the intermediary stages between these two complaints.

The above described form of skin ulceration, as has been pointed out previously, is not of rare occurrence. Most of the patients who came under observation had been living for years in the western parts of North Queensland. The fact that these ulcers occur, without exception, on parts of the body which are exposed to the sun's rays, *i.e.*, on the face or on the arm of persons who lead an outdoor life, as farmers and labourers, etc., seem to indicate that these ulcerations are caused by the influence of the sun on the skin of certain individuals particularly susceptible to it. It is more than a coincidence that most of the cases seen had been living in the dry parts of North Queensland. Keratosis hardly ever occurs amongst the coastal population.

Stelwagon[1] points out that Carcinoma of the skin is "essentially a disease of advancing years somewhat rare before the age of forty, and more commonly seen after fifty or sixty." Exceptional instances are now and then noted in which the growth presents itself in earlier years. He quotes Hyde[2] and Dubreuilh[3] as having called attention to the possible factor of continued exposure to the sun's rays as etiological moment for skin cancer. Most of our cases of keratosis and epithelioma occurred in men who were about 40 years of age, and as has been pointed out previously only in fair-haired and fair-skinned individuals. On the whole, one can single out persons by the appearance of their skin, who are likely to be affected by Keratosis and Epithelioma.

In our opinion the conclusion is justified that exposure to the influence of the sun may give rise to keratosis and subsequent epithelioma of the skin. In all probability the peculiar dryness of the skin, which is unavoidable in a dry climate, may serve as a predisposing factor.

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1. Stelwagon Treatise on Diseases of the Skin, Saunders Company, 1910.
2. Hyde, *Americ. Journ. Med. Sci.*, January, 1906.
3. Dubreuilh Annals, 1907.

Ferrer, Ethiologie Clinique de l'Epithelioma cutané Thèse Bordeaux, 1906-1907.

TWO CASES OF "CLIMATIC BUBO."

In 1896 Ruge[1] reported cases of inguinal glandular swelling, occurring amongst sailors on the Zanzibar coast, which did not seem to be caused by any of the factors giving ordinarily rise to glandular enlargement.

Since then the same pathological condition has been observed in the West Indies, East Africa, South America, Malay Straits, China and Japan.

As a rule, the disease sets in with a slight rise of the body temperature; at the same time a hard swelling of the inguinal glands of one side or rarely of both sides is noticed, which is very painful on pressure. The swelling may increase within a few days to a varying degree, and become sometimes as large as a hen's egg or more. At times only one gland is affected, sometimes two, or even more. This swelling and pain may disappear after a few days, and the lymph glands regain their normal size; in other cases the swelling of the lymph glands increases and distinct fluctuation may be felt, due to suppuration, which often leads to the formation of a fistula.

The etiology of this disease is still unknown. Various bacilli were isolated, and amongst others a bacillus by Ferraro,[2] which was practically identical with bacillus pestis. Cantlie[3] later on, regarded this disease as a mild form of plague (pestis minor), because in his experience in China several cases of climatic bubo preceded an outbreak of plague. Others as Martin,[4] Segard, Smith, Lesueur-Florent regard this disease as one of the sequelae of Malaria.

Two cases of Climatic Bubo have been observed in patients admitted to the Townsville Hospital. Both cases were clinically very similar, and gave the same history. The first case was a labourer 28 years of age. He had been working for years previous in different parts of North Queensland. Three weeks before his admission to the hospital he had noticed swellings in both groins. These swellings became very painful on pressure, the pain increasing when he walked about. As the swellings did not disappear after various applications, the patient sought admission to the hospital.

In both sides of the groin one inguinal gland of the size of a hen's egg could be felt, and besides, two smaller lymph glands of the size of a pigeon's egg. Over the larger lymph glands fluctuation could be made out. The body temperature was only slightly raised; it never surpassed 99.8 degrees F., being slightly higher in the evening than in the morning.

Neither the examination nor the history of the case revealed anything which might have accounted for the swelling of the lymph glands.

The large lymph glands on both sides were removed. On cross sections the lymph glands offered a similar macroscopic appearance. The surrounding connective tissue capsule was much thickened, and the lymph gland was intersected by a well-developed frame-work of fibrous tissue. All through the surface layers

of the gland haemorrhagic infiltration was noticed extending into the central parts. Here and there, scattered throughout the lymph glands were smaller or larger irregular areas, showing suppuration, some of them contained liquid pus, others showed only softening of the lymph tissue. Some of the smaller lymph glands which were extirpated at the same time were macroscopically of normal appearance.

BACTERIOLOGY.

Gland puncture was performed, which yielded about 1/8 cc. of liquid pus. This pus was disseminated in culture tubes containing beef agar, maltose agar, glycerine sugar agar and broth. The tubes were kept at room and incubator temperature. At the same time anaerobic cultures were made in Buchner's tubes. In no instance was any growth noticed in the culture tubes. Cultures were made a second time after the extirpation of the glands, when a large amount of pus was inoculated into different media; with the exception of the appearance of *Staphylococcus albus* in one tube, no other growth could be obtained; the *Staphylococcus albus* had to be regarded as contamination.

HISTOLOGY.

Sections were prepared of different parts of the larger lymph glands. Microscopically, the connective tissue capsule and frame-work were very hyperplastic, large tracts of connective tissue formed a thick net-work; haemorrhagic infiltration was more or less pronounced throughout the sections of the lymph glands. The lymph tissue was hyperplastic, and in many parts of normal appearance. Here and there were smaller or larger round areas, where the lymphocytes were interspersed with leucocytes, which areas did not show any demarcation from the surrounding normal lymph tissue. In other round areas the lymph tissue was completely replaced by leucocytes. In these parts plasma cells were very conspicuous. The microscopic examination of the smaller lymph glands showed normal conditions. The lymph follicles were well marked.

The second case occurred in a stockman, who had been living in Richmond, 41 years of age. His clinical history was similar to the preceding one. Two weeks previous to his admission to the hospital he had noticed a swelling in his right groin, which became painful, and prevented him from working.

The inguinal glands of his right side were enlarged, the largest about 5 cm. in diameter, being very painful on pressure. No fluctuation could be felt; the careful examination did not reveal any cause which might have accounted for the swelling. The evening temperature was slightly above normal.

The enlarged lymph glands were extirpated. Cross sections showed the above described changes. There was a well-marked hyperplasia of the connective tissue of the lymph gland, a slight haemorrhagic infiltration, but suppuration had not set in. *Histologically* the lymph gland showed a slight haemorrhagic infiltration throughout its substance. The connective tissue was hyperplastic; here and

there round areas could be noticed, where the lymphocytes were interspersed with numerous leucocytes.

The bacteriological examination of the gland juice aerobically and anaerobically gave entirely negative results.

The bacteriological and histological findings in these two cases proved beyond doubt that the clinical diagnosis "Climatic Bubo" was correct, and that this disease does occur in North Queensland, although only in rare instances.

Our findings agree with Castellani and Chalmers'[5] opinion that Climatic Bubo is a disease *per se*, and not related to plague. During an outbreak of plague cases of Climatic Bubo might easily be mistaken for cases of bubonic plague, but the absence of plague bacilli in the juice obtained by puncturing the lymph gland easily verifies the diagnosis.

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1. Ruge "Die der Zanzibar Küste eigenthümlichen Leistendrüsentzündungen," *Arch. f. Dermat. u. Syph.*, 1896, Br., xxxvi., H. 4.

2. Ferraro, 1903, *Ann. Med. Naval.*

3. Cantlie, A., "Lecture on the Spread of Plague," *Lancet*, 1897, January 7th and 9th.

4. Martin, "Aerztliche Erfahrungen über die Malaria der Tropenländer," Berlin, 1889.

5. Castellani and Chalmers' "Manual of Tropical Medicine," London, 1910.

PARASITIC PROTOZOA ENCOUNTERED IN THE BLOOD OF AUSTRALIAN NATIVE ANIMALS.

Work in this direction has been undertaken only recently by Cleland and Johnston and Gilruth and Sweet, and published in the *Proceedings of the Linnean Society of New South Wales*, and in the *Proceedings of the Royal Society of Victoria*. Parasitic entozoa and haematozoa met with in native animals of New South Wales, Victoria, and of the Zoological Gardens, were recorded. Comparatively little is known about the parasites in native animals of North Queensland. A systematic survey of ento- and haematozoa of the native animals of North Queensland has therefore been undertaken, and has yielded interesting and valuable results from a scientific point of view.

Unfortunately the lack of literature prevents us from giving a complete survey of the already described species. Sweet[1] has given a list of the endoparasites of Australian stock and native fauna only.

TRYPANOSOMIDAE.

Trypanosoma Lewisi occurs frequently in rats in and around Townsville. About 15 per cent. of the rats examined were found to be infected.

Trypanosoma pteropi, n.sp.

Only in one specimen of *Pteropus gouldi* (Gould's Flying Fox) out of about 25 examined, a small number of trypanosomes was found.

The trypanosome (Fig. 1, Pl. vii.) possesses a slender body, and has a pointed blepharoplastic end. The blepharoplast is large, and seems to consist of two ring-shaped chromatin masses, which are placed in the shape of a cross. In nearly all specimens a vacuole was present in front of the blepharoplast; the nucleus does not show any characteristic features. The parasite has a long, free flagellum; the undulating membrane is not well developed.

The few trypanosomes found were of approximately the same size; the distance from the blepharoplastic end to the blepharoplast measured 2.5 to 3 μ. The nucleus was 5.6 to 7 μ. distant from the blepharoplast. The total length averaged between 20 to 22 μ. The width at the level of the nucleus was 2.5 to 3 μ.; the free flagellum averaged 11-12 μ.

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1. Sweet, *Proc. Roy. Soc. Vict.*, vol. xxi., pt. 11.

BIRD TRYPANOSOMES.

Trypanosomes, parasitic in the blood of birds have been first described by Danilewski.[1] A comprehensive study of the bird trypanosomes of North America and their cultivation has been published by Novy and MacNeal,[2] who regarded most of the trypanosomes found, as belonging to Danilewski's original species, *Trypanosoma avium*. They encountered the two types, *T. majus* and *T. minus* in nearly every infected bird.

We found trypanosomes in four species of birds, namely, *Haliastur girrenera*, *Falco hypoleucus*, *Chlamydodera orientalis*, and *Notophoyx novachollandiae*. The trypanosomes of the two first named species were morphologically similar, although slight differences were noticed, as the presence of numerous granules scattered throughout the cytoplasm, which detail, however, does not seem to justify the creation of a new species. The latter two trypanosomes, however, showed morphologically well marked differences from the original species, *T. avium*, and are being regarded as new species.

TRYPANOSOMES IN THE BLOOD OF *HALIASTUR GIRRENERA*, VIEILL.

In the blood of *Haliastur girrenera* (white-headed sea-eagle), shot in the Lower Burdekin district, trypanosomes were observed. All trypanosomes found were of the same type, and approximately of the same dimensions. The trypanosomes belonged to the large group of *Trypanosoma avium*, and corresponded to the larger forms, *Trypanosoma majus*, Dan.

The length of the parasite (Fig. 2, Pl. vii.), varied from 44.5 to 58.5 μ. Forms below 50 μ. have only been seen in small numbers. The blepharoplastic end is very narrow, and tapers gradually to a fine point; the blepharoplast is from 6 to 11 μ. distant from the end, and a vacuole is, as a rule, present in front of it. The nucleus takes the stain well, and is transversely placed, extending through the whole width of the parasite, which measures from 7 to 9 μ.

The distance of the nucleus from the blepharoplast is from 12 to 16.5 μ. The cytoplasm takes a dark blue stain, if Giemsa's solution is used, and shows distinct striation. The undulating membrane is broad and bordered by the flagellum, the free end of which measures from 4 to 6 μ.

TRYPANOSOMES IN THE BLOOD OF *FALCO HYPOLEUCUS*.

In the blood of one *Falco hypoleucus*, trypanosomes were found in a fairly large number; on the average one parasite could be seen in 10 to 12 fields of a stained specimen. Two distinct forms could be observed, a small and a large form, the larger forms being more numerous. The small forms which are stiffer, resemble somewhat the forms seen in a chronic infection of *Trypanosoma Lewisi*. They are from 35 to 40 μ. long; both ends are pointed. The blepharoplast is

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1. *Danilewski, La Parasitologie Comparée du Sang. Kharkoff*, 1889.
2. "On the Trypanosomes of Birds," *The Journal of Infectious Diseases*, vol. ii., No. 2, 1905.

about 10 μ. distant from the posterior end. The nucleus is 7 to 10 μ. distant from the blepharoplast, extending across the whole width of the parasite, which averages 3.5 μ. The cytoplasm stains light blue by Giemsa, and in no instance did it show any striation. Red-staining granules are scattered throughout the cytoplasm. The undulating membrane is not pronounced, although it can be distinctly made out. The free flagellum is from 5 to 7 μ. in length (Fig. 3, Pl. vii.).

The larger forms (Fig. 4, Pl. vii.) are similar to the trypanosomes found in the white-headed sea-eagle. The body of the parasite tapers to both ends, the blepharoplast lies from 10 to 15 μ. from the posterior end. Occasionally a vacuole is seen in front of the blepharoplast. The nucleus stains readily by Giemsa's method, and is placed transversely, filling the entire width of the parasite, averaging 6 to 7 μ. The nucleus is 12 to 15 μ. distant from the blepharoplast. The cytoplasm does not show any distinct striation, and is filled with reddish granules. The undulating membrane is distinct, the flagellum fairly fine, and the free end measures 6 to 7 μ.

We are inclined to consider the described trypanosomes as representatives of *Trypanosoma avium* Danilewski.

In films of the heart blood of the same bird in rare instances peculiar parasitic forms (Fig. 5, Pl. vii.) could be seen. They were spindle-shaped, 24 to 28 μ. long and about 3 μ. broad, occurring in "rosettes." Each parasite possessed two masses of chromatin; one large one, extending over about three-quarters of the total width of the parasite, and a second smaller one which stained more deeply, and was either adjoining the nucleus, or separated from it by a short distance. The cytoplasm took the blue stain very lightly. These parasites occurred in clumps or rosettes consisting of five to eight individuals.

The described forms are very similar to the culture rosettes of the bird trypanosomes as described by Novy and MacNeal,[1] and correspond in all probability to the segmentation forms of *Trypanosoma Lewisi*[2] and *Trypanosoma loricatum*.[3]

Although carefully searched for, no intermediary forms between the described ones, and the fully developed trypanosomes could be found.

TRYPANOSOMES IN THE BLOOD OF BOWER BIRDS,

(*Chlamydodera Orientalis* Gould). *Trypanosoma Chlamydoderae,* n.sp.

In the blood of one bird out of five examined, trypanosomes were found in small numbers. The trypanosomes were similar to *Trypanosoma avium* (Figs. 6-7, Pl. vii.) in as far as two distinct forms could be observed. A more slender form of a stiff appearance, possessing darkly-staining cytoplasm and a second broader form staining more lightly. The former parasites (Fig. 7, Pl. vii.) are from 34 to 38 μ. long

1. Novy and MacNeal, *loc. cit.*
2. Moore, Breinl, and Hindle, "Annals of Tropical Medicine and Parasitology," vol. ii., No. 3.
3. Dutton, Todd, and Tobey, "Annals of Tropical Medicine and Parasitology," vol. 1, No. 3, p. 310.

and 2-3 μ. broad, and show a large blepharoplast about 4.5 μ distant from the posterior end. The nucleus, which does not stain readily by Giemsa, is 10-13 μ. distant from the blepharoplast, and is represented by a round reddish area. The cytoplasm is stained dark bluish, and does not show any striation. The free flagellum is short, measuring about 3 μ. in length.

The broad forms were of a distinct appearance. The parasites were about 35 to 40 μ. long, and in the middle 6-8 μ. broad, tapering to both ends; the blepharoplast was fairly large, and about 3 μ. distant from the end. The nucleus, which is about 6 μ. in diameter, is about 12 μ. distant from the blepharoplast, and can be distinctly made out.

The undulating membrane is not well developed, the flagellum is a very slender filament, the free end measuring about 3 μ. The cytoplasm takes the stain irregularly; no striation could be distinguished.

This trypanosome differs considerably from *Trypanosoma avium* Danilewski, not only in its measurements, but also in other morphological details as the smallness of nucleus and blepharoplast. We propose for it the name *Trypanosoma Chlamydoderae,* n.sp.

TRYPANOSOMES IN THE BLOOD OF *NOTOPHOYX NOVAE-HOLLANDIAE* (Blue Crane), TRYPANOSOMA NOTOPHOYXIS, n.sp.

In the blood of one blue crane out of six examined, trypanosomes could be detected, which differed morphologically from the species described previously. As in the previously recorded forms, two different types of parasites could be observed, a long and slender form, and a shorter, broad, spindle-shaped form (Figs. 8, 9, Pl. vii.). The slender forms are from 27 to 32 μ long, not including the free flagellum. The blepharoplast is fairly large, represented by a dark staining chromatin mass, and is about 3 μ. distant from the pointed end. The nucleus, which takes the stain readily, extends, as a rule, across the whole width of the parasite, which measures from 3 to 4 μ. and is very often placed obliquely. Its distance from the blepharoplast measures 12-14 μ. The cytoplasm takes a dark bluish stain, has no striation, and does not contain any granula. The undulating membrane is present, the flagellum is well developed, and extends about 8 μ. beyond the cytoplasm of the parasite.

The parasites of the second type are 32 to 36 μ. long, pointed on both ends; the nucleus, which is large and stains dark reddish, is surrounded by a clear, slightly reddish staining area, and is situated at a distance of 14 μ. from the blepharoplast. The width of the parasite measures about 7-8 μ. The cytoplasm stains dark bluish, and contains numerous vacuoles (in all probability artefacts), and shows longitudinal striation. The undulating membrane is well developed, the flagellum is slightly thinner than in the slender forms, and extends only 4-5 μ. beyond the cytoplasm.

We consider this trypanosome as belonging to a new species, and propose for it the name *Trypanosoma notophoyxis,* n.sp.

TRYPANOSOMA CHELODINA.

This trypanosoma described by Dr. A. E. Johnston[1] as occurring in the Murray River tortoise, *Chelodina longicollis*, and redescribed by Johnston and Cleland[2] has been found in the blood of two specimens of *Chelodina longicollis* out of ten examined.

TRYPANOSOMES IN THE BLOOD OF NINOX BOOBOOK.

In the blood of one specimen of *Ninox boobook* (four were examined) scanty trypanosomes were found. In one fresh specimen of heart-blood one trypanosome was noticed. In twenty films made at the same time only one parasite was found (Fig. 10, Pl. vii.). The owl was heavily infected with *Haemoproteus noctuae.*

The distance of the blepharoplast from the posterior end measured 3 μ. The distance of the nucleus from the blepharoplast was 9 μ. The total length measured 26 μ. and the width at the level of the nucleus 3 μ.

The trypanosome is short and stumpy, possesses a dark bluish staining cytoplasm with distinct striation; the nucleus is large, and the free flagellum is short.

The small number of trypanosomes is remarkable, and points again to the fact that a large number of blood films must be examined before the presence of trypanosomes in the blood of an animal can be denied.

PROTEOSOMA PRAECOX.

A grey falcon, *Falco hypoleucus* Gould, was found dying on the wayside in the Lower Burdekin district. The blood films made were found heavily infected with a blood parasite belonging to the genus of Proteosoma. Trypanosomes and microfilariae were present in the blood at the same time. The number of proteosoma found, explained the dying condition of the bird.

The youngest forms, the small amoeboid sporozoits (Fig. 1, Pl. viii.) show signet ring shape. The chromatin is represented by a small dense mass placed peripherally, the cytoplasm is lightly stained; a large vacuole is present. Sometimes three or four sporozoits enter one red blood corpuscle. During the growth of the parasite the cytoplasm becomes denser, the chromatin increases in bulk, and the pigment which appears first as minute yellowish brown granules becomes larger and darker in colour (Fig. 2, 3, Pl. viii). The nucleus of the blood corpuscles becomes displaced. During sporulation the chromatin splits up into a small number of particles, which aggregate in the periphery of the parasite; the pigment, which is at first scattered over the whole parasite, collects in the centre, where it is to be found in the form of a cluster or ring. There are usually 18 to 24 spores formed (Fig. 4, Pl. viii.); sometimes the whole blood corpuscle is packed with spores, as frequently two or more parasites sporulate in the same blood corpuscle.

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1. A. E. Johnston, *Aust. Med. Gaz.*, xxvi., 1907, p. 26.
2. Johnston and Cleland, *Proceedings Linnean Soc. New South Wales*, vol. xxvi., part 3, p. 779, 1911.

Gametocytes were observed in small numbers free (Fig. 7, Pl. viii.), and intracellular. The microgametocytes (Fig. 5, Pl. viii.) showed light bluish staining cytoplasm, the chromatin is represented by an open mesh-work. The pigment consists of blackish, coarse granules. The macrogametocytes (Fig. 6, Pl. viii.) are of the usual form, bean or sausage shaped, causing a displacement of the nucleus of the infected blood corpuscles. The cytoplasm is stained dark bluish by Giemsa's stain; the chromatin is collected in the form of a dense central mass. There are a few dark pigment granules present, which are much coarser than those of the sporozoits. In some instances fully-developed sporulating forms are found in leucocytes. *Proteosoma praecox* is widely distributed the world over, and has been found in many different species of birds.

PLASMODIUM PTEROPI, n.sp.

In the blood of flying foxes, *Pteropus gouldi*, shot in the neighbourhood of Townsville, blood parasites were found. Similar parasites have been previously described from the blood of *Miniopterus Schreibersi* and *Vespertilio Murinus* by Dionisi,[1] and Ziemann mentions the occurrence of parasites in the blood of flying foxes. Attempts to use wet fixation and stain the parasites by our saffranin methylenblue or our modification of Heidenhain's method have failed. Our description, therefore, is based on dry films stained by Giemsa's method.

One of the animals was heavily infected; as many as two to three parasites could be seen in one microscopic field. Others showed only a slight infection, not more than one to two parasites in 20 or 30 fields could be detected. Only intracellular forms have been observed.

The young agametes (Fig. 8, Pl. viii.), which have been seen in the blood of one animal only, resembled the small ring forms of plasmodium vivax; they are round and possess a large vacuole, and contain one nucleus consisting of dense chromatin. These forms have a small amount of fine pigment. In the later stages (Figs. 9, 10, Pl. viii.), the parasites lose their signet ring shape and become amoeboid; the pigment granules of this stage are much coarser.

The chromatin of the nucleus increases in size, and the cytoplasm of the agametic form takes the blue stain of Giemsa lightly. At a later stage the chromatin becomes a loose mesh-work, and splits up into a small number of chromatin masses (Figs. 11 and 12, Pl.viii.). The pigment consists of small granules of a dark mahogany brown colour, which are scattered throughout the parasite. Sometimes the affected blood corpuscles show a slight enlargement.

The parasite, during its growth, replaces the cytoplasm of the red blood corpuscles, and finally the remainder of the blood corpuscle surrounds the parasite in the form of a thin pellicle. Nothing can be said about the duration of the developmental cycle. Gametocytes occur in a fairly large number.

The cytoplasm of the microgametocytes stains light bluish (Fig. 13, Pl. viii.),

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1. *Dionisi, Die Malaria einiger Fledermausarten. Moleschotts Untersuchungen zur Naturlehr des Menschen und der Tiere*, Bd. 17, Heft 3-4.

and shows alveolar structure. The chromatin, which forms a loose mesh work, is placed excentrically. Coarse yellowish brown pigment-granules are present. The macrogametocytes (Figs. 14, 15, Pl. viii.) possess a dense dark blue staining cytoplasm, the chromatin is very dense, and is often surrounded by an achromatic area. The macrogametocytes are filled with coarse dark-yellowish pigment-granules.

As only dry films were examined nothing definite can be said about the finer structure of the nucleus.

The parasite described resembles closely the plasmodium described by Gonder and Berenberg-Gossler[1] from the blood of monkeys. It undoubtedly has all the characteristic features of the genus Plasmodium, and we therefore propose the name *Plasmodium pteropi,* n.sp.

HAEMOGEGARINES.

A number of turtles, *Chelodina longicollis,* were examined. Haemogregarines were frequently found in their blood in varying numbers. Sometimes as many as 20 or 30 parasites could be counted in one microscopic field; sometimes only one or two parasites could be found after prolonged search. Our parasites agree with the description given by Johnston,[2] and Johnston and Cleland.[3] Now and again one red blood corpuscle was seen containing two haemogregarines. The infected red blood corpuscles were always enlarged. The dimensions of a normal blood corpuscle being 9-10 μ. x 15-18 μ. ; infected blood corpuscles measure as much as 10-15 μ. x 22-27 μ.

HAEMOGREGARINA VARANICOLA (Johnston and Cleland).

This parasite has been found in three out of five *Varanus varius* examined. It was recorded first by Gilruth[5] from the blood of an Iguana, from the Lower Burdekin district.

Of one of our animals, which contained parasites in a good number, organ films were made. Whereas in the peripheral blood the greatest number of the parasites were contained in red blood corpuscles, numerous free forms were encountered in the lung smears, some of them showing a dividing nucleus.

Only in two films stained after Breinl's saffranin methylenblue method were several parasites observed, which showed besides the main nucleus, a second smaller nucleus (Figs. 16, 17, Pl. viii.) surrounded by a round, lightly staining area. This second chromatic staining mass was present in intracorpuscular as well as in free forms.

Nearly all specimens of *Varanus varius* encountered have been found in-

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1. *Malaria*, vol. 1, part 1, p. 47.
2. Johnston, *Proc. Linnean Soc. New South Wales*, vol. xxxiv., p. 407, 1909.
3. Johnston and Cleland, *Proc. Linnean Soc. New South Wales*, vol. xxxvi., p. 482, 1911.
4. Johnston and Cleland, *Proc. Linnean Soc. New South Wales*, vol. xxxvi., p. 487.
5. Gilruth, *Proc. Roy. Soc. Victoria*, vol. xxiii., p. 36.

fested with *Aponoma trimaculatum*. Numerous haemogregarines could be found in the contents of the intestines of these ticks, which act, in all probability, as intermediary host.

HAEMOGREGARINES IN THE BLOOD OF *DIPSADOMORPHUS* FUSCUS.

In the blood of one out of two snakes examined, haemogregarines were found in fairly large number (Figs. 18, 19, Pl. viii.).

The infected blood corpuscles, on the whole, were enlarged, the protoplasma being lighter in colour. The nucleus of the host cell, as a rule, is not, or only slightly displaced through the parasite. Normal blood cells shows measurements 10-14 μ. by 15.5-17.5 μ. Infected blood corpuscles measure 13.4-17.05 μ. by 17.5-20 μ. The parasites measure on the average 5 μ by 17 μ. No free forms could be detected in the blood. Only on rare occasions a double infection of one blood corpuscle was noticed. The lung smears contained free forms.

HAEMOGREGARINA SHATTOCKI.

In one out of three specimens of the carpet snake, *Python spilotes*, var. *variegatus*, a small number of blood corpuscles were infected by haemogregarines corresponding to *H. Shattocki*, as described by Sambon and Seligman,[2] and recorded by Johnston and Cleland.[3] Most of the forms were about 16 x 3.4 μ. The nucleus of the host cell was laterally displaced, the capsule could be easily distinguished.

LEUCOCYTOZOON.

Leucocytozoon were found in the blood of one bird, *Tropidorhynchus corniculatus* (Friar bird) (Figs. 20, 21, Pl. viii.), and then only in a very small number; three parasites were discovered in three blood films. *Haemoproteus Danilewski* was present in small numbers (Fig. 22, Pl. viii.).

HAEMOPROTEUS, KRUSE.

Blood parasites belonging to the genus of haemoproteus have been frequently met with. A large percentage of all birds examined have been found infected; sometimes numerous parasites were present, sometimes only a few could be found after careful search.

1. *Haemoproteus noctuae.*

Two out of three Boobook owls, *Ninox boobook*, examined were found to be infected with *Haemoproteus noctuae*.. These parasites did not differ morphologically from those described by Schaudinn. Unfortunately we were not able to obtain living specimens of the bird to repeat Schaudinn's work on the life history of this interesting parasite in its intermediary host, the mosquito.

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1. Annals of Tropical Medicine and Parasitology, vol. i., p. 439, 1908.
2. Sambon and Seligman, *Proc. Zool. Soc.*, 1907, p. 284.
3. Johnston and Cleland, *loc. cit.*

2. *Haemoproteus Columbae.*

In the blood of the purple-crowned fruit pigeon, *Ptilopus superbus,* blood parasites have been found belonging to the species *Haemoproteus columbae,* as found in pigeons in Italy, Algeria, France, and Brazil. As the animal had been in the chronic stage of the infection, parasites were present in scanty numbers only. Most of the forms found in the peripheral blood were gametocytes, and occurred either free or intracellular.

The intracellular parasites were sausage-shaped up to about 15 μ. in length and 6 μ. in width. The cytoplasm stained, as a rule, deep bluish with Giemsa, the chromatin was usually collected in the centre, and the pigment occurred in the form of a smaller or larger number of dark brownish or blackish granules.

Macro-and microgametocytes were observed, the former (Figs. 23, 24, Pl. viii.) with the chromatin collected in the centre, dark bluish-staining cytoplasm and baton-shaped, dark brownish pigment-granules; the cytoplasm of the latter (Fig. 25, Pl. viii.) stains light bluish by Giemsa, the chromatin has the form of an open mesh work and pigment is scanty.

Films were taken of the internal organs, liver, spleen, bone marrow and lung, but in no instance could sporulation forms as described by Aragao[1] be seen, most probably on account of the animal being in the chronic stage of infection.

3. *Haemoproteus Danilewski.*

A comparatively large number of birds harboured in their blood parasites corresponding to *Haemoproteus Danilewski.* These parasites were found in the blood of *Haliastur girrenera, Chlamydodera orientalis, Notophoyx novaehollandiae, Anellobia chryoptera, Chibia bracteata, Cracticus destructor, Megalurus gramineus,* and *Eudynamis cyanocephalus.*

Further careful study of these parasites will enable us to pronounce definitely whether all these parasites belong to the same species or whether they have to be regarded as specific for the different hosts.

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1. Trabalho do Instituto de Maguinhos, Rio de Janeiro, 1907.

NEMATODES OBSERVED IN NORTH QUEENSLAND.

FAM. *ANGIOSTOMIDAE*, GEN. *STRONGYLOIDES GRASSI.*

Strongyloides stercoralis, Bavay.

Strongyloides stercoralis, Bavay, has been discovered in six cases. Four cases were children who harboured at the same time, *Agchylostoma duodenale* in their intestines. Two cases underwent treatment for other complaints in the hospital, and the presence of the parasite was only accidentally discovered.

FAM. *FILARIIDAE.*

Filaria infections in men and beast are very common throughout many parts of North Queensland.

Filaria Bancrofti.

See page 18.

Filaria immitis

Filaria immitis is of frequent occurrence in dogs in and around Townsville and causes a comparatively heavy mortality amongst the animals infected.

The adult worms agree morphologically with the description of *F. immitis* as given by previous observers; the vagina in our specimens was situated from 1.6 to 2.5 mm. from the anterior end, and not 7 mm. as given in most text books.[1] In this respect our observations coincide with Fülleborn's[2] findings, in whose specimens (from Italy and Japan), the vagina was about 1.6 mm. distant from the anterior end.

FILARIA OF THE COMMON OPOSSUM, Trichosurus vulpecula, Kerr, *Filaria trichosuri* n.sp.

In three out of nineteen opossums filaria larvae were found in the peripheral blood. The number of larvae was never very large; at the most 3-5 microfilariae were found in a fresh ¾in. coverslip preparation. Hourly examination at day and night did not reveal any periodicity; the number of larvae found was always constant. The opossum did not seem to suffer any ill effects from the presence of this parasite. The animals were killed after a short time of observation, and in each case the adult filariae were found free in the abdominal cavity. The worms could be seen moving about actively between the coils of the intestine. After having been transferred to normal saline solution the activity of the

1. Braun, Railliet, Castellani and Chalmers.
2. *Archiv. f. Schiffs und Tropenhygiene Beiheft* 8, 1908.

worms increased and they could be seen coiling and uncoiling for a considerable time.

Description.

Male (Figs 1, 2, Pl. ix.) is from 10.7-13 cm. long, having a uniformly cylindrical body of whitish or yellowish colour; the outer layer of the cuticle shows a fine transverse striation, which becomes finer towards the anterior and posterior ends. The head end is bluntly rounded off; the tail end is spirally coiled up, showing 3-6 turns. The terminal mouth possesses six papillae. The pharynx is very short and funnel-shaped. The oesophagus is 1.84 to 2.25 mm. long, being a straight tube. The ganglionic ring is .24 to .32 mm. distant from the anterior end. The chyle intestine is, in most of the specimens, filled with dark yellowish granular material, and forms a straight tube of approximately uniform thickness, extending throughout the length of the worm. The anal opening is .600-1.500 mm. from the posterior end, and is, as frequently observed in filariae, guarded by two projecting lips.

Two spicules are present, the longer one is .530-.750 mm. in length, and at its proximal end .045 mm. in diameter. The shorter spicule possesses a spatulated distal end, in which the longer spicule glides to and fro; its length is .3-.33 mm., and its diameter .045 mm. In the majority of the specimens there are three pairs of praeanal papillae present, and three pairs of postanal papillae (only in one specimen four pairs of postanal papillae could be observed). Two pairs of caudal papillae are present close to each other, situated on the extreme tip of the tail.

The testicular tube extends in form of a simple tube throughout the length of the worm; it turns upon itself about 2 mm. from the anterior end, ending after a short distance in a bulb-like swelling.

Female (Figs. 3, 4, Pl. ix.) is from 18.5 to 36.5 cm. long; the anterior end is bluntly rounded off; the posterior end attenuated. The anus is 1.26 to 1.725 mm. distant from the posterior end, leading into the rectum which forms a short, thin tube, which widens out into the chyle intestine. The extreme tip of the tail is armed with one pair of papillae-like protuberances.

The vulva is 3.150 to 3.63 mm. distant from the anterior end, and has the shape of a transverse slit; the muscular vagina, which begins as an oval bulb-like swelling, is much coiled up, leading into the uterus, which, at a varying distance, divides into two uterine tubes. The uterus, in many specimens fills the whole width of the worm, and is tightly packed with larvae, which are the less developed the further distant from the vagina. The two ovaries are much-coiled narrow tubes, extending within 3.150 mm. from the posterior end.

The chyle intestine of the female is filled with dark-yellowish material, and can even in living specimens often be seen as a dark line, extending throughout the whole length of the worm.

Larva.—Microfilariae occur in the peripheral blood, and in the organs in a varying number. Only in one animal of three were the larvae so numerous as to

be easily detected in stained specimens. The same staining method as for *Microfilaria bancrofti* was used.

The microfilariae (Fig. 1, Pl. x.) are, on the average, .180 to .220 mm. long, and .003 to .005 mm. broad, with a rounded-off anterior end, the posterior end gradually tapering to a fine point. The outer cuticle shows fine striations. The anterior spot is from .04 to .05 mm. from the anterior end. The nucleus of the excretory cell (e.c.) can easily be made out if stained by our wet film method, being .06 to .08 mm. from the anterior end. In front of the nucleus of the excretory cell there is an excretory pore (e.p.) as described in *Microfilaria bancrofti.* The main genital cell is situated about .06 to .08 mm. from the posterior end, and three to four additional genital cells can be clearly made out.

FILARIA OF THE FRILLED LIZARD (Chlamydosaurus Kingii).

Filaria Chlamydosauri, n.sp.

The finding of Filaria in reptilia is rare. We had opportunity of examining three specimens of *Chlamydosaurus Kingii,* and found microfilariae in the blood of one specimen. The larvae occurred in a fairly large number; sometimes as many as six could be seen in one microscopic field. No turnus was noticeable; microfilariae were present in the peripheral blood at all hours of examination at day and night.

The animal was killed, and a thorough search made for the adults. Only one male could be found in one of the retraperitoneal lymph vessels. No female worm could be detected.

Description of the Male.—The male (Figs. 2, 3, Pl. x.) is 24 mm. long, of whitish colour, having a fairly uniform cylindrical body, broader in the middle, slightly tapering towards the anterior end, which is bluntly rounded. The tail end is curved ventrally. The outer layer of the cuticle is finely striated; the foremost anterior and posterior parts of the worm are smooth. The mouth opening is surrounded by three lips, each of them being armed with one large papilla. Three smaller papillae can be noticed further back.

The oesophagus is about 1.950 mm. long, narrower in front. At the level of the ganglionic ring the wall of the oesophagus becomes more muscular, the organ broadening out at the same time. At the junction of the oesophagus and the chyle intestine a valve-like arrangement can be seen in form of a funnel-shaped membrane hanging free into the chyle intestine. The chyle intestine forms a narrow straight tube extending to the cloacal opening, which is .135 mm. from the tip of the tail situated in the mid-ventral line.

From the ano-genital orifice the straight testicular tube runs forward up to 2.220 mm. from the anterior end, returning upon itself a distance of 1.920 mm., and ending spirally coiled up. There are two spicules of different shape and size; the longer spicule is .245 mm. long and .0175 mm. broad, having two bulb-like swellings, one at its proximal end and one about the middle. The smaller spicule is about .150 mm. long, and has a diameter of .015 mm.; its proximal end is spoon-

shaped. The papillae are arranged in three groups, praeanal, postanal and caudal. There are five pairs of praeanal papillae; four large pairs placed closely together, and one smaller nipple-like pair situated close to the anal opening. Three pairs of large postanal papillae are grouped near to each other; the caudal group is formed of two pairs of small papillae; one pair situated bilaterally on the extreme tip of the tail and the second pair a short distance in front of it.

Microfilariae.—The larvae (Fig. 4, Pl. x.) occurred in the blood showing, in fresh specimens besides lateral movements a slow progressive movement. In stained specimens (wet films) the anterior V spot could not be made out distinctly, although numerous films were examined. The total length varied between .08 and .105 mm., the majority measured about .090 mm.; the largest diameter varied between .003 and .005 mm. The head end is bluntly rounded off, the tail-end pointed, the nuclei of the matrix cells in the foremost parts of the larvae are usually smaller than those in the centre.

No excretory cell could be found, although carefully looked for. The cells representing the rudiment of the genital system, however, were well marked. Usually one large main genital cell was present, situated between .028 to .033 mm. from the tip of the tail, and a group of three smaller additional genital cells, further back, placed closely together.

The nuclei of the genital cells could be easily made out in the majority of the specimens; they were much larger than the epidermoidal cells, and possessed a distinct nucleolus in the centre.

FILARIA OCCURRING IN THE CONJUNCTIVAL SAC OF DACELO LEACHII.

(*Filaria*) *Dacelonis*, n.sp.

In two specimens of *Dacelo leachii* (Leach's Kingfisher), out of five examined, nematodes were found in small numbers free in the conjunctival sac, in each case three worms could be found, two females and one male.

Description.—The body tapers towards both ends; the anterior end is bluntly rounded off, the posterior end pointed. The outer layer of the skin shows distinct transverse striation; the segments in the middle of the parasite are about .026 mm. broad, becoming narrower towards the anterior and posterior end, where they are about .017 mm. broad. The mouth is oval, surrounded by a chitinous ring, which shows clefts (Fig. 1, Pl. xi.), making the mouth-opening appear to be surrounded by six lips. No papillae could be distinctly made out. The ganglionic ring is from .285 to .330 mm. from the anterior end of the body. The pharynx is from .024 to .028 mm. long, slightly narrower than the oesophagus, cup-shaped and lined with a cuticular membrane. The oesophagus is club-shaped, from .750 to .825 mm. long. In the majority of specimens only a slight constriction marks the transition of oesophagus into the chyle intestine.

Male is 10 to 11 mm. long and .39 to .4 mm. thick. The tail is curved ventrally (Fig. 2, Pl. xi.); the tip is bluntly rounded off. The cloacal opening is .180 mm.

from the posterior end. There were in one specimen five pairs of praeanal papillae distinctly discernible, and two pairs of postanal papillae. The second specimen only showed four large pairs of praeanal, and one pair of postanal papillae. Two spicules are present; one long and narrow, the other short and thick. The long spicule is 2.100 mm. long, broader at its proximal end (.021 mm. in diameter) distally only .010 mm. broad. The short spicule is about .180 mm. long, and .030 mm. broad; the proximal end is funnel-shaped, the distal end simply rounded off. The testicular tube is a straight tube, returning upon itself about 2.250 mm. from the anterior end, ending knob-like.

Female is 11 to 14 mm. long by .5 mm. thick; the vagina is .525 to .555 mm. distant from the anterior end (Fig. 3, Pl. xi.); the anal opening .255 mm. from the posterior end. The vagina possesses a strong muscular wall, and is about 1.050 mm. long. The end of the vagina is swollen bulb-like, and leads into the common uterus, represented by a simple tube, possessing a fairly thick wall. It is from .525 to .600 mm. long and about .030 to .040 mm. broad, bifurcates and increases in breadth, so that about the middle of the length of the parasite three-quarters of the width is taken up by the uteri.

About 4.500 to 6.600 mm. from the posterior end both uterine tubes lead into the ovaries, which are about .030 mm. in diameter, extending, slightly coiled, to about .7 mm. from the posterior end.

The posterior end of the female (Fig. 3, Pl. xi.) tapers slightly to within about .225 to .300 mm. from the tip of the tail, then ending conically. The anal opening is about .255 mm. from the posterior end, and armed with a strong muscle.

Filaria dacelonis resembles in some ways *Oxyspirura parovum,* as described by Georgina Sweet, a parasite which is found in the conjunctival sac of chickens, but the position of the vagina which opens out near the anterior end differentiates it from this species. The presence of the worm in the eye of the bird does not give rise to any pathological symptoms. Even on careful examination no conjunctivitis of the affected eye nor any opacity of the cornea could be noticed.

MICROFILARIAE IN THE BLOOD OF PITTA STREPITANS.

In the blood smears of *Pitta strepitans* (Noisy Pitta) microfilariae were found. Wet films were stained with polychrome methylenblue after fixation in Hofer's fluid. Most of the structural details observed in *Microfilaria nocturna* could be made out.

The microfilariae (Fig. 5, Pl. x.) were from .232 to .225 mm. long; the anterior clear spot corresponding to the rudiment of the nervous system was well marked, situated about .054 mm. from the anterior end. The nucleus of the excretory cell is oblong, situated .093 mm. from the head, and possesses a distinct nucleolus. Manson's innerbody is well marked. Some distance behind the innerbody is a collection of small metachromatically staining granules, similar to those seen in *Microfilaria bancrofti.* The main genital cell is about .093 mm. from the posterior end,

filling nearly the whole width of the parasite; its nucleus is large, and has a distinct nucleolus.

In most of the specimens only one additional genital cell was present (g.e.).

Oxyspirura parovum.

This parasite, which was first described by Georgina Sweet,[1] from material collected by Dr. Dodd, in Rockhampton, has been repeatedly met with in Townsville. In fowls, which had been infected for a considerable time, the whole lachrymo-nasal fossa was filled with cheesy, purulent material, but no worms could be found in these cases. In the earlier stages of the infection, on the other hand, numerous worms, from 12 to 14, could be extracted from the conjunctival sac. The infection seems to spread from chicken to chicken by contact; in several instances, all the young birds, which sleep under the wing of the mother, have been found to be infected.

FAM. *STRONGYLIDAE,* GEN. *AGCHYLOSTOMA.*

Agchylostoma duodenale was frequently met with in children and adults, and giving rise to the well-known clinical symptoms.

Necator americanus.

Specimens of *Necator americanus* have been found in the stools of patients, who were suffering from typical symptoms of Agchylostomiasis. It was remarkable that this worm was always present in conjunction with *Agchylostoma duodenale,* and always occurred in very small numbers. The patients had contracted the infection in those parts of North Queensland where Agchylostomiasis is prevalent. This observation tends to prove that *Necator americanus* has a fairly wide distribution in Queensland, which corresponds, on the whole, to the distribution of *Agchylostoma duodenale.*

Intestinal worms, which had been found in the stools of New Guinea natives, and had been sent to the Institute by Dr. W. E. Giblin, of Samarai, were identified as *Necator americanus.* They corresponded in every detail with the description of this parasite.

Agchylostoma caninum.

This worm has been found on more than one occasion in the small intestine of dogs and cats. On the occasion of a severe epidemic amongst cats in the neighbourhood of the hospital a small number of these parasites were found in every animal examined.

NEMATODES FOUND IN THE LUNG SAC OF TILIQUA SCINCOIDES.

(*Blue-tongued Lizard.*)

In the lung sac of two specimens of *Tiliqua scincoides* out of five examined nematodes were found, which were, as a rule, slightly adherent to the inner wall of the lung sac. Altogether twelve adult females were collected.

1. Sweet, *Proc. Royal Soc. Victoria,* vol. xxiii., p. 242.

The worms were from 5.8 to 8.39 mm. long, and had a largest diameter of .18 to .27 mm. (Fig. 4, Pl. xi.). The anterior end is slightly tapering, ending bluntly; the posterior end is pointed. The cuticle shows a fine transverse striation, being well marked only in the middle third of the body, and becoming less distinct towards the anterior and posterior ends, which are nearly smooth. The female has laterally two pairs of swollen cuticular wings, beginning a short distance from the anterior end (Fig. 5, Pl. xi.) The first pair is about .60 mm., the posterior pair about .045 mm. long, with a maximum width of about .022 mm.

The mouth is round, and shows a chitinous ring, which is armed with four papillae, which are situated crosswise. The nerve ring is from .130 to .150 mm. from the anterior end of the parasite, and is, as a rule, very distinct.

The pharynx is short, about .012 mm. long, and has a smooth cuticular lining; the oesophagus is .540 to .570 mm. long, very muscular, showing, anteriorly, a slight swelling and a distinctly club-shaped posterior ending. No valvular apparatus is discernible at the junction of the oesophagus and the chyle intestine. The anterior third of the worm shows, on cross section, a constriction in the middle, dorsally and ventrally, so that the worm appears on cross section somewhat dumb-bell shaped. This constriction is due to a ventral and dorsal thickening of the outer skin, which is about .018 mm. broad, and carries on each border a row of hooks of varying size; the first hook is situated about .150 mm. from the anterior end. In the anterior part of the parasite the hooks gradually increase in size, and become smaller further back. The smaller hooks consist of a chitinous half-moon shaped basal plate, which carries a spine, the larger ones are uniformly chitinous.

Behind the junction of the oesophagus and the chyle intestine larger and smaller hooks alternate irregularly; the larger hooks always take their origin from the lateral borders of the above-mentioned chitinous plate. Further back the hooks become smaller and smaller, being thorn-like, and take their origin from the central part of the chitinous plate. The number of hooks varies slightly; the greatest numbers counted were 38 and 39 respectively on each side. The larger hooks measured, on the average, .087 mm. at the base, and were .056 mm. high; the median ones .021 mm. by .028 mm., the smaller ones .017 mm. by .035 mm. The chyle intestine forms a straight tube throughout the length of the parasite, possessing a thick muscular wall, and is approximately of the same thickness. In some instances the anterior part is filled with red blood corpuscles. The posterior part of the chyle intestine is very muscular, ending abruptly about .105 mm. from the anal opening, and is connected by a thin tube with the anal opening, which is from .436 mm. to .510 mm. from the posterior end.

Genital System.—The vaginal opening is a transverse slit placed about the middle of the body, slightly prominent. From there a short narrow muscular tube about .090 to .130 mm. long leads into the uterus. The uterus is a simple sac about 2 mm. long, occupying nearly the whole width of the parasite, being tightly packed with coiled up larvae still surrounded by their egg shell. Both ends of the uterus are connected by means of a thin-walled sac-like ampulla with

the ovarian tubes, which are arranged symmetrically, leading firstly forward or backward respectively, and then turn back after some convolutions about 1.5 mm. from the posterior or 3 mm. from the anterior end of the parasite. The part of the ovaries nearest to the uterine openings is filled with a single row of fairly large square unicellular ova, which become smaller and smaller the further distant from the uterus, forming, in the more distant parts three to four rows of small cells. No male could be found, although carefully looked for.

We have not been able, with the literature at our disposal, to determine the genus of this parasite. In all probability this parasite represents a new genus of the family *Gnathostomidae.*

EXPLANATION OF PLATES.

Plate i.

Fig. 1.—*Onchocerca gibsoni.*
(a) complete female, H. head end, T. tail end; (b) male, natural size.
Fig. 2.—Male worm, head end.
Fig. 3.—Male worm, tail end. Normal position of papillae.

Plate ii.

Fig. 4.—Nodule. Partly dissected out. Note presence of two males and relative position in regard to female head.

Plate iii.

Fig. 5.—Female worm. Head end.
Fig. 6.—Female worm. Tail.
Fig. 7.—Armature of cuticle (middle of female).
Fig. 8.—Male tail end. Note additional pair of papillae (p.).

Plate iv.

Fig. 9-18.—Developmental stages of larvae of *Onchocerca gibsoni*.. Abbe drawing apparatus. 1/12 oil immersion Occular 4.

Plate v.

Fig. 19.—Later development stage of larva of *Onchocerca gibsoni.*
1/12 oil immersion Occular 4.
Fig. 20.—Ditto, Apochromat, 2mm Occular 2.
Fig. 21.—Fully developed larva; n., nerve spot; g., genital cell.
Fig. 22.—Head end of fully developed larva; n., nerve spot; e., excretory cell.
Apochromat, 2 mm. Ocular 8.

Plate vi.

Fig. 1.—Scheme of the structure of microfilaria (after Rodenwaldt).
m., matrix cells of subcuticle; e.p., excretory pore; e.c., excretory cell; g.1-4, genital cells; g.p., genital pore.
Fig. 2.—*Microfilaria bancrofti;* n., nerve spot; e.p., excretory pore; e.c., excretory cell; i.b., inner body; g.c., genital cells.
Fig. 3.—Anterior end of *Microfilaria bancrofti*, showing excretory cell and excretory pore.

Fig. 4.—Anterior end of *Microfilaria bancrofti*.. Excretory cell absent. Note the row of fine granules connected with excretory pore.
Figs. 5, 6, and 7.—Inner body.
Fig. 8.—Genital cells.
Fig. 9.—Early development stage of *Microfilaria bancrofti* from hydrocele fluid.
All figures drawn with Abbe drawing apparatus.
Figures 2, 7, and 9. Apochromat, 2 mm. Comp. ocular 4.
Figs. 3 to 7.—Apochromat, 2 mm. Comp. ocular 8.

Plate vii.

Fig. 1.—*Trypanosoma pteropi*, n.sp. In the blood of *Pteropus Gouldi*.
Fig. 2.—*Trypanosoma avium*, Dan., in the blood of *Haliastur girrenera*.
Figs. 3 and 4.—*Trypanosoma avium* from the blood of *Falco hypoleucus*.
Fig. 5.—Segmented trypanosoma in the heart blood of *Falco hypoleucus*.
Figs. 6 and 7.—*Trypanosoma chlamydoderae*, n.sp., in the blood of *Chlamydodera orientalis*.
Figs. 8 and 9.—*Trypanosoma notophoyxis*, n.sp. in the blood of *Notophoyx novae-hollandiae*.
Fig. 10.—Trypanosoma in the blood of *Ninox boobook*.
Abbe drawing apparatus.
Figs. 1 and 2.—1/12 oil immersion, Ocular 4.
Figs. 3 to 10.—2 mm. apochromat, Comp. ocular 8.

Plate viii.

Figs. 1 to 7.—*Proteosoma praecox* in the blood of *Falco hypoleucus*.
Figs. 8 to 15.—*Plasmodium pteropi* (n.sp.) in the blood of *Pteropus Gouldi*.
Figs. 16 and 17.—*Haemogregarina varanicola* in the blood of *Varanus varius*.
Figs. 18 and 19.—Haemogregarina in the blood of *Dipsadomorphus fuscus*.
Figs. 20 and 21.—Leucocytozoon in the blood of *Tropidorhynchus corniculatus*.
Fig. 22.—*Haemoproteus danilewski* in the blood of *Tropidorhynchus corniculatus*.
Figs. 23 to 25.—*Haemoproteus columbae* in the blood of *Ptilopus superbus*.
Figs. 1 to 25 drawn with the large Abbe drawing apparatus. Apochromat, 2 mm. Comp. ocular 8.

Plate ix.

Fig. 1.—*Filaria trichosuri*, n.sp. ♂ Head.
Fig. 2.—*Filaria trichosuri*. ♂ Tail.
Fig. 3.—*Filaria trichosuri*. ♀ Head.
Fig. 4.—*Filaria trichosuri*. ♀ Tail.

Plate x.

Fig. 1.—*Microfilaria trichosuri*..
Fig. 2.—*Filaria chlamydosauri*, n.sp. ♂ Head.
Fig. 3.—*Filaria chlamydosauri*. ♂ Tail.
Fig. 4.—*Microfilaria chlamydosauri*.
Fig. 5.—Microfilaria from the blood of *Pitta strepitans*.
Figs. 1, 4, and 5 stained after wet fixation.

Plate xi.

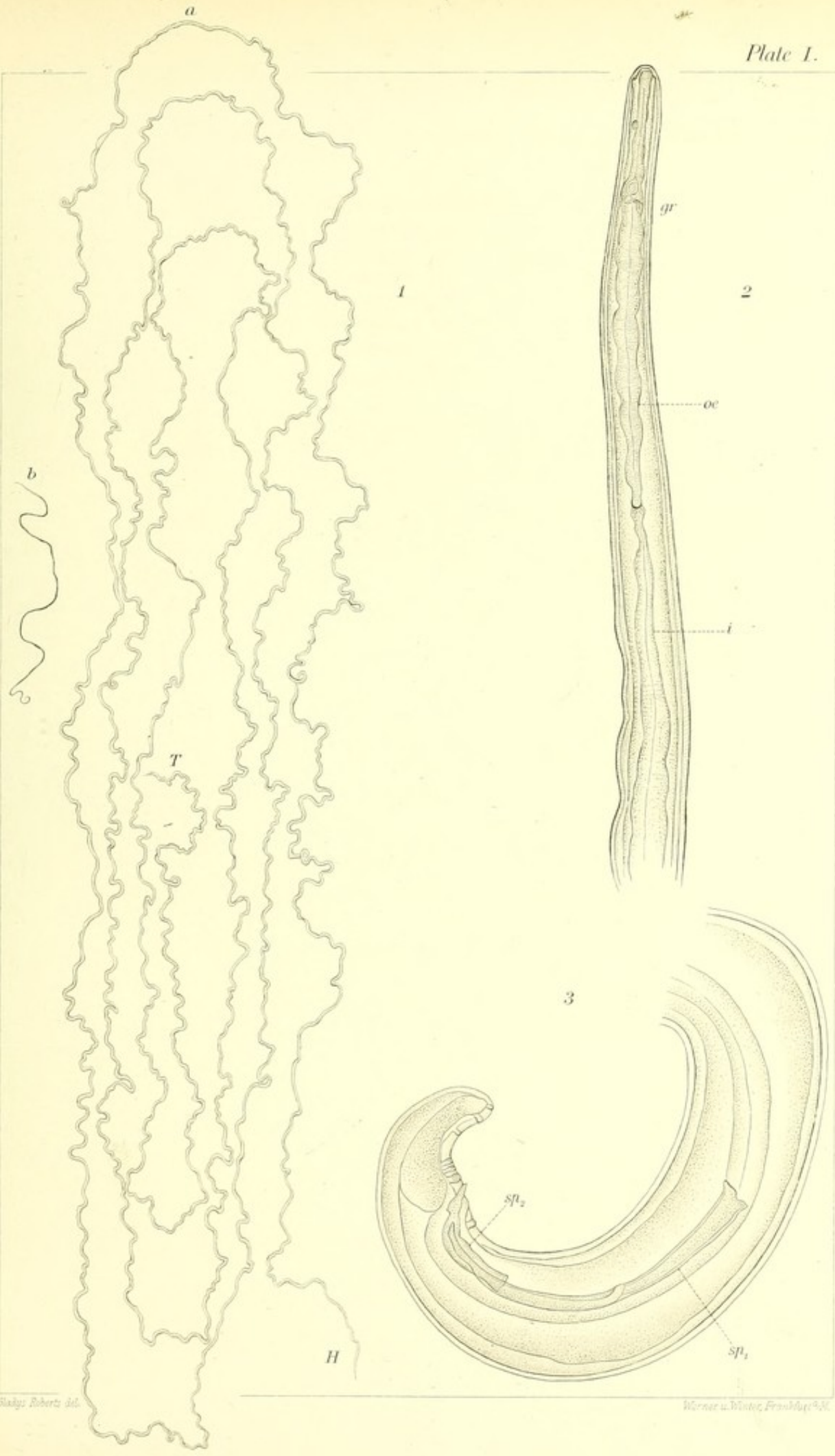
Fig. 1.—*Filaria dacelonis*, n.sp. ♀ Head.
Fig. 2.—*Filaria dacelonis*. ♂ Tail.
Fig. 3.—*Filaria dacelonis*. ♀ Tail.

Fig. 4.—Nematode found in the lung sac of *Tiliqua scincoides*.
Fig. 5.—Head end of same.

Reference Lettering.

vu., vulva.
va., vagina.
ut., uterus.
ov., ovary.
g.r., ganglionic ring.
oe., œsophagus.
i., intestine.

Plate I.



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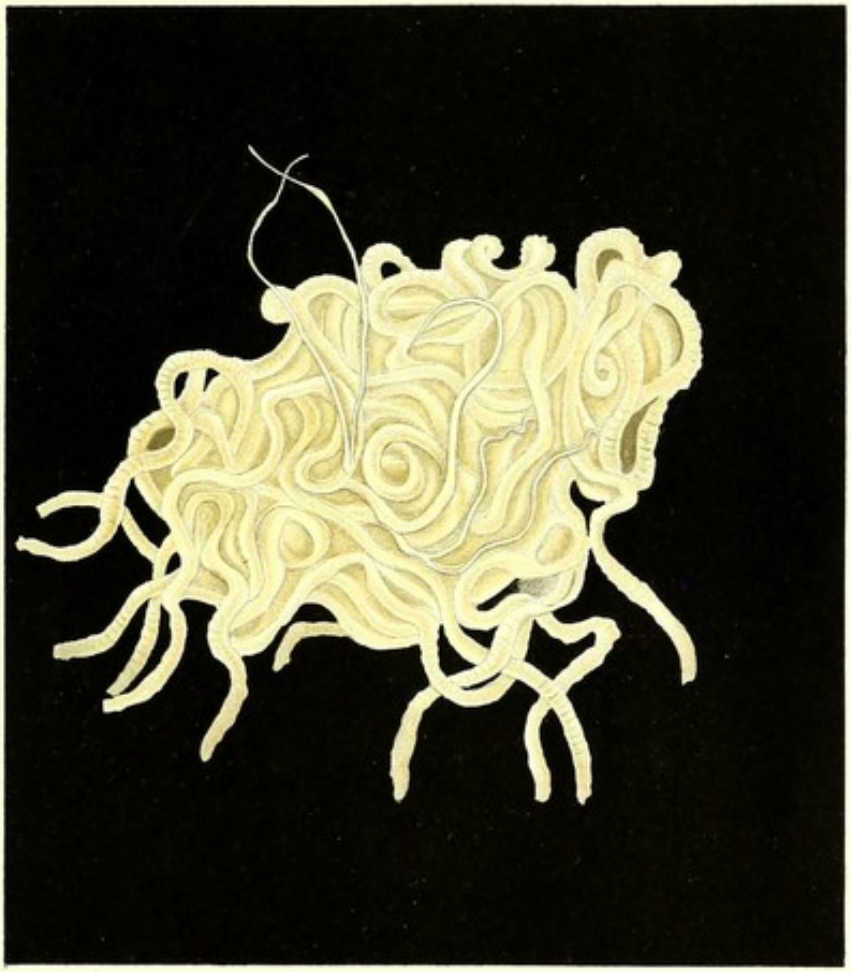

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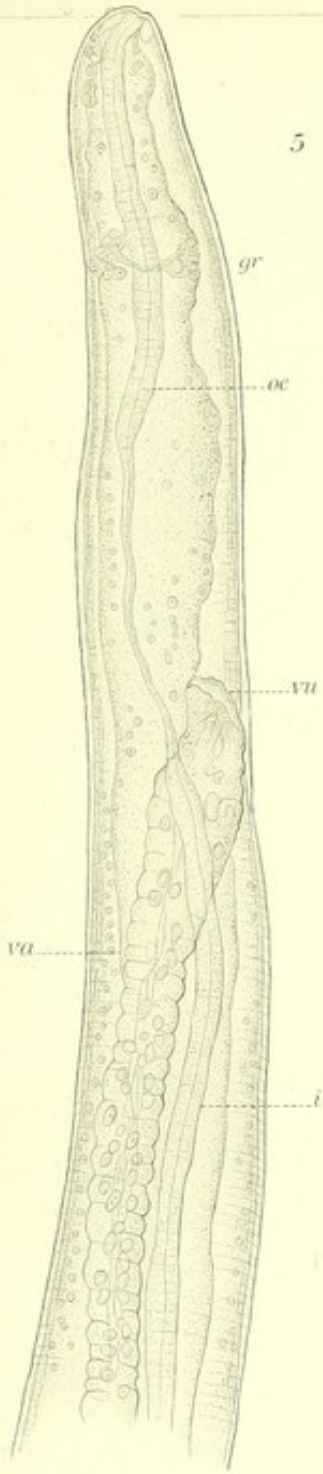

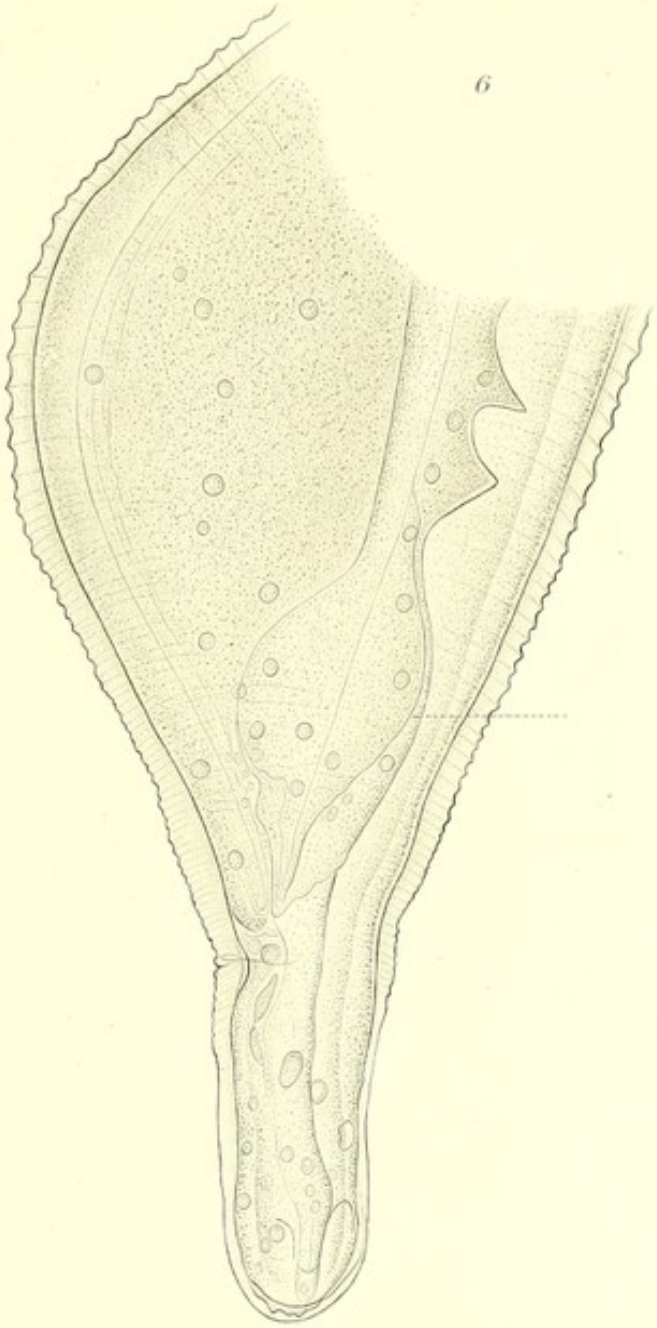

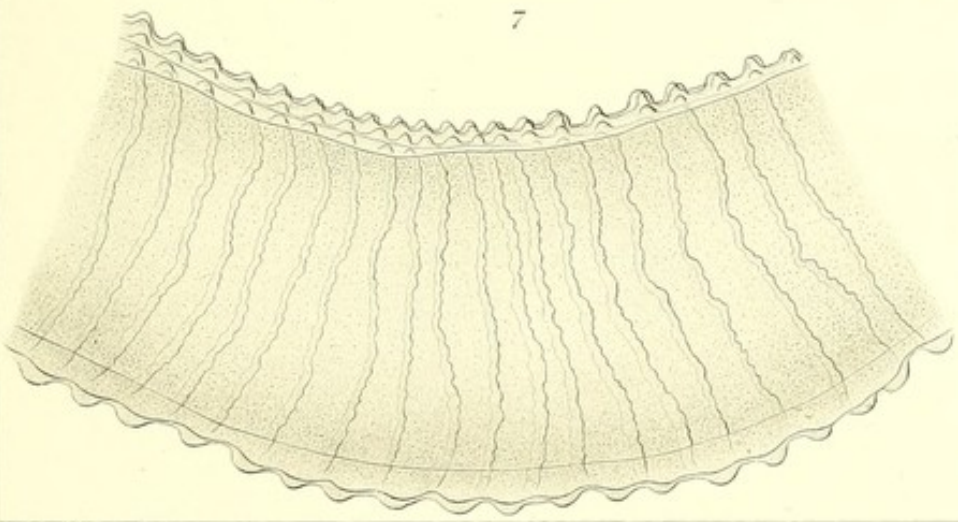

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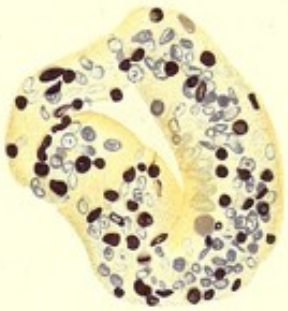

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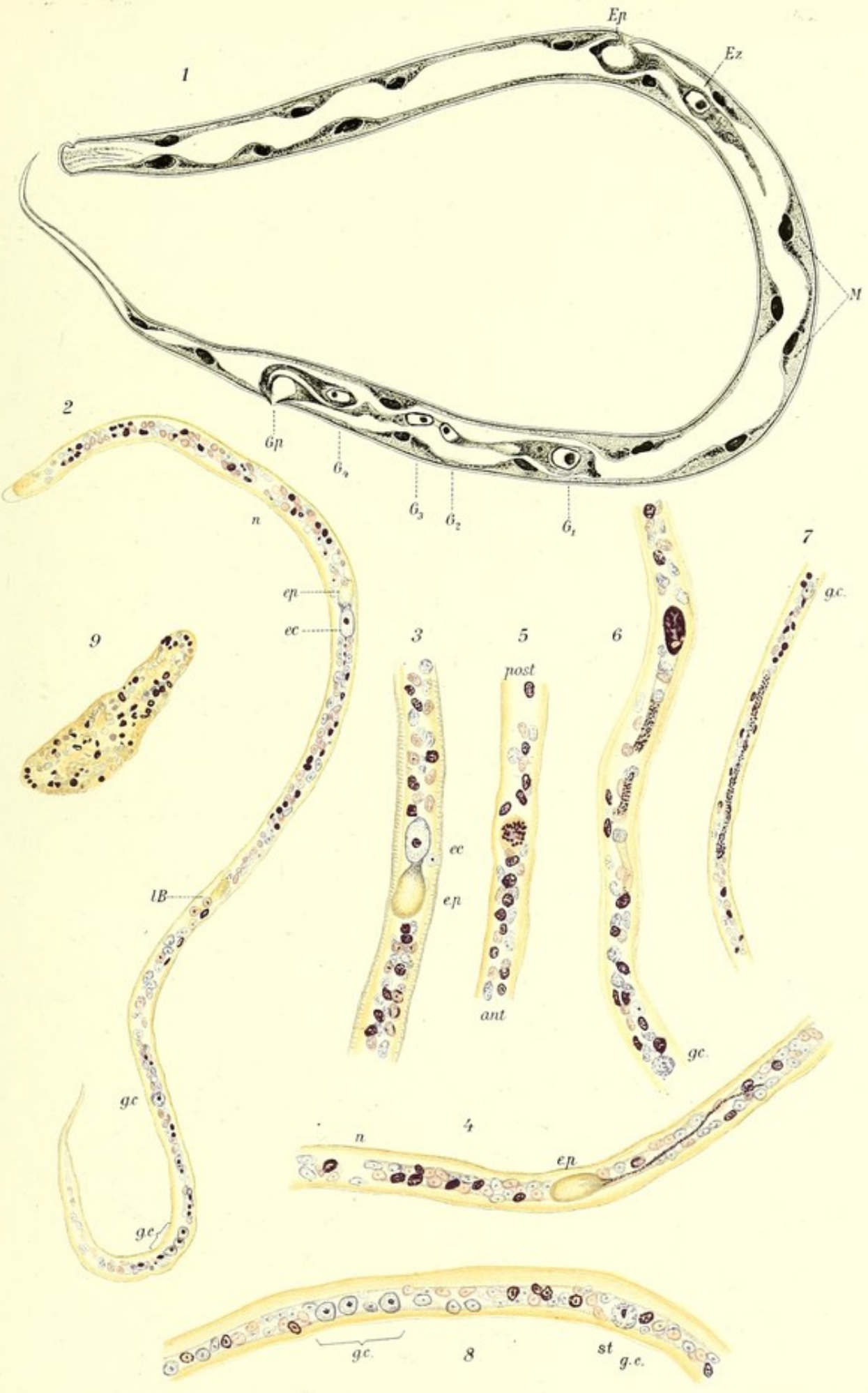

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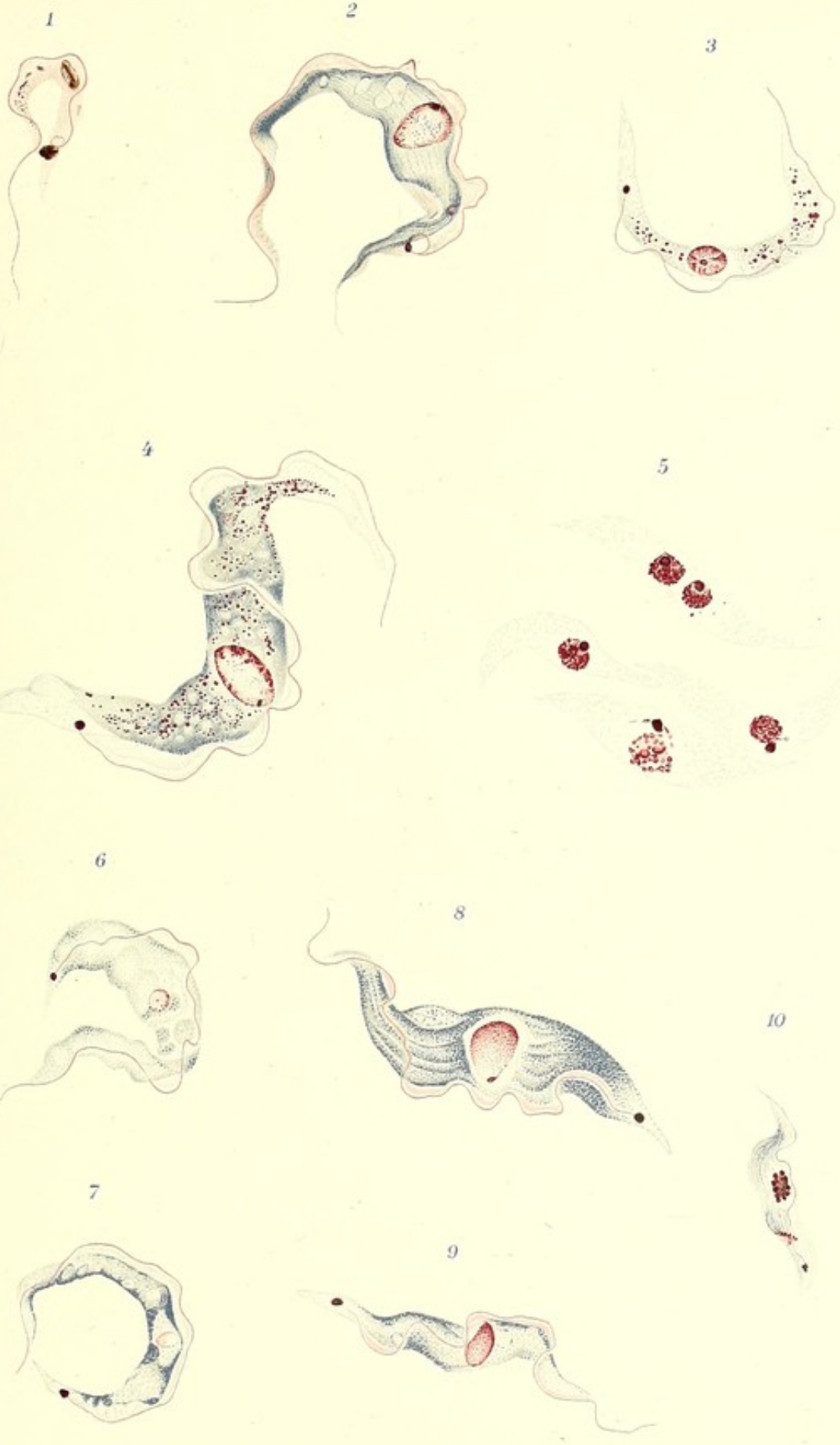

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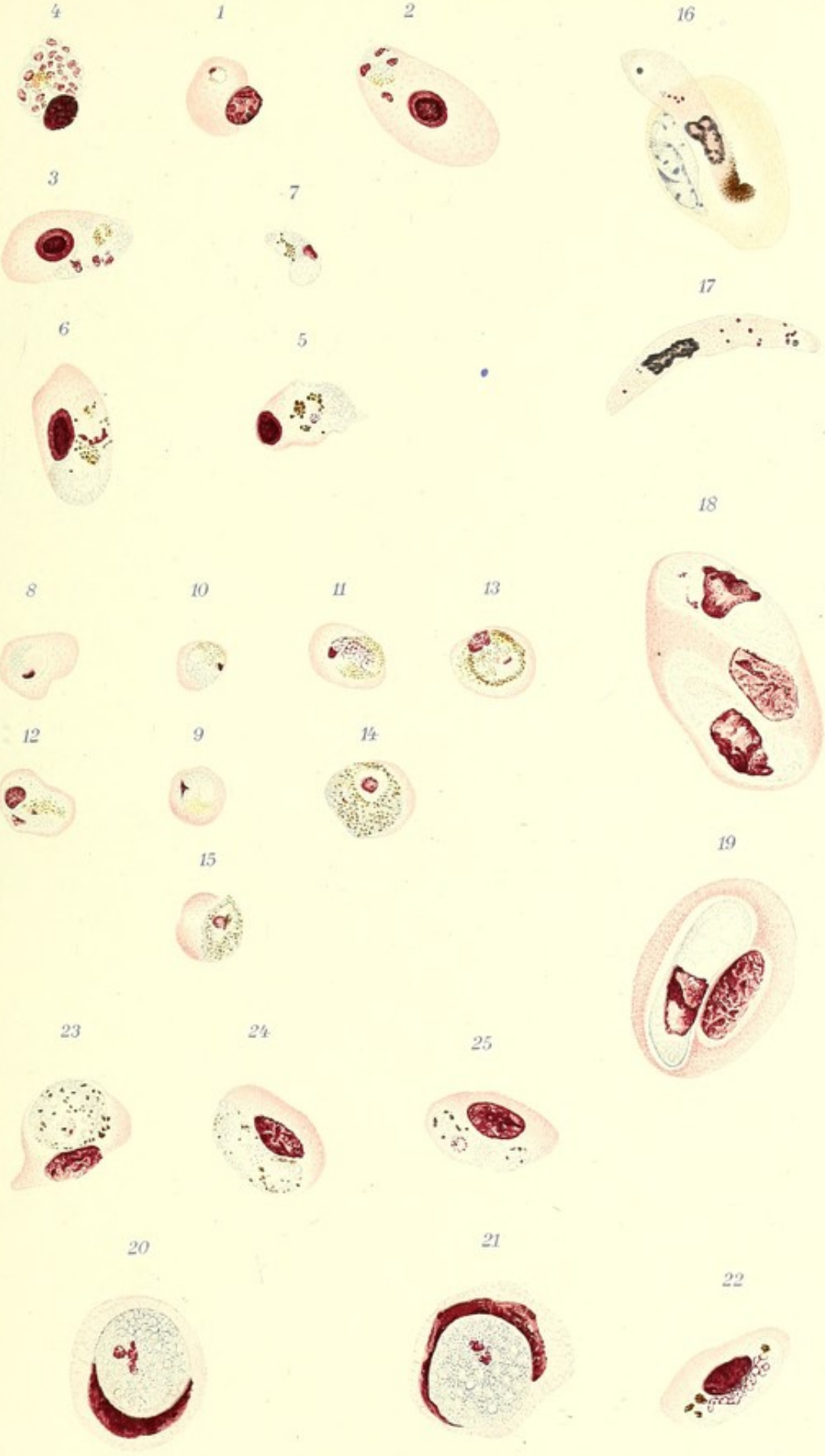

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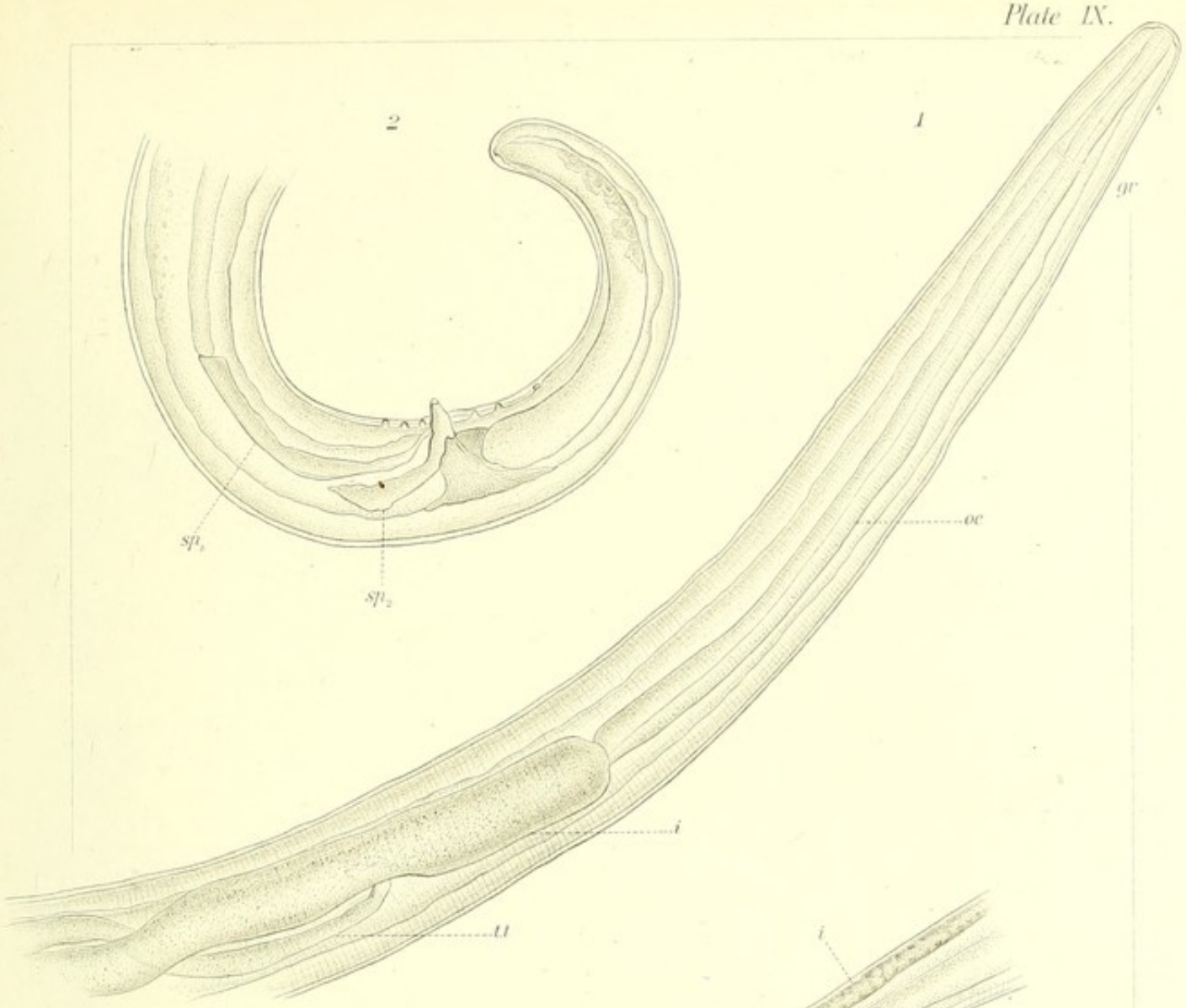

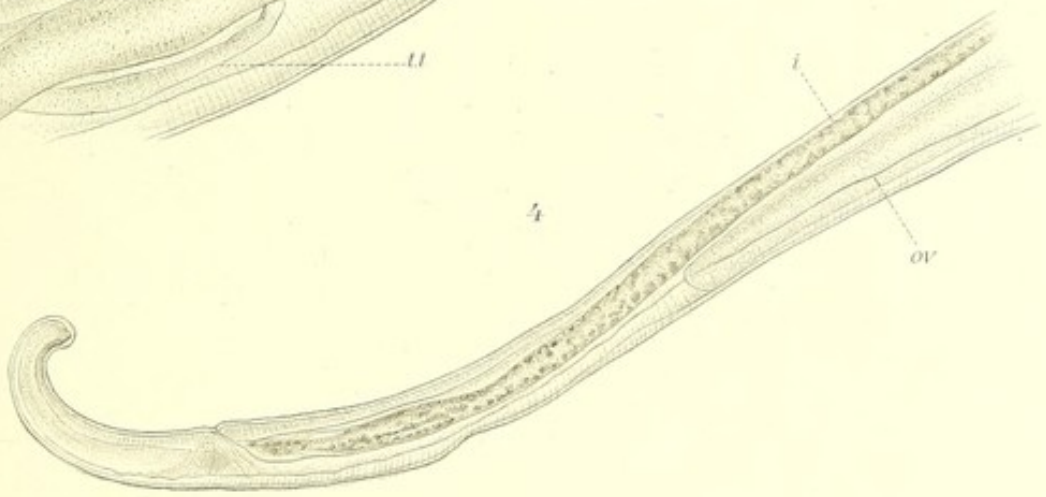

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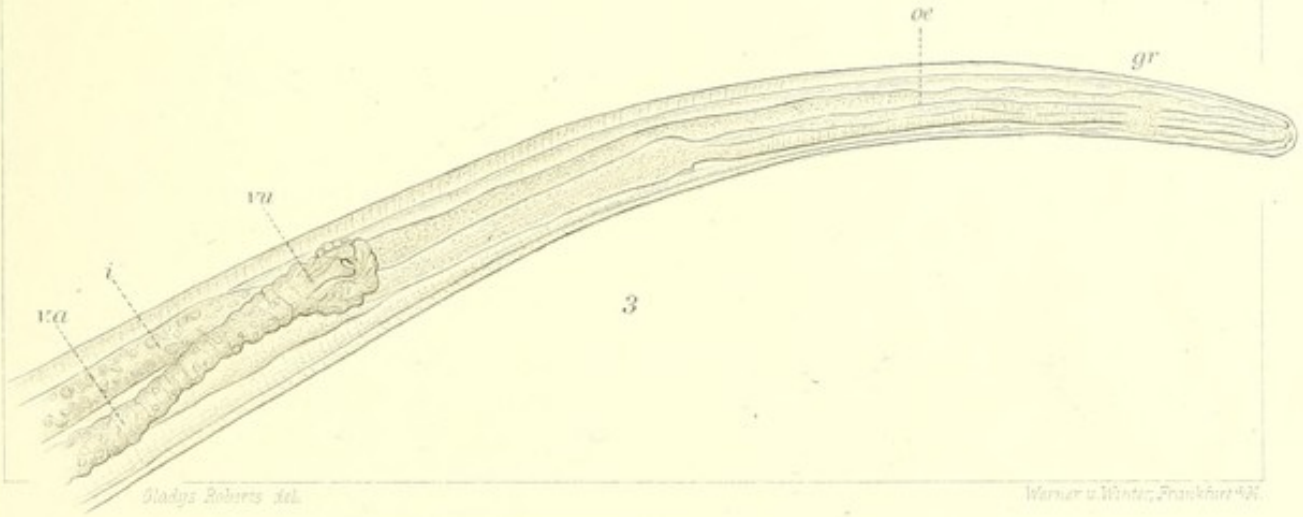

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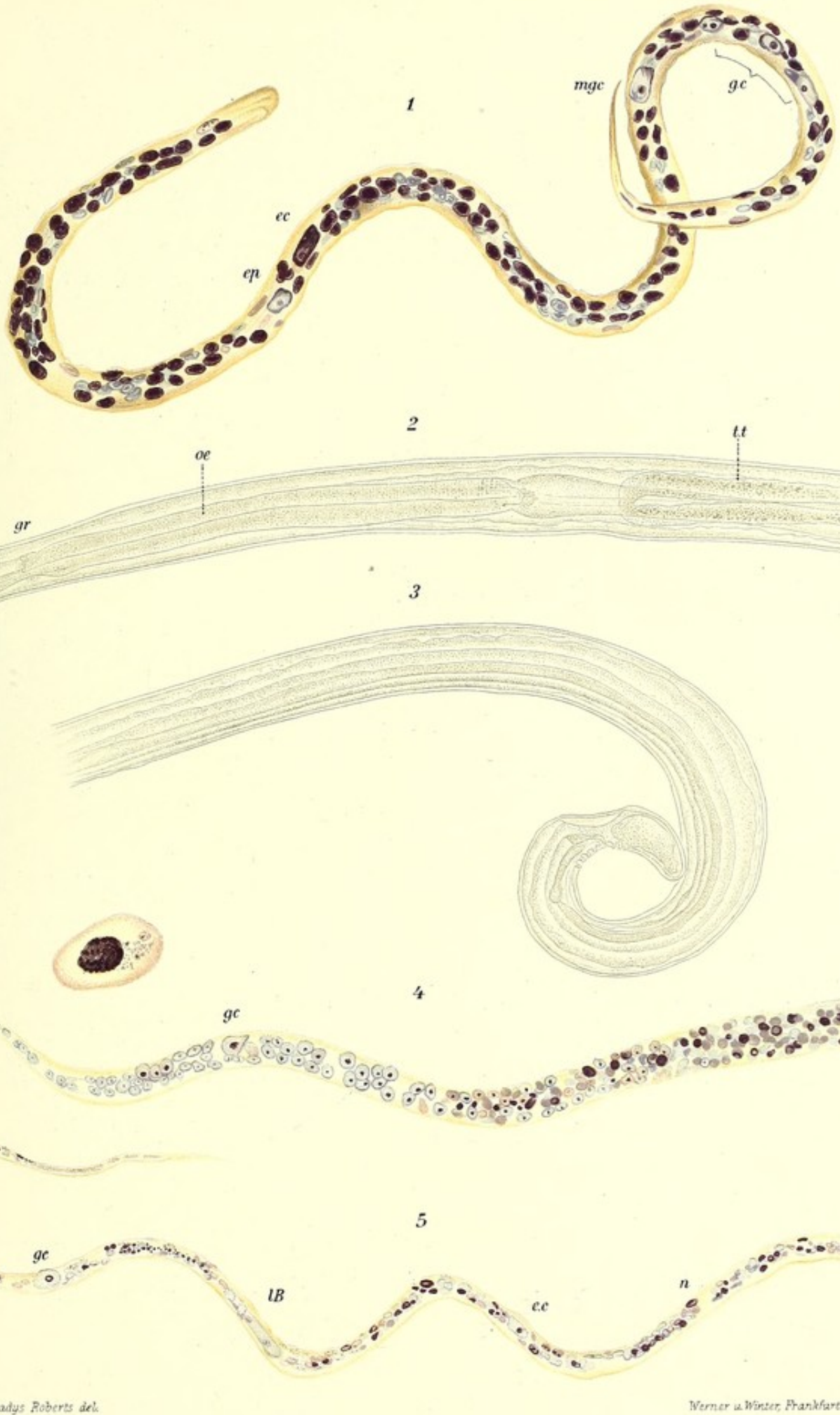

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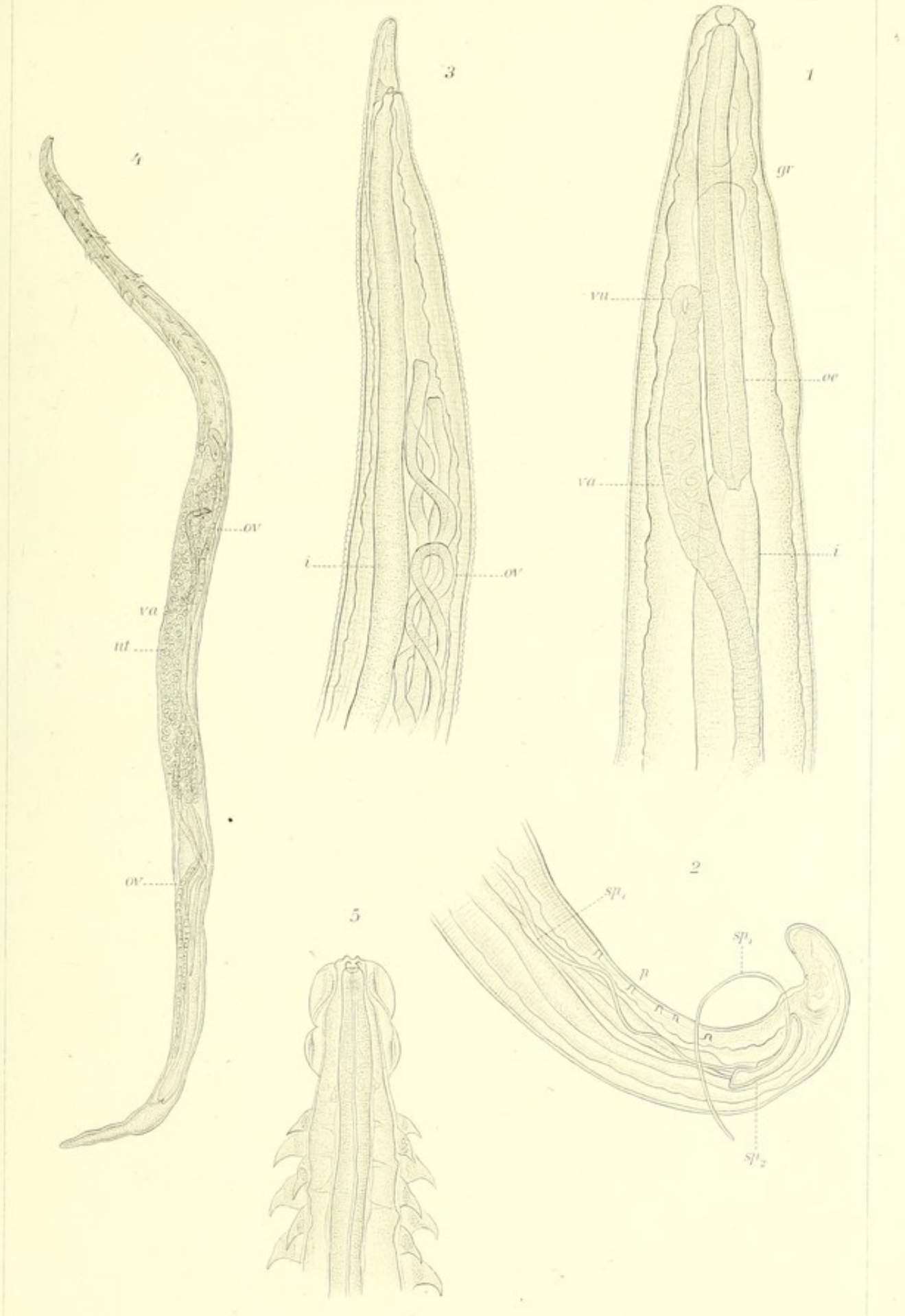
Werner u. Winter, Frankfurt a/M.



Giulio Roberts del.

Werner & Winter Frankfurt a/M.

REPORT OF THE ENTOMOLOGIST.

FRANK H. TAYLOR, F.E.S.

Plates xii-xiv.

Systematic work on the mosquitoes of tropical Australia has only been attempted up to the present, and this only with regard to mosquitoes from Queensand by Dr. T. L. Bancroft; his results being embodied in the annals of the Queensland Museum, Bulletin No. 8, 1908, and based on F. V. Theobald's detailed descriptions in his monograph of the Culicidae.

Our work comprises mosquitoes collected, for the most part, in the neighbourhood of Townsville, and will form part of a complete mosquitoe survey of Northern Australia.

A survey of Northern Australia is urgently needed since mosquitoes, as is well known, act as carriers of certain diseases and the presence or absence of certain species accounts for the existence or non-existence of these diseases, and affords a definite clue which diseases might, if once introduced, gain a firm foothold and are likely to spread far afield.

Our short experience of the prevalence of different species of mosquitoes in the limited area over which the observations extended, proved that there are cyclical and seasonal changes. During the summer months of 1911 *Culex fatigans* and *Stegomyia fasciata* were ubiquitous, in the summer of 1912 *Culicelsa vigilax* was frequently met with in and around the town, while *Culex fatigans* was only occasionally seen.

Bancroft's work has already shown that, on the whole, the mosquitoes found, are peculiar to Australia; but species commonly found in other parts of the tropics, as *Culex fatigans, Stegomyia fasciata* and *Taeniorhynchus uniformis* are equally prevalent wherever looked for.

As may be expected, representatives of genera common in the East are met with in tropical Australia, as *Finlayia, Taeniorhynchus, Skusea,* and *Scutomyia.*

Two species, *Myzorhynchus bancrofti,* Giles, and *Toxorhynchites speciosa,* Skuse, have been re-described on account of the existent descriptions being based on imperfect specimens; four species, new to science, are described in detail and additional localities given for several species.

The microphotographs have been prepared by Dr. W. B. Nisbet, to whom we are greatly indebted.

Myzorhynchus bancrofti, Giles.

Handbook Gnats (2nd ed.), p. 511, 1902; Theobald, Mon. Culicid iii., p. 88, 1903; Bancroft, Ann. Queensland Mus., No. 8, p. 14, 1908.

Head black, clothed with brown upright forked and narrow curved scales; thorax black with fairly long pale golden hairs, golden brown towards the sides.

Abdomen clothed with golden brown hairs. Legs brown, the front femora with the basal half club-shaped.

♀. Head black, clothed with brown narrow curved and upright forked scales, a few upright forked ones in front with pale hairs overhanging the eyes from the centre; palpi brown densely clothed with black scales, scarcely as long as the proboscis, the latter black with the basal half densely black scaled; eyes deep blue black; antennae blackish brown, clothed with short white pile, basal lobe with a few flat pale scales at its apex, second segment about twice the length of the third, light brown at the base, densely clothed with brown scales, third short and pale at the apex. (Pl. xii., Fig. 1.)

Thorax dark brown to black, covered with rather long dense pale golden hairs, anterior margin with pale narrow curved scales in the centre with broad brown upright ones on the edges above the prothoracic lobes, the latter brown and prominent, clothed with pale golden hairs and broad upright brown scales on their inner edges; scutellum with the sides creamy yellow, with pale yellowish hair-like scales, centre black, nude, fringed with pale brown hairs; metanotum brown; pleurae mottled black and brown, with a few scattered white scales.

Abdomen black clothed with golden brown hairs; venter brown, black towards the apex, clothed with flat white scales and brown hairs, the apical half of the seventh segment tufted with dark scales.

Wings (Pl. xii., Fig. 2) with the veins clothed with black and creamy white lanceolate scales; costa deep black with a creamy white spot opposite the middle of the stems of the fork cells, and a slightly larger apical patch at the junction of the first long vein, the basal half of the latter mottled with creamy white scales, anterior branch of the second long vein with the apex creamy white, and a similar spot towards the base of the posterior branch, the apical end with a greyish white patch, the third long vein with a creamy white patch towards the apex, rest of vein mottled, anterior branch of fourth long vein with a patch of creamy scales, mottled towards the apex, posterior branch mottled, anterior branch of fifth vein with an apical and basal creamy spot, rest of vein densely mottled, sixth long vein usually with one prominent white apical area, with a short double row of black scales near its centre; fringe with pale areas where the veins join the costa except at the junction of the posterior branch of the second, third and sixth long veins. Halteres with ochraceous stem and black knob.

Legs: coxae and tronchanters brown with patches of white scales; fore, mid and hind femora pale beneath, brown scaled above, with the pale ground colour showing through, the fore femora with the basal half club-shaped; tibiae dark brown, with the apex dilated and with a white spot, a fairly dense line of white scales above; first tarsi black with creamy white apical banding, second tarsi brown with creamy apical banding, remaining tarsi brown; second tarsi of mid legs black with a white apical spot, third and fourth black, fifth brown; the second to fourth tarsi of hind legs black with creamy white apical banding, the fourth with basal banding also fifth tarsi; first tarsi of hind legs slightly longer than the tibiae.

Length.—5-6 mm excluding proboscis.

Habitat.—Caboolture to Enoggera, Lower Burdekin district, and Townsville, Badu Island, Torres Straits, widely distributed in the Northern Territory.

This species seems to be prevalent all through Northern Australia, and is a vicious biter, the irritation lasting a considerable time. It possesses the peculiar habit of continuing to suck up blood, even after being gorged, the blood passing out of the anus.

Postscript.—After a careful examination of a large series of specimens in conjunction with specimens of *M. barbirostris*, from the Philippine Islands, it has been found impossible to retain the above as a distinct species, and it must be sunk to varietal rank.

Toxorhynchites speciosa Skuse.

Megarhinus speciosus Skuse.

Skuse, *Proc. Linn. Soc. N.S.W.*, p. 1722, 1888; Theobald, *Mon. Culicid.*, 1, p. 228, 1901; iii., p. 124, 1903; v., p. 108, 1910; Bancroft, *Ann. Q. Mus.*, No. 8, p. 16, 1908.

Thorax black, clothed with iridescent flat spindle-shaped scales, lateral edges with yellowish scales (in some lights showing black and blue as well); pleurae densely clothed with creamy scales. Abdomen above clothed with deep azure blue scales, with golden lateral patches to most of the segments. Legs deep blue-black. (Pl. xii., Fig. 3.)

♂. Head black clothed with mixed yellowish and pale greenish blue flat scales, in some lights showing lilac patches, four stout brown bristles projecting over the eyes; a thin fringe of narrow black upright scales at the base; antennae with the basal joint black with white tomentum, second joint black with creamy white flat scales, about twice as long as one of the following joints, basal half of segments three to thirteen broadly banded white, segments two to twelve with a narrow apical band also; segments fourteen and fifteen very long and slender, each about four times the length of one of the preceding segments, last segment black and clothed with short fine pale hairs; palpi black clothed on outer edge with black flat scales, except the upper surface of the second segment, which is entirely clothed by creamy scales, under surface covered by mixed creamy and black ones, inner edge of segment three clothed with creamy scales forming into a patch in front of the middle, apex with a patch of bluish green scales, fourth segment with the inner edge clothed with yellow and black iridescent scales; terminal segment black scaled; proboscis black with a downward curve near the centre, the top, sides and outer surface of curve covered with bluish green scales; under surface of basal half clothed with black iridescent and deep blue scales, apical half clothed with black iridescent scales.

Thorax black clothed with black iridescent flat spindle-shaped scales; the fore, hind and lateral margins with blue green opalescent scales; the sides from the scutellum towards the centre with a black fringe of hairs; sides below the blue green scales densely clothed with flat creamy white scales; prothoracic lobes pro-

minent and clothed with pale bluish scales with yellowish reflections and a row of short black hairs on front edge; scutellum densely clothed with iridescent scales, the lateral edges with creamy reflections and moderately long brown hairs; metanotum brown; pleurae with a naked blue-black elongate horizontal stripe, below densely clothed with broad creamy scales and hairs.

Abdomen black clothed with deep azure blue scales with the lateral margins bright golden, except the apical half of the sixth and whole of the seventh segments; segments six to eight heavily tufted, sides of abdomen fringed with golden hairs; first segment densely clothed with bright golden scales with the centre clothed with broad greenish ones, anterior and posterior lateral border, the fourth of hairs, segments two and three with a narrow golden lateral border, the fourth without the lateral golden border, fifth with the lateral border forming an obtuse angle in the centre, the basal half of the sixth segment with a narrow golden lateral border, the apical half tufted with long golden and a few dark blue hairs, the seventh with a few golden scales at the basal end of the border, and heavily tufted with long dark blue hairs, eighth segment clothed with golden scales with a narrow central stripe of deep blue, densely tufted with long dark golden hairs; genitalia with the outer edges with golden scales, the inner edges with short golden and black hairs; venter black, first segment brownish, remainder clothed with broad golden scales, with a median longitudinal stripe of azure blue scales, on segment four the blue stripe is much broader than on the others; eighth segment clothed with green and azure blue scales, laterally bordered with broad flat golden scales, with an apical border of dark hairs, segments two to six apically fringed with short golden hairs; genitalia brown.

Legs: coxae and trochanters brownish clothed with scattered flat golden scales; fore femora deep blue above, beneath with the basal two-thirds golden, apical third deep blue, mid and hind femora deep blue above, golden beneath, fore and hind tibiae deep blue, mid tibiae deep blue with a patch of creamy scales extending from the centre towards the apex; first and second tarsi white scaled, except basal third of former, which is deep blue, remaining tarsi deep blue; first tarsi of mid-leg with a narrow basal blue band, then a broad white band, the rest blue; second tarsi white, third white with a narrow apical deep blue band, fourth and fifth blue black; hind tarsi blue black, except the second, which is white with narrow apical and basal blue black bands; fore and mid ungues unequal, the larger with a single tooth, hind ungues equal and simple.

Wings (Pl. xii., Fig.4) brownish with the costal, first, third and fifth long veins clothed with violet blue scales; the rest clothed with brown scales; first sub-marginal cell very short and narrow about half the length of the second posterior cell; supernumerary cross vein vertical about four and a half times its length nearer the apex of the wing than the mid cross vein, the latter short forming an obtuse angle with the posterior cross vein. Halteres, knob pale yellow, stalk creamy.

Length.—9 to 10.5 mm., excluding proboscis.

♀. Head clothed with iridescent flat scales with a border of pale blue ones around the eyes, with three stout black bristles projecting over the eyes from the

vertex; antennae black, basal lobes clothed with whitish scales on apical half, second segment clothed with short black hairs and white pile, remaining segments clothed with whitish pile; palpi three-jointed about one-fourth the length of the proboscis, clothed with black scales, scales on second and third segments iridescent, deep violet blue in some lights; proboscis curved downward in the middle, black scaled, in some lights bright blue; eyes black.

Thorax black clothed with black iridescent flat spindle-shaped scales; fore, hind and lateral margins with greenish yellow reflections below this edge of coloured scales, the sides are clothed with white flat scales, which form a broad patch behind the prothoracic lobes, the latter clothed with broad flat yellowish green scales, the lower edge with broad white ones, with a fringe of brownish black hairs on front edge; scutellum black clothed with iridescent flat scales; sides and apical edge with broad flat yellowish ones, apical margins of lobes clothed with numerous black hairs; metanotum brown; pleurae as in ♂.

Abdomen black, the first segment golden-yellow with the central portion greenish blue, with apical and basal fringe of golden hairs; second and third segments clothed with dark green scales, with a lateral border of golden scales; the remaining segments as in ♂.

Legs: femora deep blue above, golden yellow beneath with a small patch of blue scales at the apex, hind femora with a golden basal band; fore and hind tibiae deep blue, mid tibiae deep blue with a central patch of yellowish scales; first tarsi of fore leg white with a narrow basal blue band, second white, third fourth and fifth with creamy ground colour, and clothed with deep blue scales; mid tarsi; first with basal half white, apical half blue black, second and third white scaled, fourth with mixed blue black and white scales, fifth blue black; hind tarsi, first deep blue with a small patch of lemon-coloured scales near the base, second white scaled with a narrow deep blue basal band, remaining tarsi deep blue. Ungues equal and simple.

Wings with the veins clothed with deep blue scales mixed with brown ones on the subcostal, first, second, fourth and fifth long veins; supernumerary cross vein vertical and about four times its length nearer the apex of the wing than the mid cross vein, the latter forming an acute angle with the posterior cross vein (one specimen has the posterior cross vein nearly its own length nearer the apex of the wing than the mid cross vein). Halteres creamy.

Length.—12 mm., excluding the proboscis.

Habitat.—Brisbane, Queensland.

The above description is founded on perfect specimens bred from pupae kindly sent by Dr. Elkington, Public Health Commissioner of Queensland.

Culicelsa abdominalis, n.sp.

Thorax dark umber brown, clothed with narrow curved scales. Abdomen dark brown with blackish brown and ochraceous scales, apically banded with ochraceous scales. Legs dark brown.

♀. Head dark brown, with dark brown narrow curved scales and blackish upright forked ones; a row of dark brown bristles around the eye, a patch of flat white scales on the sides; antennae dark brown clothed with short white hairs, basal lobes blackish, base of second segment pale yellowish; proboscis covered with brownish black scales, a creamy yellow band on its middle third; palpi short, about one-fifth the length of the proboscis, first three segments clothed with dark scales, mottled with pale creamy ones, last segment creamy yellow scaled with a narrow dark brown band; eyes black and silvery; clypeus dark brown.

Thorax dark umber brown, clothed with dark brown narrow curved scales and three rows of black bristles extending from the front of the mesothorax to the scutellum, densely clothed with long black bristles from the root of the wings to the scutellum; scutellum dark brown clothed with dark brown narrow curved scales; border bristles long and dark brown, twelve on the mid lobe, lateral lobes with two rows, six in front and four behind; metanotum dark brown; pleurae brown with patches of creamy white scales and brown bristles, with a few pale ones at the base of the wings.

Abdomen dark brown, with a moderately dense lateral fringe on either side; first segment pale and clothed with ochraceous scales and yellowish brown hairs, remaining segments clothed with blackish brown scales mottled with ochraceous ones, with narrow ochraceous apical bands, posterior borders with a fringe of short yellowish hairs, apical band on seventh segment not as wide as segment; apical band on segments four to six expanded into a moderately broad lateral patch, last segment with basal banding as well; venter densely mottled with blackish brown and ochraceous scales.

Legs yellowish brown with brownish black scales; coxae and trochanters creamy yellow, coxae clothed with pale flat scales and a patch of brown ones on the front, the hind coxae with a row of brown bristles on the hind edge and a few at the apex in front; mid and hind femora pale beneath, femora and tibiae faintly mottled with pale scales; first, second and third tarsi with narrow creamy white basal and apical banding, the fourth with basal banding only, fifth covered with brown scales, pale at the base. Ungues equal and simple.

Wings (Pl. xii., Fig. 5) with the veins clothed with moderately long dark brown scales, with a few creamy ones towards the base of the first and fifth long veins; first sub-marginal cell slightly longer and narrower than the second posterior cell, the stem of the former not quite one-fourth the length of its cell, that of the latter half the length of its cell, their bases almost opposite each other; posterior cross vein slightly longer and about twice its own length distant from the mid cross vein; junction of sub-costal vein almost level with the base of the first sub-marginal cell. Fringe brown. Halteres with basal half of stalk creamy the remainder dark brown.

Length.—6.5 to 7 mm., excluding the proboscis.

Habitat.—Ayr, Townsville, N.Q.

A striking species on account of its abdominal markings, the ochraceous scales being very conspicuous.

Culicelsa consimilis, n.sp.

Thorax chocolate brown with yellowish and bronze-coloured narrow curved scales. Abdomen brown, with narrow white basal bands. Legs brown, the tarsi with basal and apical banding.

♀. Head dark brown, clothed with narrow curved pale scales, and dark brown upright forked ones, with flat creamy white ones at the sides; pale yellowish hairs overhanging the eyes from the centre, and with a fringe of brown ones behind the eyes, the latter black and silvery; proboscis deep brown with a creamy white, almost median band; palpi dark brownish black, the last two segments thinly mottled with white scales, the last segment clothed with dark brown hairs and the apex white scaled; antennae brown covered with short white pile, basal lobe dark yellowish brown, inner edge dark brown covered with small flat white scales, basal half of second segment pale yellowish brown; clypeus dark brown.

Thorax brown covered with yellowish and bronze-coloured narrow-curved scales, with four rows of dark brown bristles, and a dense lateral border of brown ones on each side, denser above the origin of the wings; prothoracic lobes fairly prominent, clothed with bronzy narrow curved scales and dark brown bristles; scutellum brown clothed with pale narrow curved scales, mid lobe with ten border bristles, lateral lobes with four; pleurae brown with pale hairs and patches of white flat scales.

Abdomen brown clothed with brown scales; first segment light brown clothed with two patches of brown scales in the middle, and with a fairly dense covering of yellowish hairs, second segment with a basal white patch of scales, and posterior border of pale yellowish hairs, segments three to eight with narrow white basal banding and with an apical fringe of pale yellowish hairs, seventh segment with an apical patch of white scales, with the ventral white scales extending to the lateral edges; venter brown densely clothed with white scales, the seventh segment with a brown apical band, segments five to eight clothed with short brown hairs.

Legs: coxae and trochanters pale clothed with white scales; femora dark brown above, white scaled beneath, with a small brown apical patch above, and a few pale creamy scales at the apex; fore tibiae dark brown scaled with a pale ground colour showing through, pale scaled beneath, mid and hind tibiae brown, the latter with the apex dilated, with basal and apical banding of creamy white scales forming a knee spot with the femoral band; tarsi brown, the first, second and third with basal and apical white banding, fourth with basal banding only, the fifth pale brown and unbanded.

Wings with the veins clothed with small median and moderately long linear scales; first sub-marginal cell longer and slightly narrower than the second posterior cell, their bases level, stem of the former not quite half the length of its cell, that of the latter half the length of its cell; posterior cross vein about two and a half times its length distant from the mid cross vein; cross veins pale. Halteres with the stem pale creamy, the knob light brown.

Length.—5 to just under 6 mm., excluding the proboscis.

♂. Head as in the ♀(Pl. xii., Fig. 6); palpi longer than the proboscis, black scaled, two creamy bands on the first joint, one towards the base, the other towards the apex, second and apical segments with creamy basal bands, last segment with the apical third creamy; hair tufts dark brown; proboscis black with a pale creamy narrow band towards the basal end of the apical third.

Abdomen slightly narrower than in the ♀ densely covered with brown hairs on the lateral edges; venter densely clothed with pale golden and brown hairs; claspers dark brown clothed with brown hairs on their outer edges.

Legs as in the ♀, but with the banding pale creamy white; fore and mid ungues unequal, the larger with a large tooth, the smaller with a small one, hind ungues equal and simple.

Wings (Pl. xii., Fig. 7) narrower, scales brown, except costa, which is black, shorter and less dense than in the ♀; fork cells with their bases almost level, stem of the first sub-marginal cell about half the length of the cell, stem of the second posterior cell nearly as long as its cell; posterior cross vein longer than the mid cross vein, and about one and a half times its own length distant from it; fringe pale brown.

Length.—4 to 4.5 mm., excluding the proboscis.

Habitat.—Ayr.

Resembling *C. abdominalis,* n.sp., but the abdominal markings of the latter render it quite distinct.

Culicelsa paludis, n.sp.

Thorax blackish brown covered with narrow curved golden brown scales; abdomen black scaled, with narrow white basal banding. Legs brown.

♀. Head brown clothed with white and brown narrow curved, and upright brown forked scales, with flat white ones on the sides, a thin fringe of brown hairs behind the eyes, the latter silvery and violet black; palpi black scaled, with the apex pale; clypeus brownish black; antennae black covered with silvery pile, basal lobe pale yellowish brown on the outer edge, darker on the inner edge, covered with small flat white scales, second joint pale at the base; proboscis black sealed, with a narrow creamy white band slightly above the centre.

Thorax blackish brown covered with dark golden brown narrow curved scales, with a few pale white ones on the posterior end of the mesonotum, a lateral border of dark brown bristles moderately dense above the origin of the wings; prothoracic lobes dark brown, prominent, clothed with brown bristles and narrow curved scales; scutellum dark brown clothed with pale narrow curved scales, border bristles dark brown, eight on the mid lobe and five on the lateral lobes with a few pale golden hairs behind them; pleurae mottled light and dark brown, with a few patches of white flat scales and pale yellow hairs.

Abdomen brown clothed with black scales segments with narrow white basal banding, first segment brown clothed with brown hairs and two median patches of dark brown scales, the basal band on the seventh produced into a small lateral patch; venter with the first four segments black scaled with narrow white basal bands, the rest densely clothed with white scales.

Legs: coxae and trochanters yellowish brown, with a few pale scales on the coxae; femora pale scaled beneath, with the apex brown scaled, above dark brown scaled, apex creamy, tibiae black above, mottled with white scales beneath with creamy white basal and apical banding forming a creamy knee spot with the femoral speck; first tarsi brownish black, with basal and apical banding, second to fourth of the fore and mid legs brownish black, with creamy basal banding, fifth brown, unbanded; second and third of hind legs dark brown, with white basal banding, fourth and fifth dark brown, unbanded; ungues equal and simple; those of the hind legs rather short.

Length.—5 to 6 mm., excluding the proboscis.

Habitat.—Townsville, in mangrove swamps.

This species is somewhat similar to *Culicelsa vigilax* Skuse, but can be easily separated from it by its banded proboscis, leg banding and the fore and mid ungues.

Pseudohowardina linealis, n.sp.

Head clothed with brown and yellowish flat lateral scales, the centre with golden narrow curved ones. Thorax black with bronzy black narrow curved ones. Abdomen with basal patches of creamy yellow scales. Legs dark brown.

♀. Head black clothed with a median patch of golden narrow curved and upright golden and brown forked scales, the sides with brown and golden patches of flat scales and upright forked brown ones, a few golden hairs overhanging the eyes from the centre, and a thin row of brown ones behind the eyes, the latter black and silvery; palpi black scaled; proboscis with the base and apex darker; clypeus dark brown; antennae dark brown, clothed with white pile, basal lobe and basal half of second segment light brown.

Thorax black clothed with bronzy black narrow curved scales on the posterior half of the mesothorax, lateral and anterior borders with a dense and moderately broad stripe of golden narrow curved scales; prothoracic lobes brownish black, fairly prominent and clothed with brown bristles; a patch of golden bristles at the base of the wings, and a lateral row of dark brown ones below the golden border of narrow curved scales; scutellum brownish black, the mid lobe clothed with golden yellow narrow curved scales and border bristles, the latter eight in number; lateral lobes with brown narrow curved scales, border bristles brown, in a double row, four in front and three behind; metanotum blackish brown; pleurae dark brown with patches of pale scales and a few dark hairs.

Abdomen black, first segment mottled with brown and creamy yellow scales, and covered with pale yellowish hairs; segments two to eight clothed with brown opalescent scales and with basal patches of creamy yellow ones to each of the segments; posterior borders fringed with pale yellow hairs, last segment clothed with brown opalescent scales; venter dark scaled.

Legs: coxae and trochanters pale, femora pale beneath, dark brown above; tibiae blackish brown, hind tibiae slightly longer than first tarsi; tarsi brown; ungues of fore and mid legs equal and uniseriated, hind ones equal and simple and somewhat straighter than the fore and mid ones.

Wings clothed with brown scales, the median ones small, the lateral ones linear; first sub-marginal cell longer and slightly narrower than the second posterior cell, the base of the latter nearer the base of the wing than that of the first sub-marginal cell, stem of the latter scarcely half the length of its cell; that of the second posterior cell almost as long as its cell; posterior cross vein about the length of the mid cross vein, and about twice its length from it; costa black scaled; fringe light brown; halteres with stem pale, knob black.

Length.—5 to 5.5 mm., excluding the proboscis.

Habitat.—Ching Do and Townsville, N.Q.

This species is easily separated from its congeners by its bright golden head and thoracic marking.

Nyssorhynchus annulipes Walker.

Ins. Saund., i., p. 433, 1850; Theobald, *Mon. Culicid*, i., p. 164, 1901; iii., p. 104, 1903; iv., p. 97, 1907; Skuse, *Proc. Linn. Soc. N.S.W.*, p. 1754, xiii., 1888.

This mosquito is found in small numbers in the coastal districts of North Queensland. (Pl. xiii., Fig. 8.)

Additional Localities.—Proserpine, Merinda, Lower Burdekin, Cairns, Townsville and Badu Island, Torres Straits.

Mucidus alternans Westwood.

An. Soc. Ent. Fr., iv., p. 681, 1835; Skuse, *Proc. Linn. Soc. N.S.W.*, xiii., p. 1726, 1888; Theobald, *Mon. Culicid*, i., p. 269, 1901; iii., p. 134, 1903; iv., p. 162, 1907. (Pl. xiii., Figs. 9, 10.)

Additional Localities.—Mackay, Ayr, and Townsville..

Time of Capture.—February and March.

Stegomyia fasciata Fabr.

Syst. Antl., 36, 13, 1805; Theobald, *Mon. Culicid*, i., p. 289, 1901; iii., p. 141, 1903; iv., p. 176, 1907; v., p. 158, 1910; *Rec. Ind. Mus.*, ii., pt. iii., No. 30, p. 291, 1908.

This mosquito occurs throughout the whole year all along the Queensland coast.

Pseudoskusea similis Theob.

Mon. Culicid, v., p. 188, 1910.

Specimens from Badu Island, Torres Straits, and Lucinda Point, agree well with Theobald's description, the main differences being that none of them show the dull golden thoracic scales.

Culicelsa vigilax Skuse.

Proc. Linn. Soc. N.S.W., xiii., p. 1731, 1888; Theobald, *Mon. Culicid*, i., p. 396, 1901; iii. p. 178, 1903; iv., p. 382, 1907; v., p. 317, 1910.

Additional Localities.—Proserpine, Mackay, Townsville, and Badu Island. (Pl. xiii., Fig. 11.)

Culicelsa annulirostris Skuse.

Proc. Linn. Soc. N.S.W., xiii., p. 1737, 1888; Theobald, *Mon. Culicid,* i., p. 365, 1901; iii., p. 162, 1903; iv., p. 382, 1907.

Specimens from Townsville agree with Theobald's description in all details but the thoracic scales, which are narrow curved instead of flat spindle-shaped. The base of the first sub-marginal cell is also slightly nearer the base of the wing.

Additional Localities.—Lower Burdekin, Townsville.

Time of Capture.—Lower Burdekin (October), Townsville (May).

Culex fatigans Wiedemann.

Aus. Zweiflug. Ins., p. 10, 1828; Theobald, *Mon. Culicid,* ii., p. 151, 1901; iii., p. 225, 1903; v., p. 383, 1910.

This mosquito, like *Stegomyia fasciata* Fabr., is a very ubiquitous species, and is the common house mosquitoe.

Culex tigripes Grandpre and Charmoy.

Les. Moust. (*Planters Gaz. Press*) 1900; Theobald, *Mon. Culicid,* ii., p. 34, 1901; iii., p. 227, 1903; D'Emmerey de Charmoy, *Ann. Trop. Med. and Par.* ii., No. 3, p. 262, 1908.

Additional Localities.—Ayr and Townsville.

Time of Capture.—May in Townsville.

Chrysoconops acer Walker.

List. Brit. Mus. Dipt., p. 7, 1848; Theobald, *Mon. Culicid,* ii., p. 211, 1901.

This species enjoys a wide range of distribution, being found in Darwin, throughout Queensland and has been recorded from New Zealand.

Additional Locality.—Townsville.

Time of Capture.—May.

Taeniorhynchus uniformis Theob.

Mon. Culicid, i., p. 180, 1901; ii., p. 87; *Rec. Ind. Mus.,* ii., pt. iii., No. 30, p. 300, 1908.

The specimens in our collection show slight variation from the type, and also from Giles' description of *Panoplites australiensis,* but without doubt belong to this species.

It enjoys a very wide distribution being found from Africa, throughout India, to the Philippine Islands, New Guinea, across to Port Darwin, and extending through Queensland to Newcastle, N.S.W. (Dr. R. Dick).

Aedeomyia venustipes Skuse.

Proc. Linn. Soc. N.S.W., xiii., p. 1761, 1888; Theobald,*Mon. Culicid,* ii., pp. 218, 223, 1901.

The squamose characters of this mosquito agree with Theobald's description of the genus *Aedeomyia,* and also with Skuse's description of the species. (Pl. xiii., Fig. 12-13.)

It has been originally described by Skuse from a single female from Elizabeth Bay, Sydney, and was met with again last year in the Northern Territory.

Additional Locality.—Townsville.

Time of Capture.—May.

TABANIDAE.

The family of Tabanidae is an important group of flies economically. Very little is known about their occurrence and distribution in tropical Australia. Throughout the world nearly 2,000 species have been described, the typical genus *Tabanus* claiming about half of them. Up to now about 100 distinct species have been described from Australia and Tasmania, mostly collected in the southern parts of Australia.

These blood-sucking flies are commonly called "March Flies" in Australia, and are common in some localities throughout the summer, sometimes appearing in countless numbers, and becoming a severe pest on account of the savage way they attack man and beast in the bush.

Numerous species of Tabanids are represented in Northern Australia; no less than eight different species of Tabanus have been collected in the vicinity of Darwin by Dr. C. L. Strangman.

Some species have a wide distribution; f.e., *Tabanus gregarius* Er., originally described from Tasmania, is found at Brisbane and Darwin. *T. nigritarsis,* n.sp., was found in the Lower Burdekin district and Darwin. *T. abstersus* Walk. occurs in the southern parts of New South Wales and in the Cairns hinterland.

When systematically collected, especially in the north, it is probable that a large number of new and interesting forms will be found, closely related to species from the Oriental region.

One species from Cairns has already been found, *T. pseudoardens,* closely related to the Javanese *T. ardens* Wied.

We are greatly indebted to Mr. W. W. Froggatt, Government Entomologist, New South Wales, who has assisted us with his valuable advice, and has presented named specimens for comparison.

Tabanus abstersus Walker.

Insecta Saund., Dipt., i., p. 58, 1856; Schiner, *Novara Reise,* Dipt., 85, 14, 1868.

♀. Length just under 15 to 17 mm.; width of head just over 5 to 5.5 mm.; width of front at vertex under .5 to .5 mm.; length of wing 14 to 15 mm. (Pl. xiv., Fig. 14.)

A black robust species; dorsum of abdomen with a median line of white spots; venter brown, with white apical bands; legs deep black.

Head.—Front black sparsely clothed with short erect black hairs; face and jowls covered with white bloom, jowls sparsely clothed with short erect black hairs; base of head clothed with moderately long white hairs. Eyes (dried specimens) dull bronzy black, the inner margins sloping inwards towards the vertex;

sub-callus black covered with grey bloom. Frontal callus glossy black, tapering to a fine point, about two-thirds the length, and its base almost as broad as the front; palpi white, ground colour black, clothed with mixed black and white hair on the upper margin and outer edge, except the base which is clothed with fairly long white hairs. Antennae black, first and second segments clothed with moderately long black hairs, the upper edge of the second segment produced into a sharp moderately long point; terminal segment with expanded portion moderately broad, and the angle on its upper margin prominent.

Thorax.—Black clothed with black appressed hairs, with a few mixed golden and white hairs at the base of the wings, a few golden ones at the base of the thorax; humeral calli with a long black fringe; pleurae slaty grey clothed with long white hairs, denser at the base of wings; scutellum, with similar ground colour to rest of thorax, clothed with black appressed hairs, with lateral border of bright golden hairs.

Abdomen.—Black, except the first segment which is greyish clothed, with black appressed hairs; first segment with a patch of bright creamy hairs in the centre of the apical edge with a patch of white ones on either side towards the base, and with a broad lateral grey spot; segments two to six with a median apical white spot clothed with white hairs; segments two to four with broad lateral white spots. Venter brown clothed with black appressed hairs; all the segments, except the first, with white apical bands; segments two to five have the bands clothed with white appressed hairs; bands on sixth and seventh are clothed with black appressed hairs.

Wings.—Veins dark brown, with the cells mostly clouded brown along the veins. Stigma dark brown, elongate; squamae oblong, light brown, with dark brown edges.

Halteres.—Knob dark brown, base and stem above brown.

Legs.—Coxae and femora blackish clothed with mixed white and black hairs; tibiae and tarsi black (in one specimen the tarsi are dark brown) clothed with black hairs.

This is a very distinct species; it does not entirely fit into Walker's description, but, for the present, it is left under his name.

The following is Walker's description:—

"Nigro-cinereus, thoracis lateribus, pectore abdominisque segmentorum marginibus posticis ferrugineis, antennis ferrugineis apice piceis, pedibus ferrugineis, tibiis anticis apice tarsisque piceis, tarsis anticis nigris, alis cinereis.

"Body black, head adorned wth a hoary covering, which is interrupted by a black, shining, club-shaped mark on the crown; under side clothed with white hars; eyes bronzed, facets as usual; sucker black, lancets and palpi pale ferruginous, a hoary tinge on the palpi; feelers dark ferruginous, seated on a ferruginous tubercle, third joint forming above an extremely obtuse and shallow angle, whose fore side is slightly concave; its hind side slightly convex; compound joint pitchy, very slightly curved upwards, much longer than the third joint; chest tinged with grey, sides and breast pale ferrunginous, thinly coated with hoary hairs; abdomen

slightly obconical, much longer than the chest, thinly coated with short hoary and black hairs; hind borders of the segments pale ferruginous; legs ferruginous; hips and thigh tinged with grey; feet and tips of the fore shanks pitchy; claws of the fore feet black; foot cushions tawny; wings grey; wing ribs ferruginous, veins black; ferruginous towards the base, angle of the top cross vein slightly obtuse, very distinct, its stump as long as its shorter side, scales grey; poisers tawny with pitchy tips. Length of the body five lines; of the wings ten lines. New South Wales."

Habitat.—S. Queensland (H. Tryon), Kuranda (F. P. Dodd), and Mourilyan Harbour.

Tabanus fuscipes, n.sp.

Length, ♂ 13 mm. (1 specimen); ♀, 14 to 15 mm. (5 specimens); width of head, ♂ just under 5 mm.; ♀, 5 to 5.5 mm.; width of front of ♀ at vertex .5 to just under 1 mm.; length of wing, ♂, 12 mm.; ♀, 13 to 14 mm. (Pl. xiv., Fig. 15.)

Dorsum of thorax, with ground colour blackish brown, and covered with yellowish bloom; dorsum of abdomen yellow changing to yellowish brown towards the apex. Legs clove brown.

Head.—Frontal triangle in ♂ pale yellow; front of ♀ golden yellow, sparsely clothed with appressed black hairs; face and jowls in both sexes pale yellow, ground colour blackish with the base of the head greyish clothed with creamy white hairs, jowls sparsely clothed with erect black hairs; sub-callus ground colour blackish, covered with yellow bloom. Eyes (dried specimen) black, with a coppery tint in some lights. Frontal callus dark reddish brown, gradually tapering to a point, its base about two-thirds of the width of the front and about half its length. Palpi cream coloured in both sexes, in the ♂ clothed with fairly long creamy white erect hairs, terminal segment cylindrical, in the ♀ basal half of terminal segment swollen, and ending in a sharp point, the upper and outer edges clothed with black appressed hairs, its base clothed with mixed creamy and black ones. Antennae golden yellow, first segment clothed with creamy hairs, with black ones on dorsal edge, the second segment with the sides clothed with mixed creamy and black hairs and with its upper edge produced into a point projecting over the base of the terminal segment, expanded portion of the latter moderately broad, with the angle on the upper margin fairly prominent, terminal annuli same colour as the rest of the antennae with a few scattered black hairs.

Thorax.—Dorsum of thorax with black ground colour clothed with golden yellow bloom, and mixed appressed black and creamy hairs; humeral calli clothed with mixed creamy and black hairs; pleurae creamy white clothed with fairly long creamy hairs; scutellum similar in colour to rest of thorax, clothed with creamy and black appressed hairs.

Abdomen.—Segments one to four of dorsum clove brown, remainder brown clothed with black appressed hairs, the basal edge of segment one in ♂ partly black; in some specimens there is a creamy apical band to the segments, lateral edges yellowish with creamy hairs in both sexes; first segment with a median patch of creamy hairs; two specimens have median triangular creamy patches on seg-

ments two to six; ♂ genitalia clove brown clothed with black appressed hairs, the apex with golden hairs; venter in the ♂ with the first three segments yellowish brown, the remainder clove brown, genitalia shining yellowish brown, sparsely clothed, with black appressed hairs, the apical edges with creamy ones, inner margin of basal lobes of genitalia clothed with fairly long mixed creamy and black hairs, outer margins with moderately long black ones; segments two to five with creamy apical bands.

Wings.—Dusky brown, veins dark brown, base of anterior branch of third longitudinal vein without an appendix. Stigma yellowish brown, elongate, inconspicuous. Squamae light brown. Halteres with the knob cream, the base and stalk light brown.

Legs.—Coxae cream coloured, clothed with white hairs; femora and tibiae clove brown, former clothed with mixed cream and black hairs, the latter with black ones; fore tarsi black covered with black hairs; mid and hind tarsi dark brown, with apex of each segment black, clothed with black hairs.

Habitat.—Magnetic Island, off Townsville.

Close to *T. nigritarsis*, n.sp., but its dusky brown wings, yellowish abdomen, and its slighter build will easily separate it.

Tabanus gregarius Erich.

Archiv. f. Naturgesch., 1, 271, 1842; Walker, *List. Dipt. Brit. Mus.*, v., 252, 436, 1854.

♀. Length 13.5 to 15 mm.; width of head, 4.75 to 5.5 mm.; width of front at vertex .5 to just under 1 mm.; length of wing, 12 to 13 mm. (Pl. xiv., Fig. 16.)

Somewhat stout elongate species; dorsum of thorax black, with two longitudinal grey stripes; dorsum (anterior portion) of abdomen yellowish brown, last three segments black; venter yellowish with last three segments dusky; in one specimen all but the first two segments are dusky.

Head.—Front creamy white with black ground colour, clothed with cream and black appressed hairs; face and jowls creamy clothed with white hairs, denser towards base of head, sub-callus creamy yellow. Eyes (dried specimen) black, inner margins parallel. Frontal callus shining black, basal third broad and about half the width of front, apical two-thirds drawn out into a fine line. Palpi yellowish, proximal segment clothed with long white hairs, terminal segment clothed with mixed black and white appressed hairs on outer edges. Antennae first segment yellowish, covered with cream-coloured tomentum, clothed with fairly long whitish hairs on the lower half of outer edge, upper half of upper, outer and inner edges clothed with short black appressed hairs, the upper apical edge produced into a blunt black point; second segment yellowish with an apical fringe of black hairs, terminal segment reddish brown, covered with pale tomentum, terminal annuli brown, expanded portion moderately broad with the angle on its upper margin prominent.

Thorax.—Ground colour of dorsum black, covered with greyish white tomentum, and clothed with erect black hairs with a median longitudinal brown stripe

from the centre to the apex; humeral calli light brown, clothed with moderately long black hairs; pleurae slaty grey clothed with fairly long white hairs, creamy at the roots of the wings; scutellum with similar ground colour to thorax, the sides greyish white.

Abdomen.—Dorsum clothed with mixed black and pale appressed hairs on the first three segments, clothed with black appressed ones on the rest, first three segments brown, with a median black stripe, basal half of first segment greyish, third to fifth segments with a median creamy longitudinal stripe, segments four to the end black, segments three to six with apical creamy bands expanded to form a lateral patch, apical segment with a creamy lateral patch; venter, first segment grey, apical segment black, clothed with erect black hairs; remaining segments yellow clothed with appressed pale hairs, sixth segment with black appressed hairs mixed with pale ones.

Wings.—With the bases of cubital to discoidal cell and the whole of the anal cell light brown; rest of wing hyaline, veins dark brown. Stigma yellowish brown, elongate, conspicuous; squamae light brown; halteres, knob creamy yellow, base and stalk light brown.

Legs.—Coxae and femora slaty grey, apex of femora brownish, clothed with white hairs, basal half of fore, mid and hind tibiae yellow; apical half of fore tibiae dark brown, clothed with creamy white hairs; fore, mid and hind tarsi blackish brown, clothed with black hairs.

Habitat.—Bowen, Queensland,

This species was originally described by Erickson from Tasmania. It is very distinct.

Tabanus brevidentatus Macquart.

Dipt. Exotic Suppl., v. 28, 1855.

♀. Length 8 to 8.5 mm.; width of head just over 3 to 3.5 mm.; width of front at vertex .5 to just over .5 mm.; length of wing, 8.5 to 9 mm.

Somewhat small and dingy species; dorsum of thorax black; dorsum of abdomen black segments apically banded brown; legs brown.

Head.—Front blackish brown, covered with golden bloom and clothed with appressed black hairs; face and jowls golden with black ground colour, lower half of face yellowish brown ground colour, base of head densely covered with erect creamy white hairs; sub-callus golden with reddish brown ground colour. Eyes (dried specimen) black; inner margins almost parallel, gently sloping towards the vertex. Frontal callus shining deep reddish brown, about half the length and two-thirds the width of front. Palpi golden yellow, proximal segment clothed with erect white hairs, terminal segment with the base and under surface clothed with erect creamy white hairs, outer edge clothed with short black appressed hairs, anterior end swollen and tapering to a fine point; first and second segments of antennae golden, clothed with appressed black hairs, terminal segment bright reddish brown, terminal annuli slightly darker, clothed with golden pubescence, expanded portion moderately broad, no angle formed on its upper margin.

Thorax.—Dorsum black, sparsely clothed with appressed black hairs; humeral calli clove brown, clothed with erect black and creamy hairs. Pleurae blackish brown, clothed with creamy white hairs; scutellum black clothed with black appressed hairs and creamy ones on the edges.

Abdomen.—Dorsum black with apical and lateral brown banding to the segments clothed with black and white appressed hairs; venter black, covered with creamy yellow bloom, and clothed with black appressed hairs; segments four to the end each with a lateral yellowish apical spot.

Wings.—Tinted with yellowish brown, costal, sub-costal and radial cells yellowish brown; veins on the basal half of the wing light brown, dark brown on apical half. Stigma yellowish brown, elongate, inconspicuous; base of anterior branch of third longitudinal vein with an appendix. Squamae yellowish brown, with brown margin.

Legs.—Fore legs clove brown, apical third of the tibiae and the tarsi black, under surface of femora clothed with erect black hairs, rest of leg clothed with appressed black hairs; coxae and basal third of mid femora brownish, apical two-thirds and tibiae clove brown, femora clothed with white appressed hairs, coxae and femora of hind legs yellowish brown, clothed with creamy hairs, tibiae and basal half of first tarsus yellow, remaining tarsi blackish brown, tibiae and tarsi clothed with black appressed hairs.

Habitat.—Darwin, Northern Territory (Dr. C. L. Strangman).

Tabanus lineatus, n.sp.

♀. Length 11 to 12.5 mm.; width of head, 3.75 to 4.5 mm.; width of front at vertex .5 to just under 1 mm.; length of wing, 9 to 10.5 mm. (Pl. xiv., Fig. 17.)

Somewhat narrow bodied elongate species; dorsum of thorax greyish white, with blackish ground colour, dorsum of abdomen black, with a median and two lateral grey stripes. Legs with coxae and femora grey-white; tibiae creamy, tarsi blackish.

Head.—Front moderately broad, creamy white, with blackish ground colour, clothed with white appressed hairs; subcallus cream coloured; face creamy white, clothed with white hairs, denser towards the base. Eyes (dried specimens) black; inner margin parallel. Frontal callus shining black, divided into two by a narrow area of creamy white bloom, lower portion nearly a square, upper portion oblong, the base of the lower portion almost as wide as front and resting on apical edge of sub-callus. Palpi creamy white, first segment clothed with moderately long white hairs, terminal clothed with short appressed black and white hairs, the base with fairly long white hairs. Antennae with the first two joints deep brown to black, clothed with black semi-erect hairs, terminal segment yellowish brown, clothed with minute pale pubescence, terminal annuli darker, the expanded portion moderately broad, with the angle on its upper margin fairly prominent.

Thorax.—Dorsum slaty grey, clothed with short appressed yellow hairs, with two short median longitudinal slaty stripes, and two lateral slaty ones, extending the whole length of the thorax; humeral calli with a pale reddish tint near the

origin of the wings, clothed with short erect black hairs. Pleurae grey, clothed with fairly long white hairs; scutellum similar in colour to rest of thorax, the median portion with a faint reddish tint.

Abdomen.—Dorsum black, with a broad median and two lateral longitudinal creamy white stripes, terminating on the penultimate segment, covered with black appressed hairs, except on the longitudinal stripes, where they are creamy white; posterior margins of the segments pale, expanding to patches on the lateral edges; venter black, clothed with grey bloom; posterior margins of th segments pale yellowish.

Wings.—Hyaline, veins brown; stigma yellowish brown, elongate, conspicuous; base of anterior branch of third long vein with an appndix. Squamae pale yellow. Halteres, knob creamy yellow, base brown with the stalk light brown.

Legs.—With the fore, mid and hind coxae slaty grey, and clothed with fairly long greyish white hairs, fore femora slaty clothed with greyish appressed hairs and a few black appressed ones at the apex, mid and hind femora with the basal third slaty, rest clove brown, fore tibiae with the basal half clove brown, apical half black, clothed with mixed pale and black appressed hairs, mid and hind tibiae clove brown, the latter black at the apex, clothed with black and a few white appressed hairs; tarsi all black, and clothed with black appressed hairs.

Habitat.—Bowen and Ayr, Queensland.

This is a very marked and striking species, apparently belonging to the same group as *T. gregarius* Er.

Tabanus pseudoardens, n.sp.

♀. Length, 12 to 13.5 mm.; width of head just over 4 to 4.5 mm.; width of front at vertex just under .5 to .5 mm.; length of wing, 11 to just over 12 mm. (Pl. xiv., Fig. 18.)

Dorsum of thorax pale golden, with reddish brown ground colour, clothed with mixed black and golden hairs; dorsum of abdomen clove brown, changing to brown towards the apex; venter clove brown, and becoming darker towards the apex.

Head.—Front creamy yellow, greyish at the vertex, sparsely clothed with short black appressed hairs; face pale golden; jowls and base of head greyish, the latter clothed with fairly long greyish hairs; sub-callus golden yellow. Eyes (dried specimens) black. Frontal callus amber brown, tapering to a fine point about the middle of the front; its base almost as broad as the base of the front. Palpi golden, terminal joint clothed with black hairs, mixed with a few pale ones, except on the inner edge. Antennae with the first two segments golden yellow, the first clothed with black hairs, the second clothed beneath, and the apical half above with black hairs, terminal segment reddish brown, the expanded portion moderately broad, the angle on the upper margin of expanded portion not conspicuous.

Thorax.—Pale golden, with reddish brown ground colour, and clothed with mixed golden and black hairs; humeral calli clothed with fairly long black hairs. Pleurae with the yellowish ground colour covered with white bloom and creamy white hairs, which are denser at the base of the wings; scutellum similar in ground

colour to rest of thorax, and clothed with golden and a few scattered black appressed hairs.

Abdomen.—First three segments and last segment clove brown, remainder clove brown, with irregular black patches, clothed with black appressed hairs, a median pale stripe composed of triangles extends from segments two to six; venter with the first three and basal half of segment four clove brown, the apical half of the fourth and remaining segments brown; all but last segment sparsely clothed with black appressed ones.

Wings.—Hyaline with a creamy tint, veins dark brown; stigma yellowish brown, elongate, conspicuous. Squamae dusky brown; halteres, knob brown, stalk yellowish.

Legs.—Redish brown ground colour, with creamy bloom and white hairs, a few black ones on mid coxae; fore, mid and hind femora and tibiae reddish brown, clothed with black and creamy hairs; fore and mid tarsi blackish brown, clothed with black hairs; hind tarsi dark reddish brown, clothed with black hairs.

Habitat.—Kuranda, Queensland. In open scrub 28/11/1911.

Close to *T. ardens* Wied., from Java and Solomon Islands, but a larger and more robust species. The thorax of *T. ardens* Wied. has also a distinctly reddish appearance.

Tabanus nigritarsis, n.sp.

♀. Length, 15 to 17 mm.; width of head, 5 to 6 mm.; width of front at vertex .5 mm. to just under 1 mm.; length of wing, 13 to 14.5 mm.

Somewhat broad species; dorsum of thorax pale golden yellow; dorsum of abdomen dull yellowish brown; venter yellowish, with a brown longitudinal stripe running through the centre; femora slaty black, with greyish bloom, tibiae partly reddish brown, front tarsi black, middle and hind tarsi reddish black. (Pl. xiv., Fig. 19.)

Head.—Front golden yellow, clothed with black and golden hairs; face and jowls creamy clothed with fine whitish hairs. Eyes violet black (green in living specimens), inner margins parallel. Frontal callus dark brown, shining; its base almost as broad as front, and tapering to a fine point, about half the length of the callus. Palpi creamy yellow, clothed with black and golden hairs on the dorsal surface, sides with golden hairs only, terminal joint swollen and ending in a blunt point; first joint of antennae golden clothed with short black and yellow hairs, second and third joints reddish brown, the former with an apical ring of short black hairs, the latter with the expanded portion moderately broad, and with a few minute black hairs on the tip of the curve, terminal annuli dark brown.

Thorax.—Dorsum clothed with black and golden erect hairs, a fringe on sides composed of black hairs near base of wing, creamy near head; pleurae slaty grey, clothed with creamy hairs, tufted at the root of wings; scutellum agreeing in ground colour with that of remainder of dorsum, thinly covered with short erect golden and black hairs, a fringe of yellowish hairs on the edge; the hairs on the scutellum are somewhat longer than on the thorax; when denuded the thorax and scutellum are black.

Abdomen.—Dorsum clothed with short black hairs; first segment and part of second yellow, remaining segments brownish yellow, with the lateral edges of segments two to five yellowish; all the segments except the sixth with a lateral border of short yellowish hairs; venter creamy yellow, thinly clothed with short erect greyish hairs, a longitudinal brown stripe extending from the middle of the first segment to the sixth; the stripe clothed with short erect black hairs.

Wings.—Faintly tinged with black, almost hyaline, base yellow; veins dark brown, sub-costal area yellowish; base of anterior branch of third longitudinal vein with an appendix. Stigma pale yellow, elongate, inconspicuous. Squamae creamy white. Halteres stalk brownish, knob yellowish brown.

Legs.—Trochanters and femora black, clothed with grey hair, front tibiae brown, with the apical third blackish, clothed with short black pale hairs, mid and hind tibiae clove brown, clothed with short black hairs; fore and mid first tarsi reddish black, remaining tarsi black; apical border of last tarsus of fore, mid and hind legs with moderately long black hairs.

Habitat.—Ching Do on the Houghton River (December, 1911), Queensland; Darwin, Northern Territory (Dr. C. L. Strangman, October, 1911).

This species is closely related to *T. fuscipes,* n.sp., but can be easily told from it by its hyaline wings, etc.

Tabanus tetralineatus, n.sp.

♀. Length, 17 to 18.5 mm.; width of head, 6.5 to just under 7 mm.; width of front at vertex just under 1 mm. to 1 mm.; length of wing, 16.5 to 17.5 mm. (Pl. xiv., Fig. 20.)

A robust species; dorsum of thorax greyish, with four longitudinal lines, two median and two lateral; dorsum of abdomen chestnut brown, becoming dark towards the apex with two lateral grey stripes (composed of globular patches extending towards the apical edge of each segment). Venter clothed with white bloom.

Head.—Front golden, dark reddish brown when denuded, face creamy yellow, clothed with creamy white hairs; sub-callus creamy yellow; eyes black. Frontal callus reddish brown, elongate, spear shaped, slightly raised; palpi yellow, terminal joint clothed on its outer side with short black appressed hairs, with a few creamy lateral hairs at its base, swollen, gradually tapering to a fine point. Antennae with first and second joints reddish brown; first joint with creamy yellow bloom and clothed with short black appressed hairs, second joint with an apical ring of short black appressed hairs, expanded portion of terminal segment red brown, rest of segment brown, expanded portion not particularly broad, and the angle on its upper margin not prominent.

Thorax.—Greyish yellow, with four longitudinal brown stripes, the median pair only extending to the centre separated by a narrow grey stripe, lateral stripes the entire length of the thorax, sparsely clothed with short appressed creamy hairs, a dense border of pale cream coloured hairs above root of wings, border in front

of wings mostly composed of black hairs; pleurae slaty grey, clothed with greyish white erect hairs, denser at the base of legs and root of wings; scutellum similar in ground colour to rest of thorax, clothed with black appressed hairs and edged with creamy yellow hairs.

Abdomen.—Dorsum, except last segment, which is creamy yellow, chestnut brown, clothed with short black appressed hairs, with two lateral grey stripes (composed of globular grey patches, which are almost as long as the segments); lateral margins of segments three, four and five with a creamy yellow lateral border; venter clothed with white bloom, and moderately long white appressed hairs, except the sixth segment, which is clothed with erect black hairs mixed with creamy ones, the apical edges of all the segments tinted with creamy yellow.

Wings.—Faintly dusky, veins light brown; stigma pale creamy yellow, elongate, inconspicuous; base of anterior branch of third longitudinal vein without an appendix. Halteres, knob yellowish brown, stalk yellow to yellowish brown.

Legs.—Coxae clothed with white hair, femora and tibiae reddish brown, clothed with white hair; tarsi reddish brown, clothed above with black appressed hair.

Habitat.—Darwin, Northern Territory (Dr. C. L. Strangman, October, 1911).

Tabanus parvus, n.sp.

♀. Length, 8.5 to 10 mm.; width of head, 3 to 3.5 mm.; width of front at vertex just under .5 to .5 mm.; length of wing, 7.5 to 8.5 mm.

Somewhat short and slender species. Dorsum of thorax golden mottled with patches of dark brown; dorsum of abdomen yellow changing to yellowish brown towards the apex; venter creamy yellow, brownish towards the apex; coxae, femora and tibae clove brown, tarsi brownish black.

Head.—Front golden, greyish at vertex, clothed on upper half with minute black hairs, face white, base clothed with moderately long white hair, sub-callus cream coloured. Eyes (in dried specimen) deep black. Frontal callus brown, situated just above the sub-callus, its base about half the width of front and drawn out to a fine point about half the length of the front. Palpi cream coloured, sparsely covered on outer edge with short black hairs, mixed with cream coloured ones on basal half of terminal joint, the latter swollen and tapering to a point. Antennae, first and second segments golden yellow, first segment thinly covered with creamy and black hairs, second segment with a narrow apical fringe and third segment reddish brown, with the extreme tip brown, expanded portion moderately broad, and the angle on the upper margin not prominent.

Thorax.—Dorsum golden, with black patches showing beneath, sparsely clothed with black and cream coloured hairs; area immediately above root of wing clothed with moderately long greyish white hairs, lateral fringe in front of wings mainly composed of black hairs; pleurae slate grey, clothed with white hairs, denser on the sides beneath the wings; scutellum agreeing in ground colour with the rest of the thorax, and clothed with appressed black hairs, with a few scattered golden ones on the edges.

Abdomen.—First three segments golden yellow, remainder clove brown, clothed with black appressed hairs (in some specimens all but the first three segments have a blackish brown appearance); the lateral and apical edges of segments four to seven golden yellow; venter covered with gryish white bloom; ground colour of segments one to four yellow, with the edges darker; the remainder of the segments with dark brown ground colour and yellowish apical edges, sparsely clothed with greyish hairs, except segment seven, which is clothed with erect black ones.

Wings.—Hyaline, veins dark brown. Stigma elongate, yellowish, inconspicuous; anterior branch of third longitudinal vein, with a moderately long, slightly curved appendix. Halteres, knob pale brown, base paler, stalk creamy yellow.

Legs.—Coxae and femora, clothed with whitish hairs; tibiae clothed with black hairs; mid and hind tarsi brown, first tarsi with apex black, remainder with basal half brown and apical half black, all clothed with black hairs.

Habitat.—Darwin, Northern Territory (Dr. C. L. Strangman October, 1911).

TICKS.

The number of species recorded to date from Australia and Tasmania is comparatively small, only twenty-three being recorded. The genera *Ixodes* and *Amblyomma* having most representatives, as they contain more than half of the known species.

The super-family *Ixodoidea* is divided into two families, the *Argasidae* and *Ixodidae,* which are easily distinguished from each other by their habits and external structure. In the *Argasidae* the capitulum is on the ventral surface, and completely hidden, in the adult, when viewed from above.

The most striking distinction between the two families is the possession of a shield or scutum in the *Ixodidae,* which covers the whole body in the male, and which forms a small patch on the anterior part of the dorsum of the female. There is no scutum in the *Argasidae,* but they are covered with fairly uniform leathery integument

The differences also extend to their habits as well as structure. The Argasidae when fully fed, show a dorso-ventral thickening while in the Ixodidae the females show great increase in size when gorged, and their coxae widely separated. The Argasidae live for several years, and generally lay comparatively few eggs at a time; pass through two or more nymphal stages, and are capable of moulting after attaining maturity. The Ixodidae are comparatively short-lived, lay a very great number of eggs, and only moult twice, after leaving the larval and nymphal stages.

The nymphs and adults in the Argasidae are seldom carried from their habitats as they feed rapidly, mostly by night, and hide during the day in dark crevices as they would appear to shun the light, especially when waiting for a host.

The habits of the Ixodidae differ in a marked degree from those of the Argasidae. They are slow feeders, and remain attached to their host for several days, or in the case of cold-blooded hosts, for a considerable period; thus species of

Amblyomma, Aponomma and *Hyalomma* occurring on Reptilia may remain attached to the host for a considerable time. There are cases as in *Ixodes* where the male is unknown, or is only recorded as being found in the host's habitat.

Argas vespertilionis Latreille is recorded for the first time from Australia, being represented by two larvae taken from a bat.

Haemaphysalis leachi and var. *australis* Neumann is also of great interest, as the species transmits *Piroplasma canis* in Africa.

Ixodes holocyclus Neumann, 1899.

Female (partially fed) body oval, broadest about the middle. Scutum dark reddish yellow, almost as broad as long, the cervical grooves well marked in front; lateral grooves very distinct; punctuations very numerous, equal and confluent in places; porose areas large, oval, longer than broad; palpi much longer than the hypostome, first segment broad, salient outward nearer the base, segment two long, the entire palpi broadened dorsally, concave outside. Hypostome long, lanceolate with numerous small teeth, followed by six rows of large ones. Coxae large, an external lower spur, decreasing in size from coxae one to four; long white hairs on the lower half of each coxa; claws short, the pad nearly reaching to their tips.

Length.—Two specimens, long., 4 to 8 mm.; lat., 2.5 to 5 mm.

Habitat.—Kamerunga, Cairns district, Queensland and Sydney, N.S.W.

The scrub tick of New South Wales, found on man and animals.

Boophilus annulatus Say, var.*australis* Fuller.

Agric. Journ. Cape Town, No. 9, p. 5, 1899; Neumann, *Mem. Soc. Zool. Fr.*, v., 14, p. 280, 1901.

This is an extremely common tick in Queensland, and is too well known to require description.

Hyalomma aegyptium L.

Syst. Nat., Ed. 10, p. 615, 1758; Neumann, *Das Tierreich, Ixodidae*, p. 50, 1911.

Dorsal shield brown, with numerous unequal punctuations. Eyes hemispherical. Hypostome spatulate, with six rows of teeth.

♂. Adanal shields nearly rectangular (they do not quite agree with the figure given by Neumann); the internal edge longer than the posterior; accessory shields small. Dorsal shield with a short lateral groove, situated close to the edge, ending posteriorly at the last festoon.

♀. Dorsal shield oval, hexagonal, laterally grooved, almost as long as broad, edges curved.

Length.— ♂, L., 3 to 4.5 mm.; la., 1.5 to 2 mm.; ♀, L., 6-11 mm.; la., 3.5 to 6 mm.

This species closely resembles Neumann's description of *H. aegyptium* L., the main differences being the shape of the adanal shield and the length.

On dogs—Townsville.

Amblyomma moreliae, L. Koch.

Verh. Ges. Wiss. Wien., v., 17 Abh., p. 241, 1867; Neumann, *Mem. Soc. Zool., Fr.,* v. 12, p. 258, 1899; *Das Tierreich, Ixodidae,* p. 85, 1911.

♂. Eyes flat, dorsal shield reddish brown, punctuations lateral and deep, numerous in the scapular angles. Hypostome with eight rows of teeth. Coxa one with two sub-equal short spines, as broad as long, the other coxae each with a single spine, that on the fourth coxa longest; the dorsal shield with a marginal groove commencing behind the eyes, arrested by the last festoon, without encircling the posterior margin. L., 3.75 to 4.5 mm.; la., 3 mm.

Host.—The green spinifex snake.

Habitat.—Northern Territory (Hodgson Down Station).

Amblyomma australiense Neumann.

Arch. Parasitol., v. 9, p. 227, 1905.

Eyes flat; dorsal shield dark brown without spots, punctuations small; hypostome with eight rows of teeth. Coxa one with two spines, the external about twice as long as broad; remaining coxae each with a spine, that on the fourth the longest. Tarsi ending bluntly with two spurs.

♂. Dorsal shield, with a lateral groove, commencing level with the eyes, terminating at the last festoon without encircling the posterior margin. Festoons well marked. ♀. Dorsal shield cordiform, slightly broader (2.5 mm.) than long (just over 2 mm.); eyes towards the middle of its length; lateral grooves distinct. Porose areas oval and small. Palpi slightly longer than the hypostome, the latter with eight rows of teeth.

On *Tachyglossus aculeatus* Shaw.

Townsville district.

Haemaphysalis leachi Aud., var. *australis* Neumann.

Arch. Parasitol., v. 9, p. 238, 1905.

Palpi triangular, the second segment broadly expanded on its posterior edge forming a sharp external angle, with a short reversed spine near this angle, and another stouter one on its lower edge. Hypostome with eight rows of teeth; dorsal shield with numerous small deep and equal punctuations. Coxae with a short spine slightly decreasing in size from one to four. Tarsi without dorsal proturberances.

♂. Dorsal shield with a distinct long lateral groove, in some specimens terminating at the last, in others at the penultimate festoon. Tarsi four ending abruptly.

♀. Dorsal shield oval, longer than broad. Tarsi four, not ending abruptly.

♂. L., 2.5 mm.; la., just over 1 mm.; ♀, L., 5 mm.; la., 3 mm.

On *Macropus agilis* Gould.

Ching Do, North Queensland.

Aponomma trimaculatum, H. Lucas.

Ann. Soc. Ent. Fr. ser., 5, *v.,* 8 Bull, p. 77, 1878 (Ixodes); Neumann, *Mem. Zool. Soc., Fr.,* v. 12, p. 187, f. 41, 1899.

♀. Dorsal shield, cordiform, as broad as long, deep red with numerous unequal punctuations, and three green patches situated at the angles. Hypostome with eight rows of teeth. Porose areas small.

L., 5 mm.; la., 4 mm.

On *Varanus varius* Merr.

Townsville, North Queensland.

Aponomma decorosum, L. Koch.

Neumann,*Mem. Soc. Zool., Fr.,* v. 12, p. 194, f. 46-48, 1899.

♂. Body longer than broad. Dorsal shield brown, mottled creamy white, with numerous deep punctuations. Hypostome with six rows of teeth. Coxa one with two short spines, a short spine on each of the other coxae. Tarsi with a dorsal protuberance. Dorsal shield with a slight marginal groove, encircling the posterior border; punctuations equal more numerous towards the posterior margin, where some are unequal. L., 3 mm., la., 2.5 mm.

On *Tachyglossus aculeatus* Shaw.

Townsville.

Argas vespertilionis Latreille.

Neumann, *Mem. Soc. Zool., Fr.,* v. 9, p. 19, f. 22-26, 1896.

Larva.—Body short oval, 1.5 to 2 x 1 to 1.5 mm. Dorsum with fine radiating furrows on the posterior half. Hypostome narrow, long, pointed, with eight rows of teeth. Palpi slender, segment one nearly as broad as long, segments two, three and four twice as long as wide; legs slender, the coxae almost contiguous, the interval between the coxae of the two sides broad.

On *Vesperugo* sp.

Townsville.

Argas persicus, Fisch-Waldh.

Neumann, *Mem. Soc. Zool., Fr.,* v. 9, p. 12, 1896.

This tick is so well known that it scarcely requires description.

In a fowl house.

Townsville.

Family Chironomidae (Midges).

Sub-family *Ceratopogoninae.*

Culicoides, Latreille.

Genera Crustaceorum et Insectorum, T. iv., p. 251, 1809.

Culicoides ornatus, n.sp.

♀. Head black; antennae yellowish clothed, with minute, pale hairs, basal lobe large, more than twice as wide as the second segment, the latter creamy, slightly swollen, and longer than the following segment, the first nine segments slightly globular, paler than the apical five, the latter elongate and cylindrical; palpi brown, four jointed, third joint swollen and moderately long, the fourth slightly curved; proboscis brown about the same length as the palpi; eyes black.

Thorax grey brown, with two lateral patches of blackish brown on the middle third, a few short dark bristles on the lateral and anterior margins; pleurae brown; scutellum grey brown.

Abdomen black sparsely clothed with dark hairs, lateral edges with a thin fringe of dark hairs; venter black, with a fairly dense clothing of dark hairs.

Legs yellowish, with a creamy pubescence; hind femora stouter than fore and mid ones; tibiae with a thin short fringe on the outer margin, moderately long on the hind tibiae, the latter with a narrow white band near the base, the legs with dark knee spots, hind metatarsi about the same length as the four following tarsi.

Wings longer than the abdomen, infuscate and with hyaline spots; costal vein darker than the wing, with two hyaline spots at the basal and apical ends of the middle third. Rest of the wing with eleven irregular hyaline spots. Halteres with the stem, and knob pale creamy white. Length, 1 mm.

Habitat.—Townsville, in mangrove swamps, July, 1911.

A small species and a very vicious biter, settling on the hands and wrists, and causing considerable irritation; it was not seen to crawl up the arms. Immediately on settling it commences to suck blood, the "bite" being very noticeable.

EXPLANATION OF PLATES.

PLATE XII.

Fig. 1.—*Myzorhynchus barbirostris*, Van de Wulp, var. *bancrofti*, Giles ... ... ♀ Head
Fig. 2.—*M. barbirostris*, v. de Wulp, var *bancrofti*, Giles ... ... ♀ Wing
Fig. 3.—*Toxorhynchites speciosa*, Skuse... ... ... ♂
Fig. 4.—*T. speciosa* Skuse .. .. ♀ Wing
Fig. 5.—*Culicelsa abdominalis*, n.sp. ... ... ♀ Wing
Fig. 6.—*C. consimilis*, n.sp.... ... ... ♂ Head
Fig. 7.—*C. consimilis*, n.sp. ... ... ♂ Wing

PLATE XIII.

Fig. 8.—*Nyssorhynchus annulipes*, Walk. ... ... ♀ Wing
Fig. 9.—*Mucidus alternans*, Westwood ... ... ♀
Fig. 10.—*M. alternans*, Westwood... ... ... ♀ Wing
Fig. 11.—*Culicelsa vigilax*, Skuse... ... ... ♀ Wing
Fig. 12.—*Aedeomyia venustipes*, Skuse... ... ... ♂ Head
Fig. 13.—*A. venustipes*, Skuse ... ... ♂ Wing

PLATE XIV.

Fig. 14.—*Tabanus abstersus*, Walker ... ... ♀
Fig. 15.—*T. fuscipes*, n.sp. ... ... ♂
Fig. 16.—*T. gregarius*(?), Erichson ... ... ♀
Fig. 17.—*T. lineatus*, n.sp.... ... ... ♀
Fig. 18.—*T. pseudoardens*, n.sp. ... ... ♀
Fig. 19.—*T. nigritarsis*, n.sp. ... ... ♀
Fig. 20.—*T. tetralineatus*, n.sp. ... ... ♀

PLATE XII.

Fig. 1.

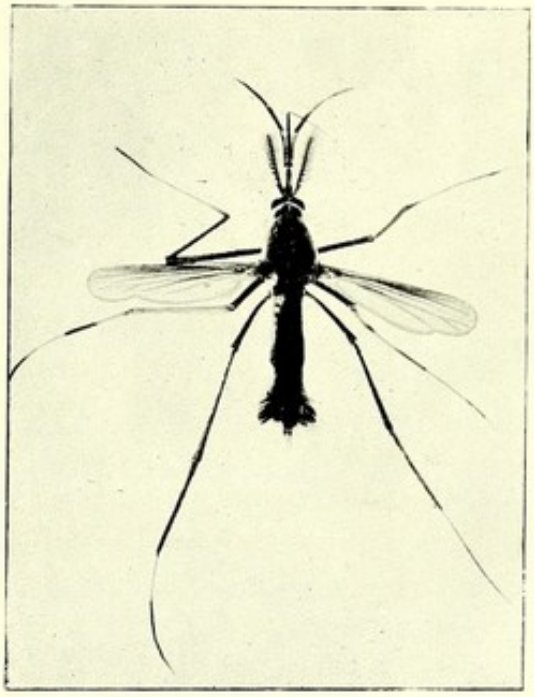


Fig. 3.

Fig. 2.

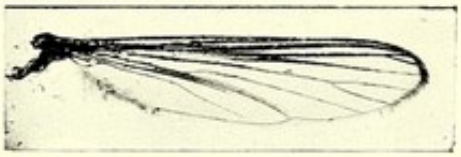


Fig. 4.

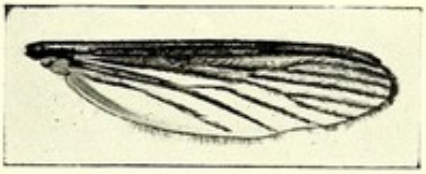


Fig. 5.

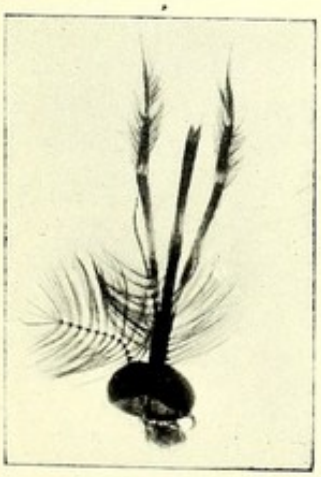


Fig. 6.

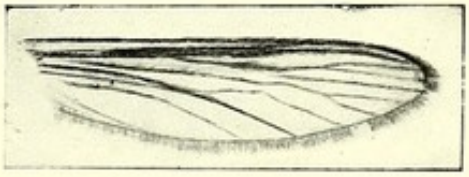


Fig. 7.

PLATE XIII.

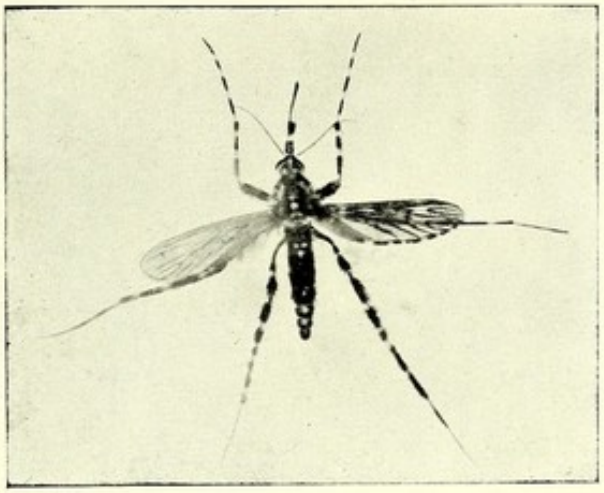


Fig. 9.

Fig. 10.

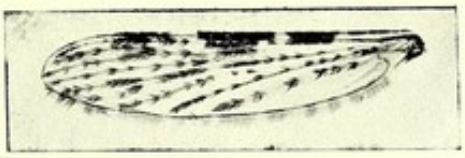


Fig. 8.

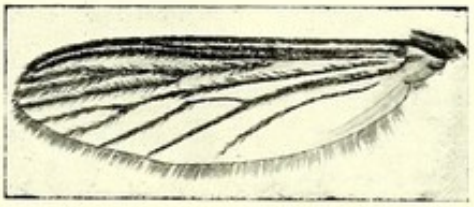


Fig. 11.

Fig. 12.

Fig. 13.

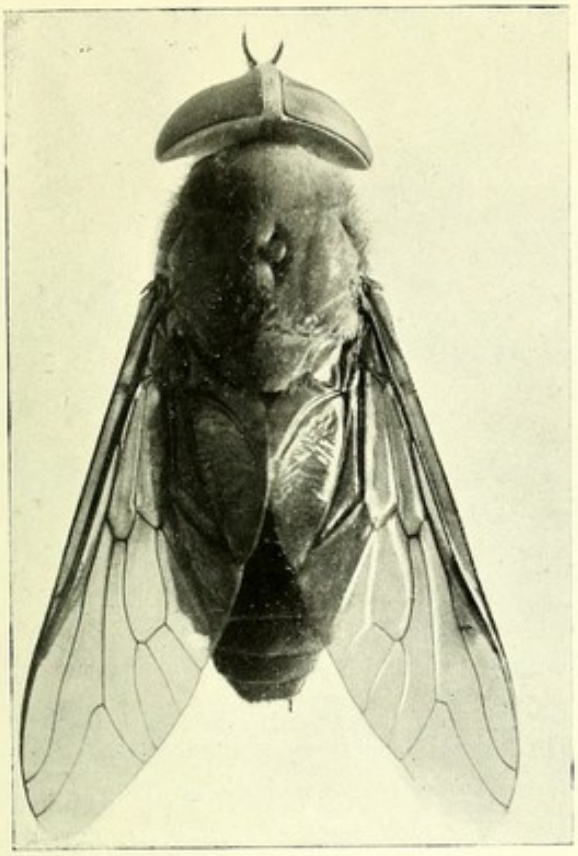


Fig. 19.

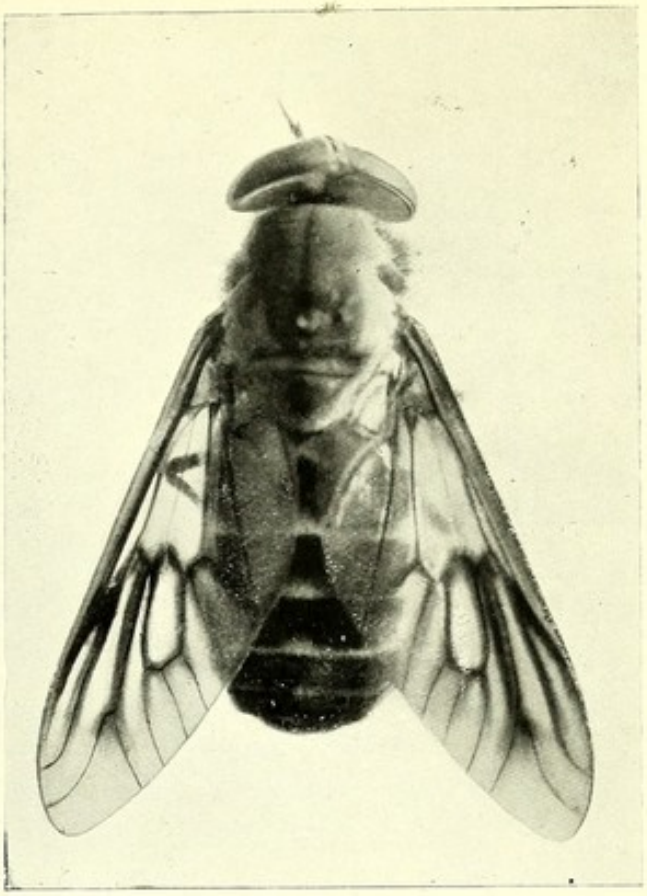


Fig. 14.

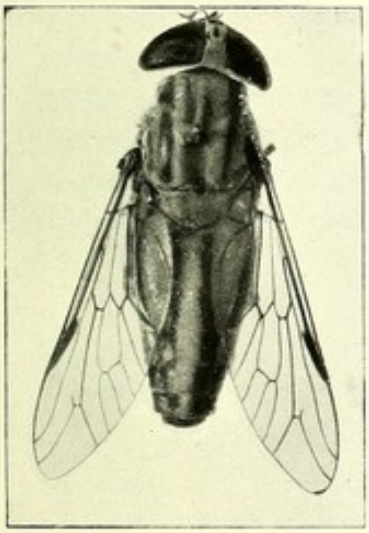


Fig. 17.

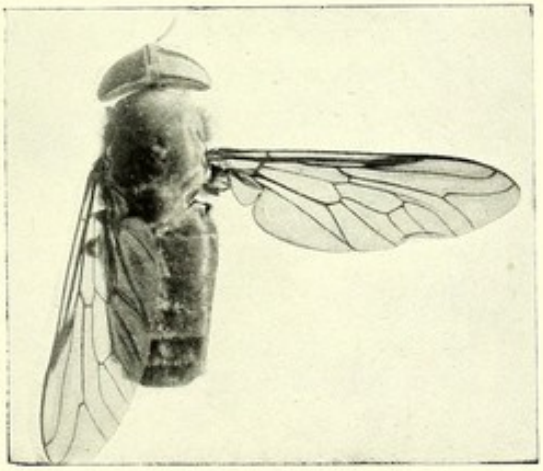


Fig. 18.

Fig. 15

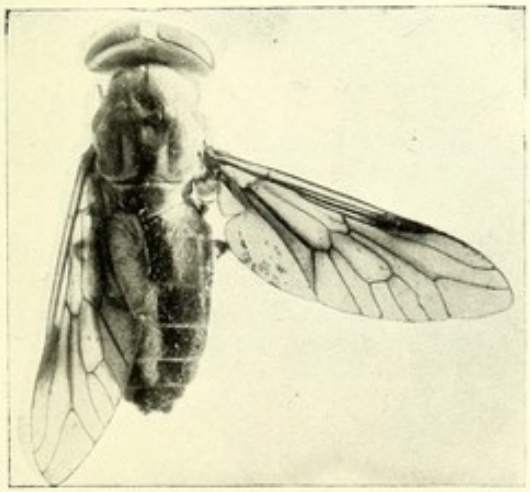


Fig. 16.

Fig. 20.

CESTODA AND ACANTHOCEPHALA.

By T. Harvey Johnston, M.A., D.Sc., F.L.S., Biology Department, University of Queensland, Brisbane.

PLATES XV.-XVII.

Dr. A. Breinl, the Director of the Australian Institute of Tropical Medicine, Townsville, North Queensland, has been kind enough to hand over to me for examination a fairly large collection of entozoa, mainly Cestoda, taken from hosts in the neighbourhood of Townsville. The majority of the forms are dealt with in this report, though some interesting material from an elasmobranch is held over for the present.

The specimens under review came from twenty-two hosts, only three of which belong to introduced species, viz., the cat, dog and brown rat. Of the twenty-three species of parasites recognised, eleven are considered as being new to science, eleven are referred to known species, while one is immature and not specifically determinable. It is not unlikely that some of the cestodes, which are here regarded as new, may belong to known species, but the lack of literature has prevented a comparison of some of the North Queensland forms with the descriptions of allied species occurring elsewhere. The range of certain already known forms has been greatly extended.

Unfortunately a great many of the specimens are in a poor state of preservation, and this is my excuse for at least some of the imperfection in the following accounts.

Type specimens have been deposited in the helminthological collection of the Institute.

LIST OF PARASITES REFERED TO.

I. CESTODA.

A. ANOPLOCEPHALIDAE.

1. *Cittotaenia tachyglossi*, n.sp.
2. *Moniezia trichoglossi* (Linstow), Johnston.

B. DAVAINEIDAE.

3. *Davainea cacatuina*, n.sp.
4. *Davainea conopophilae*, n.sp.

C. HYMENOLEPIDIDAE.

5. *Anomotaenia asymmetrica*, n.sp.
6. *Anomotaenia accipitris*, n.sp.
7. *Bancroftiella glandularis* (Fuhrmann), Johnston.
8. *Bancroftiella ardeae*, n.sp.
9. *Cyclorchida omalancristrota* (Wedl), Fuhrmann.
10. *Dipylidium caninum* (L.)
11. *Hymenolepis diminuta* (Rud.)
12. *Hymenolepis ibidis*, n.sp.
13. *Hymenolepis megalops* (Nitzsch). Parona
14. *Hymenolepis terraereginae*, n.sp.
15. *Diorchis flavescens* (Krefft), Johnston.
16. *Aploparaksis australis*, n.sp.

D. TAENIIDAE.

17. *Diploposthe laevis* (Bloch), Jacobi.

E. PROTEOCEPHALIDAE (syn. *Ichthyotaeniidae*).

18. *Acanthotaenia tidswelli* Johnston.

F. BOTHRIOCEPHALIDAE.

19. *Dibothriocephalus felis* (Creplin).
20. *Bothridium parvum*, n.sp.
21. *Sparganum* sp. (immature).

II. ACANTHOCEPHALA.

G. GIGANTORHYNCHIDAE.

22. *Gigantorhynchus moniliformis* (Bremser), Hamann.
23. *Gigantorhynchus asturinus*, n.sp.

LIST OF HOSTS AND ENTOZOA RECORDED IN THIS PAPER.

MAMMALIA.

1. *Felis domestica* Gmel., *Dibothriocephalus felis* (Crepl.)
2. *Canis familiaris* (L.), *Dipylidium caninum* (L.).
3. *Mus decumanus* Pall., *Hymenolepis diminuta* (Rud.), *Gigantorhynchus moniliformis* (Bremser).
4. *Tachyglossus aculeatus* Shaw, *Cittotaenia tachyglossi* Johnston.

AVES.*

5. *Accipiter cirrhocephalus* Vieill., *Anomotaenia accipitris* Johnston.
6. *Astur novaehollandiae* Gmel., *Gigantorhynchus asturinus* Johnston.

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* The names of the birds are those used in Gregory Mathews' "Hand-list of the Birds of Australia" (Emu, vii., suppl., 1907-8).

7. *Gallinago australis* Lath., *Apolparaksis australis* Johnston.
8. *Cacatua galerita* Lath., *Davainea cacatuina* Johnston.
9. *Trichoglossus novaehollandiae* Gmel., *Moniezia trichoglossi* (Linstow).
10. *Herodias timoriensis* Less., *Bancroftiella glandularis* (Fuhrmann), *Anomotaenia asymmetrica* Johnston.
11. *Nycticorax caledonicus* Gmel., *Bancroftiella ardeae* Johnston.
12. *Notophoyx novachollandiae* Lath., *Bancroftiella glandularis* (Fuhrmann).
13. *Platalea regia* Gould, *Cyclorchida omalacristrota* (Wedl.).
14. *Platibis flavipes* Gould, *Hymenolepis ibidis* Johnston.
15. *Dendrocygna arcuata* Cuvier, *Diploposthe laevis* (Bloch).
16. *Anseranas semipalmata* Lath., *Hymenolepis megalops* (Nitzsch), *Hymenolepis terraereginae* Johnston.
18 *Conopophila albigularis* Gould, *Davainea conopophilae* Johnston.
17. *Anas superciliosa* Gmel., *Diorchis flavescens* (Krefft).
19. *Entomyza cyanotis* Swainson, *Davainea conopophilae* Johnston.
20. *Philemon citreogularis* Gould, *Davainea conopophilae* Johnston.

REPTILIA.

21. *Varanus varius* Shaw, *Acanthotaenia tidswelli* Johnston, *Bothridium parvum* Johnston.
22. *Diemenia textilis* D.&B., *Sparganum* sp.

1. *Cittotaenia tachyglossi*, n.sp.

(Plate xv., Figs. 1-3.)

From the intestine of the echidna, *Tachyglossus aculeatus*, more frequently known under the name of *Echidna hystrix*. The only endoparasite so far known from this monotreme is *Linstowia echidnae* (Thompson), a tape-worm which frequently occurs in considerable numbers in its intestine, and is known from Victoria, New South Wales, and Queensland. *Cittotaenia tachyglossi* appears to be a much smaller cestode, but the specimens available are immature, few proglottids possessing well-developed genitalia. The longest form is only about eleven millimetres, the maximum breadth, which is fairly constant throughout the strobila, being 0.56 mm.

The scolex is not separated off from the rest of the animal by a constriction, the short unsegmented neck possessing the same width as the scolex (0.56 mm.). The anterior end is rounded, a rostellum is absent, and the four suckers appear as strongly muscular hemispherical organs of about 0.13 mm. in diameter, lying deeply buried in the scolex, with the lumen directed anteriorly and slightly laterally.

The strobila consists of segments, whose breadth is from a third to a half of their length, and whose posterior corners are rounded, and slightly projecting. There is only a small amount of overlapping by preceding proglottids. The genital pores are bilateral, opening just behind the middle of each margin. A distinct genital papilla was not observable.

As serial sections were not cut, histological details cannot be given. The excretory system consists of a pair of wide ventral stems, a wide transverse com-

missural vessel in each segment, and a pair of narrow dorsal canals lying inwardly from the ventral pair. The sex ducts pass dorsally to both longitudinal vessels of the corresponding side. At the posterior end of one strobila, the four canals were seen to enter into a short median excretory duct or vesicle, which communicated with the exterior through the excretory pore.

The testes are very numerous, being dispersed in a couple of layers throughout the dorsal medulla, and overlying the female glands as well as the inner portions of the cirrus-sac and vagina. Their diameter is only .015 mm., though it is probable that they attain a larger size in more mature segments. Each *vas deferens* becomes thrown into a number of coils near the inner end of the corresponding cirrus-sac, and within the latter widens to form a *vesicula seminalis*. The characters of the cirrus were not recognisable. Each sac is a relatively long (.20 mm.) fusiform organ, lying across the anterior corner of the segment. The maximum breadth is from .033 to .05 mm. There is a distinct cloaca present, the male pore opening into it just above and in front of the female aperture.

The paired female glands lie symmetrically a short distance on each side of the median line, each appearing as a compact mass, the lobed ovary occupying the anterior half, and the transversely elongate vitellarium the posterior half of the complex. Between these two glands lies the somewhat swollen receptaculum seminis. From the female pore the vagina travels inwards as a wide tube below the outer portion of the cirrus-sac, ultimately bending round to pass backwards above the ovary, where it becomes widened into a receptaculum seminis, which occupies the middle of the female complex. The uteri were not recognisable.

This species has been placed under the genus *Cittotaenia*, as the vagina lies below the cirrus-sac on each side, instead of being ventral to it on one side, and dorsal to it on the other as occurs in *Moniezia*. A few abnormalities were noticed. One strobila, which, though quite immature, evidently belonged to the above species possessed single genital "Anlagen" in each segment, just as in *Linstowia*, but they were irregularly alternate. In one segment belonging to another strobila two sets of mature genitalia were seen to be situated on one side of the proglottid, none being present on the other.

The generic name of the host is associated with this interesting cestode, which, like all others,* known from monotremata and Australian marsupialia, belongs to the family Anoplocephalidae.

2. *Moniezia* (*Paronia*) *trichoglossi* (Linstow).

The collection contains several fragments of the above species, taken from the Blue Mountain parrot, *Trichoglossus novaehollandiae* Gmelin. It was originally described very briefly by Linstow (1888, p. 14) from material collected from the same host species in Cape York Peninsula by the Challenger Expedition. Diamare (1900, p. 846; 1901, p. 369) gave a good account of it under the name of *Paronia*

* An exception is *Bancroftiella tenuis*, which is referred to later, along with *B. ardeae* and *B. glandutaris*.

carrinoi, from certain other parrots. Fuhrmann (1901a. p. 758; 1901b, p. 273; 1902, p. 122) also dealt with the same species, gave a full description, and showed the two forms to be specifically identical. He, however, retained the name *Moniezia carrinoi* Diamare. The question of the correct name of this cestode has been discussed (Johnston, 1910, p. 103). *M. trichoglossi* has priority. Since the species of *Moniezia* from birds possess certain modifications in regard to the eggs, they might be grouped under Diamare's *Paronia*, the latter retaining subgeneric value

For a similar reason, Shipley's *Coelodela* might be retained as a subgenus of *Cittotaenia*.

3. *Davainea cacatuina*, n.sp.

(Plate xv., Figs. 4-7.)

Numerous long delicate cestodes were taken from the intestine of the white (sulphur-crested) cockatoo, *Cacatua galerita* Lath. They are somewhat macerated and broken. The length is about 5 cm.; the breadth very gradually increasing from .050 mm. in the neck region to .194 in sexually mature proglottids, reaching a maximum of .53 mm. in ripening segments. Mature proglottids, which were about to separate from the rest of the strobila, were seen to vary in shape from elongate rectangular to subcircular, the length ranging from .32 to .40 mm., and the breadth .19 to .28 mm.

The scolex is very small, and rather easily overlooked. Its greatest breadth (.114 mm.) is just behind the suckers and gradually diminishes to pass into the long thin unsegmented neck. The suckers are comparatively prominent, and may project to such an extent as to appear to be pedunculate. They are evidently very mobile during life. Their diameter is about .045 mm. The margin bears several rows of nail-like spines of the usual type found on the suckers of *Davainea*. The longest may reach .0075 mm. There is a well-marked rostellar sac within which the rostellum lies retracted. The form and number of rostellar hooks were not discernible, though they appeared to be about .006 mm. in length.

Owing to maceration there was very great variation in the form of the segments, but the typical shape appears to be trapezoidal, the posterior margins projecting laterally and scarcely overlapping the succeeding proglottids. In a considerable portion of the strobila genitalia are not present. Sexually mature segments are relatively few in number, while the proportionately long posterior part of the chain contains developing eggs and egg-capsules. The genital pores are unilateral, lying at about the middle of the margin. A papilla was recognisable only in some ripening segments.

The cuticle is thin. Small calcareous corpuscles are abundant in the cortex, the latter occupying a relatively large area of a transverse section. The longitudinal musculature consists of numerous bundles arranged in two concentric series, each bundle containing few fibres. There is a distinct transverse musculature, but dorso-ventral fibres are weakly developed. The ventral excretory canals are very large, and lie close to the ventral transverse musculature. Neither dorsal nor com-

missural vessels were recognised. The sex ducts pass above the ventral canals and the longitudinal nerve, the latter being dorso-lateral to the excretory vessel.

There are only four or five testes (.02 mm. in diameter), one being situated posteriorly on the poral side of the ovary, the remainder lying on the aporal side of the female gland and the vas deferens. The latter appears as a conspicuous coiled mass in the anterior part of the segment. After passing over the ventral vessel it enters the cirrus-sac, forming a vesicula within it, and terminating in a short cirrus. The pyriform cirrus-sac lies obliquely or almost longitudinally in the antero-lateral region of the proglottis. The length is from .065 to .100 mm., the maximum breadth varying from .02 to .042 mm.

Owing to the condition of the specimens, very little detail regarding the female system has been made out. The ovary appears as a narrow longitudinally situated organ lying in the middle of the segment. In a few cases the gland seemed to possess dorsally-directed lobes. The vitellarium is a small structure just behind the ovary. After passing inwards from the genital pore, the vagina curves backwards to come into relation with the female complex. The uterus becomes replaced by about sixteen egg-capsules, each containing approximately a dozen eggs, whose size is .045 by .019 mm. Two shells are present. The oncosphere measures .015 by .007 mm.

Fuhrmann (1908, p. 160) quotes *Davainea leptosoma* Diesing, as a parasite of *Cacatua roseicapilla*, but I do not know on whose authority. *D. cacatuina* is a much more slender form than *D. leptosoma*, and it seems more probable that the cestode from the Galah is more likely to belong to our species than to Diesing's, which is known to infest many South American and a few African parrots. The Australian cockatoos and parrots have a restricted range. I have not been able to consult an account of the anatomy of *D. leptosoma*, all the earlier descriptions being of little use for purpose of comparison.*

4. *Davainea conopophilae*, n.sp.

(Plate xv., Figs. 8-10.)

Several specimens of a *Davainea* were taken from the intestine of the white-throated honey-eater, *Conopophila albigularis* Gould. Some fragments from the yellow-throated friar bird, *Philemon citreogularis* Gould, as well as some more or less dried parasites from the blue-faced honey-eater, *Entomyza cyanotis* Lath., are also referred to the same species. The only other cestode known from the *Meliphagidae* is *Choanotaenia meliphagidarum* Johnston (1911a, p. 58), which has been recorded as infesting several species of honey-eaters belonging to the genera *Meliornis* and *Ptilotis*.

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* Fuhrmann (1911) has recently described a number of cestodes from birds from the Aru Islands, amongst them being four from psittaciform birds. One of these tape worms *Davainea oligorchida* Fuhrm. (1911, p. 256) is very like *D. cacatuina*, in regard to the male genitalia, but the female genitalia and the scolex possess different characters. Then again *D. cacatuina* is a very much longer parasite.

The following description is based upon specimens from *Conopophila*:—

The scolex is not marked off from the rest of the strobila, its breadth being the same as that of the neck, viz., .32 mm. The anterior end is truncate, and usually slightly concave. Lying within a depression or sac is a low conical rostellum, bearing a great number of hooks arranged in single row. These possess the typical hammer form, but the claw is short, the ventral root being long. The maximum length of the hook is about .018 mm. The suckers are quite sessile, and open anteriorly or antero-laterally. Their margins support several rows of freely-projecting and closely set spines.

Imperfect segmentation begins immediately behind the scolex. The ratio of the length to the breadth in sexually mature proglottids varies from 6:1 to 7:2. There is very little overlying of segments, and the lateral edges project only slightly. The genital pores all lie on the same side of the strobila, being usually situated in a depression, though in a few instances the presence of a small papilla may be recognised.

The cortex occupies a relatively large part of the parenchyma, and contains abundant calcareous corpuscles. The ventral excretory canal is wide, the dorsal being a narrow tube overlapping it. Transverse vessels are present. The sex ducts pass between the longitudinal canals, and dorsally to the nerve.

The testes are numerous (30 to 36), and are arranged in two fields, one on each side of the female complex, the greater number of vesicles lying the aporal side. The vesicles have a diameter of from .016 to .022 mm., and are disposed in 3 indefinite layers. The vas deferens is seen to be a transversely placed, coiled mass lying anteriorly, and extending from the front of the ovary laterally above the ventral excretory vessel to enter the small cirrus-sac. The latter is a pyriform structure .09 to .100 mm. in length, and .045 to .060 mm. in breadth. There is a distinct vesicula within the sac. The cirrus is short. The male pore lies above and in front of the female aperture, both opening into the short narrow genital cloaca.

Lying near the middle of the segment is the reniform ovary, the concavity facing posteriorly; and the ovarian tubes being directed forwards and slightly outwards. The vitellarium appears as a rounded organ lying ventrally at some distance behind the ovary, while in front of the yolk gland is the shell gland. The vagina travels inwards below the posterior margin of the cirrus sac, curving backwardly to cross over the ovary. At sexual maturity, practically the whole of it becomes a swollen tube, serving as a receptaculum seminis.

There are numerous egg capsules, extending laterally between the excretory vessels into the cortex Each contains a single egg, .026 by .030 mm. in size, and possessing three shells. The oncosphere has a diameter of .015 mm., its hooklets measuring .006 mm. in length.

5. *Anomotaenia asymmetrica*, n.sp.

(Plate xv., Fig. 11.)

In addition to some specimens of a *Bancroftiella* (described below), a few detached sexually mature segments of another cestode were taken from the intes-

tine of the white egret, *Herodias timoriensis* Less. Owing to the absence of a scolex, the generic position is uncertain, but the characters of the proglottids are similar to those present in *Anomotaenia* and *Choanotaenia*. It is probably a member of the former genus.

The segments vary somewhat, but those figured may be taken as typical. They are from .4 to .7 mm. long by .44 mm. broad, with the posterior edges rounded off and projecting slightly. The regularly alternating genital pores are situated near the junction of the anterior third, and the posterior two-thirds of the margin. A genital papilla is not usually recognisable. The ventral excretory vessel passes below the sex ducts. Transverse canals are present, but dorsal tubes were not detected. There are numerous (28 to 36) testicular vesicles lying behind the female genitalia, and arranged in two layers in the medulla. Their size is about .024 by .018 mm. The vas deferens may be recognised as a narrow tube passing forwards above that ovarian lobe, which lies nearer the pore-bearing edge, becoming widened, and thrown into small loops, which terminate at the cirrus-sac. The latter is an elongate structure, .07 to .12 mm. in length, and .02 mm. in maximum breadth. The genital cloaca is short, the male aperture lying antero-dorsally to the female pore.

The ovary is a relatively large asymmetrical bilobed organ; hence the specific name *asymmetrica*, the lobe nearer the pole-bearing margin of the segment being small in comparison with the other. Each, especially the larger, is made up of numerous digitiform tubes. The gland lies near the middle of the proglottis, the female complex, as a whole, being slightly displaced towards the pore-bearing edge. The maximum breadth of the ovary is .18 mm. From the well-marked ovarian bridge there passes off postero-ventrally the oviduct, at the commencement of which is a small swallowing apparatus. The duct follows an arched course, and comes to penetrate the shell gland from below. At about midway between this gland and the bridge, the vagina comes into relation to it. The latter duct passes almost diagonally inwards and backwards from the female pore, below the outer portion of the cirrus-sac and above the ovary. In the region of the female gland a small receptaculum seminis is recognisable. The shell gland has a breadth of .022 mm., and lies midway between the ovary and the vitellarium. The latter is .065 mm. broad, and is situated just in front of the testes. It is much lobed, and possesses a comparatively long duct. The uterus extends forwards from a shell gland, passing above the oviduct and ovarian bridge as a simple narrow tube. None of the segments possessed eggs, hence the form of the mature uterus is not known.

Fuhrmann (1905, p. 315) described a species of *Anomotaenia* (*A. glandularis*) from a similar host from Sumatra. It does not appear to be a typical *Anomotaenia* on account of the arrangement of the testes. It is referred to below as *Bancroftiella glandularis*. This form is quite distinct from *A. asymmetrica*.

6. *Anomotaenia accipitris*, n.sp.

(Plate xv., Figs. 12-15.)

A few specimens of this small cestode, which is only about 14 mm. long, the

maximum breadth (ripe segments) being .65 mm., were taken from the intestine of the sparrow-hawk, *Accipiter cirrhocephalus* Vieill.

The scolex is distinctly marked off from the neck, and is from .097 to .138 mm. in width. The prominent retractile rostellum bears 24 to 30 hooks arranged in two series, those of the anterior circlet being .042 mm. in length, while those of the posterior are much shorter (.027 mm.). The dorsal root is long and straight, the ventral root small, and the blade relatively narrow, and long with a well-curved point. The rostellar sac lies anteriorly to the suckers. The latter have a diameter of .06 mm., and may project.

The short unsegmented neck is succeeded by a strobila, with strongly serrate margins. In sexually mature proglottids there is a considerable amount of overlapping, but this decreases until there is practically none in the case of ripe segments. The breadth of the strobila increases rapidly until sexual maturity is reached. Ripe segments are almost round, the posterior margin, however, being straight, with slightly projecting corners. The genital pores lie laterally in an irregularly alternating manner in the anterior fourth of the proglottis in the overlapping portion. A papilla is seldom to be seen, and even when the cirrus is everted, is quite a small prominence.

The ventral excretory trunk is fairly wide, the narrower sinuous dorsal canal lying above it. The sex ducts pass between them, and above the longitudinal nerve. Transverse vessels are present.

There are nine or ten testes behind the ovary, and from four to six in front of it on the aporal side. Some of the vesicles may overlie the female organs. Their position is distinctly dorsal. They possess a diameter of .020 mm., and are well developed, while the female genitalia are still in an immature condition. The vas deferens passes forwards becoming considerably coiled, the loops overlying the inner end of the cirrus-sac. The latter is a long tubular structure, usually slightly bent, lying close to the anterior border of the segment, and extending to the median line. The length is about .24 mm., and the breadth .030 mm., though the sac is frequently shorter and more fusiform. The cirrus is very long, and lies coiled within the sac. Everted cirri were seen to be .015 mm. in breadth, and to possess an armature of moderately strong hooks. The male aperture lies antero-ventrally to the female pore, both opening into a short cloaca.

The ovary, though relatively large, is not very conspicuous on account of the testes overlying it. The organ is bilobed, each lobe being digitate. The vitellarium appears as a rounded structure lying ventrally near the posterior margin of the segment. Its duct is long and narrow. The shell gland is quite small. The vagina travels inwards, and slightly dorsally in a sinuous course as a fairly wide tube, whose lumen becomes increased in front of the ovary. The receptaculum seminis is succeeded by a narrow tube passing backwards above the ovarian bridge to penetrate the shell gland. The uterus is at first a transverse tube lying in the region of the ovary, but later, the ends become expanded, and develop posteriorly, so that the organ assumes a horseshoe shape, partly enclosing the vitellarium. Partitions arise from the wall, and project into the lumen.

As a result of gradual growth the organ ultimately becomes a rounded sac, the partitions being less obvious as maturity advances. In ripe segments, the only persisting parts of the genitalia are the cirrus-sac and the vagina.

The eggs are rounded (.030 mm. by .027 mm.), and possess three shells. The oncosphere measures .021 by .017 mm., its hooklets being .006 mm. long.

7. *Bancroftiella glandularis* (Fuhrmann), Johnston.

(Plate xv., Figs. 16-17; Plate xvi., Fig. 18.)

This species of cestode was taken from the white egret, *Herodias timoriensis* Less., and from the blue crane, *Notophoyx novaehollandiae* Lath., only a few fragments having been collected from the latter host. In most of its characters, *B. glandularis* approaches very closely to *B. tenuis*, which I have recently described (Johnston, 1911b, p. 50), as being taken from a marsupial, *Macropus ualabatus* Less. and Garn.

The scolex (Fig. 18) is of the same general shape as in *B. tenuis* the breadth is .20 mm. The conspicuous retractile rostellum bears two series of powerful hooks (Fig. 17), there being about 20 of the latter, those of the anterior circlet measuring .087 mm., and those of the second row .053 mm. in length. As will be seen from the figure, the form is somewhat different to that given by Fuhrmann, and in addition the sizes are different. The larger hooks seem to me to belong to the anterior series. The suckers project as hemispherical organs opening laterally.

The strobila is fairly long, some specimens reaching 70 mm., with a maximum breadth of about a millimetre. Beyond the unsegmented neck, the margin is serrate. In proglottids, which have reached sexual maturity, the breadth is from four to six times the length, while in ripe segments it is only about twice. The genital pore alternates irregularly, and lies close to the anterior border of the proglottid, being frequently in the overlapping portion. A papilla may be present.

The cortex occupies a wide area laterally, and contains abundance of calcareous corpuscles. The longitudinal excretory canals travel at some distance inwardly from the margins of the strobila. The ventral vessels are wide and sinuous, the narrow dorsal tubes lying above them. Small transverse vessels are present connecting the ventral canals. Lying laterally from each of the latter is the main longitudinal nerve. The sex ducts pass between the excretory vessels and above the nerve.

There are from forty to fifty testes disposed in two fields, a post-ovarian series of about thirty, and a pre-ovarian group of from ten to eighteen vesicles. They were not detected above the female glands, though Fuhrmann has stated that he found them in this position in the single specimen at his disposal. They are arranged in two or three layers, but approach the dorsal surface rather than the ventral. Their size is about .03 by .02 mm. (Fuhrmann gives .07 mm. diameter). The vas deferens is a swollen, loosely-coiled mass, situated inwardly from the cirrus-sac, whose inner end is covered dorsally by some of the coils. The sac is relatively long (.30 to .36 mm.), and narrow (.03 mm. wide). Within it lies the cirrus,

which is thrown into several irregular coils. The male pore opens into the narrow genital cloaca below, and usually slightly anteriorly to the female aperture.

The ovary is a large bilobed transversely-placed gland, a narrow bridge connecting the lobes. Its breadth is about .56 mm., the organ extending almost to the excretory vessels on each side. The oviduct is short and narrow. The shell gland is to be recognised as a rounded structure, lying dorsally between the ovarian bridge, and the kidney-shaped vitellarium. The latter possesses a very short duct.

The vagina is at first a narrow tube, but soon widens, maintaining a relatively wide lumen, until it reaches the ovarian bridge, which it crosses dorsally. Its general course is transverse to the longitudinal axis of the strobila, above and behind the cirrus sac, and then gradually passing more ventrally. Not infrequently the duct becomes thrown into a few loose coils, or its entire course may be sinuous. The walls are lined with a cuticle, which in ripening segments is seen to extend as far inwards as the region of the ovarian bridge. Beyond this point the vagina narrows, passing backwards above the bridge, and then through the shell gland complex, which lies antero-dorsally to the vitellarium.

The uterus arises as a very short, slightly branched tube just behind and below the ovary. The extremities extend outwards and enlarge, the two testicular fields becoming pushed towards the anterior and posterior margins of the segment respectively, as in *B. tenuis.* The mature uterus is a bilobed structure, there being a posterior median septum, in which the remains of the vitellarium lie. At first sight the organ appears to be sac-like, as this septum becomes very narrow, and resembles the numerous projections, which develop from the uterine walls, dividing up the lumen into a number of chambers. Though the ovary soon disappears, the testes persist for a considerable time, but in ripe segments the only portions of the genitalia which remain, are the sex ducts. The eggs measure 28 by 19 micra, the embryo being 11.5 by 9.5 micra.

The main differences between the above account, and that given by Fuhrmann, who described it as *Anomotaenia glandularis,* are in regard to the hooks and the testicular arrangement.

The range of this parasite is now considerably widened.

8. *Bancroftiella ardeae,* n.sp.

(Plate xvi., Fig. 19.)

A few poorly preserved fragments of a tape worm collected from the night heron, *Nycticorax caledonicus* Gmelin, belong to the genus *Bancroftiella,* and appear to belong to a new species, closely related to *B. glandularis,* and still more closely to *B. tenuis.*. In fact, the fragments so nearly resemble segments of *B. tenuis* that it would be a difficult matter to separate them. The latter species was described from two mounted specimens, the name of the host being given as *Macropus ualabatus.* So far no armed adult cestode has, with this exception, been described from Australian aplacental mammals, hence it is possible that a mistake may have been made in labelling the slide. For the present, however, we must assume that the host name given by the collector of the specimens is correct, and

that we are dealing with two distinct species. It is of interest to note that with this exception, the species of *Bancroftiella* have been taken from herons, viz., *Herodias timoriensis, Notophoyx novachollandiae* and *Nycticorax caledonicus.*

There is no scolex present. The form of the proglottids may be seen by glancing at the figure (Fig. 19). They are relatively longer, and narrower than in *B. glandularis,* being about .25 mm. in length and .50 mm. in maximum breadth. The genital pores alternate irregularly, and lie on a prominent papilla in the anterior third of the margin of the segment.

Round or elliptical calcareous corpuscles (7.5 to 9.5 micra) occur abundantly in the cortex. Dorsal excretory vessels were not recognised, but the ventral canals are relatively wide tubes, the sex ducts passing over them as well as above the longitudinal nerve.

The testes are arranged in an anterior field containing about fourteen vesicles and a posterior of sixteen or eighteen. The vas deferens passes on the poral side of the anterior testes to enter the relatively large cirrus-sac. There appears to be a vesicula seminalis within the latter. The cirrus when at rest is loosely coiled. The sac is a bent structure occupying one of the anterior corners of the segment, its dimensions being—length, .16 to .19 mm., and breadth, .035 mm. The male pore opens into a long genital cloaca just below and in front of the female aperture.

The female complex is similar to that in *B. tenuis.*. The ovarian lobes consist of branched tubes. The vagina travels inwards postero-dorsally to the outer portion of the cirrus-sac, its course being usually sinuous. The lumen may gradually diminish, or it may remain at about the same size. The inner wall bears a lining of cuticle. A uterus was not present in any of the segments.

9. *Cyclorchida omalancristrota* (Wedl), Fuhrmann.

(Plate xvi., Figs. 20-21.)

Several specimens of this interesting cestode were taken from the black-billed or royal spoonbill, *Platalea regia* Gould, but none of those examined showed the presence of mature uteri. The largest is about 6 cm. long, the maximum breadth being a little more than a millimetre. Most of these tapeworms are imperfectly preserved. Hooks are missing but the positions of insertion of the two series can be recognised. The scolex is a relatively large rounded organ, measuring .40 mm. in breadth, the powerful slightly projecting suckers having a diameter of about .18 mm. The anterior end forms a short thick rostellum, which bears two series of hooks. Fuhrmann (1907, p. 525) has drawn attention to the marked difference in size between the hooks of the two series (.17 mm. and .060 mm. long respectively), Krabbe (1869, p. 34, Pl. v., Fig. 96) has figured them. The musculature of the rostellar sac is very strongly developed.

The short unsegmented neck is succeeded by a strobila with serrate margins. Sexual maturity is reached when the proglottids are about .30 mm. long by 1.3 mm. broad. Genital pores are unilateral (on the right side), and open near the middle of the margin. The cloaca is a narrow bent tube.

Calcareous corpuscles of an elongate elliptical form are abundant in the cortex. The ventral excretory canal is much wider than the dorsal vessel, which lies directly above it. The sex ducts and, later, the uterus pass between these canals and above the longitudinal nerve. As already mentioned by Fuhrmann (p. 525) the outer longitudinal musculature consists of more numerous, though smaller bundles than the inner series.

The testes are very numerous, from seventy to eighty being counted in a segment. When mature they are about .02 mm. in diameter, and are arranged in several layers, but approximate the dorsal surface. Their distribution is characteristic since they surround the female complex, the greater number of vesicles lying behind the ovarian wings. The vas deferens passes above the right lobe of the ovary, and then antero-laterally above and approximately parallel to the vagina. In the neighbourhood of the excretory canals it widens and forms a large closely-coiled mass, and even after entering the cirrus-sac it is still coiled, though to a much less degree. The walls of the cirrus appear to be smooth. In young segments the cirrus-sac extends inwards to the excretory vessels, but in more mature proglottids, it is much longer. Its inner end may be overlain by the coils of the vas deferens. The outer end terminates on a relatively large papilla projecting into the lumen of the genital cloaca. The female aperture thus opens into the common canal more internally than the male pore.

The mature ovary appears as a large organ (.57 mm. broad), occupying the middle of the segment, and approximating the ventral surface. The two main lobes are connected by a narrow bridge, the lobes being short tubes, extending dorsally and ventrally, and arranged mainly around the margins of the gland. The edges may underlie some of the testes. The short oviduct enters the vagina ventrally. The vitellarium is a reniform or bilobed organ, situated postero-ventrally to the ovary, a small yolk reservoir lying in the concavity. The shell gland is placed just antero-dorsally to the vitellarium.

At the base of the genital cloaca there lies the female pore. From it the vagina travels inwards above the cirrus-sac, at first as a rather narrow tube, but widening after passing between the excretory canals, and below coils of the vas deferens. Extending from this region to the female complex the duct is really a wide, elongate, thin-walled receptaculum seminis. After crossing above the ovarian bridge, it narrows into the fertilising duct. Gland cells occur in the walls of the outer part of the vagina.

Passing forwards from the shell gland, dorsally to the vagina and ovarian bridge, is a narrow tube—the uterine duct—which bends ventrally immediately in front of the bridge to come into relation with the developing uterus The latter is at first a narrow tubular structure, placed transversely and lying below the ovary, extending laterally between the excretory canals, and above the nerve into the cortical parenchyma. The terminal portions are slightly swollen. Fuhrmann (p. 526) states that the mature uterus fills the segment, and that ingrowths from the wall divide up its cavity. The size of the oncosphere is given as .024 mm.

Fuhrmann's specimens were collected from *Platalea leucorodia* in Egypt, while Wedl's material came from the same host species from Hungary. Fuhrmann and Krabbe (1869, p. 34) give the length as 25 cm., and the breadth as 4 mm. The finding of Wedl's species in *Platalea regia* greatly widens the geographical distribution of this parasite, which Fuhrmann has made the type of his genus *Cyclorchida*.

10. *Dipylidium caninum* (L.).

Numerous specimens from a dog. Not previously recorded from North Queensland.

11. *Hymenolepis diminuta* (Rud.)

A few specimens from *Mus decumanus* Pall. Not previously recorded from North Queensland.

12. *Hymenolepis ibidis*, n.sp.

(Plate xvi., Figs. 22-24.)

Very delicate imperfectly preserved cestodes were taken from the intestine of the yellow-billed spoonbill, *Platibis flavipes* Gould, the length being about 13 mm. and the maximum breadth .076 to .090 mm. Ripe segments possess about the same width, and slightly greater length than those bearing sexual organs. The scolex has a diameter of .097 mm., being very little wider than the neck, which, however, is gradually narrowed until it is only .032 mm. broad. There are four weak suckers (.04 mm. diameter), and a relatively long rostellum (.130 mm. in length) from whose rounded swollen extremity the hooks have fallen off. The rostellar sac is large.

The relatively long neck is succeeded by a short-segmented strobila. The genital pores are unilateral, and open just in front of the middle of the right-hand margin. Between the wide ventral excretory vessels lies the narrow medullary zone. Calcareous corpuscles are abundant in the cortex.

Owing to the small size of the parasite, and the condition of the material, the following account of the genitalia is far from being complete. Of the three testes one lies on the poral side of the midline, the remainder being on the other side, one in front of the other. The cirrus sac extends almost to the ventral vessel of the same side, and contains a protrusible wide (5.8 micra) cirrus.

The ovary is a compact, slightly lobed organ situated between the two posterior testes, which partly overlap it, while the rounded vitellarium is near the posterior edge of the segment. Coursing directly inwards from the female pore, beside and postero-ventrally to the cirrus sac, is the vagina, which becomes slightly swollen to form a long narrow receptaculum seminis. The mature uterus is a small compact, rectangular sac lying between the excretory canals, and thus occupying only about half of the medullary parenchyma.

Wedl's account (1856) of *Taenia filirostris* (*Hymenolepis filirostris*), from *Platalea leucorodia*, and *Ibis melanocephala* is not available, hence I am unable to compare it with the specimens from *Platibis flavipes*. It is quite distinct from the other species of *Hymenolepis*, known from the *Ardeiformes*.

13. *Hymenolepis megalops* (Nitzsch), Parona.

A few cestodes collected from the intestine of the pied goose, *Anseranas semipalmata* Lath., belong to the above-mentioned widely distributed species, whose occurrence in Queensland is now definitely recorded for the first time. Krefft (1871, p. 220), described a tapeworm, *Taenia cylindrica* Krefft (nec Clerc), from the black duck, *Anas superciliosa*, but an examination of his original material (Johnston, 1912, p. 33), has shown the species to be identical with *Hymenolepis megalops*, which is now known to infest several Australian anseriform birds.

14. *Hymenolepis terraereginae*, n.sp.

(Plate xvi., Figs. 25-26.)

In company with *H. megalops*, there were taken from *Anseranas semipalmata*, numerous delicate scolexless tapeworms 20 to 30 mm. long, whose anatomy, in so far as the poorly-preserved fragmentary material has allowed comparison, closely resembles that of *H. collaris* (syn. *H. sinuosa*).

The anterior segments are small, there being a gradual increase in their dimensions until a breadth of about .4 mm. is reached. The genital pore lies in the anterior third of the proglottid edge. The transverse ventral excretory vessels have a much wider lumen than the dorsal vessel. The sex ducts pass above both longitudinal canals. The musculature is weakly developed. The cortex contains numerous calcareous corpuscles.

The three testes, whose diameter is about .045 mm., lie dorsally in the mid-region of the segment, their relative positions being indicated by the figure. The vas deferens is at first a coiled tube lying in the anterior aporal corner, inwardly from the accessory sacculus. Within the long thin-walled cirrus-sac the male duct becomes swollen to form a large vesicula, occupying the inner portion of the sac. From the outer end of the vesicula there passes away the long loosely-coiled cirrus, which is frequently bent upon itself. The outer portion of the sac is long, tubular, and bent, the inner end being more or less pyriform or fusiform. The everted cirrus is relatively broad, and may project freely. Lying in the antero-dorsal part of the segment is the large accessory sacculus, whose inner portion contains a mass of radiating muscle in its walls, the outer being thin-walled. It is lined internally by cuticle, which has an appearance suggestive of the presence of numerous small ridges on its surface. The cirrus-sac opens below the sacculus.

The ovary is a trilobed gland, situated below the testes on a plane dorsal to the vitellarium, but ventral to the receptaculum seminis and accessory sacculus. The rounded vitellarium lies between and below the posterior pair of ovarian lobes. The vagina may be slightly coiled, and may be enlarged to form a receptaculum. It crosses above the ovary. The mature uterus is a sac-like structure lying ventrally to the other organs, and extending laterally above the ventral vessels into the cortex. The eggs possess two shells, and measure 19-25 micra long by 15-17 micra broad, the size of the embryo being 15 by 11.5 micra.

15. *Diorchis flavescens* (Krefft), Johnston.

The collection contains numerous specimens taken from a black duck, *Anas superciliosa* Gmelin. This species was originally described by Krefft (1871, p. 219) as *Taenia flavescens*, but has been transferred to the genus *Diorchis* (Johnston, 1912, p. 15). It is now recorded for the first time from Northern Queensland.

16. *Aploparaksis australis*, n.sp.

(Plate xvi., Figs. 27-32.)

From the intestine of the snipe, *Gallinago australis* Lath., there were taken several small cestodes varying in length from 25 to 40 mm., with a maximum breadth of one millimetre, which appear to represent a new species of *Aploparaksis*. The scolex is distinctly marked off from the rest of the strobila, being followed by a short narrow unsegmented neck. The breadth of the scolex is .16 mm. The suckers are relatively large and muscular, while the rostellum is a prominent organ bearing a circlet of eight hooks, whose length rrom the dorsal root to the end of the claw is from .019 to .022 mm. The claw is long, thin, and well curved as in *A. filum*, whose hooks are of about the same size. The terminal portion of the rostellum is somewhat swollen. The rostellar sac is relatively very long, extending backwardly within the scolex almost to the neck region.

Beyond the short neck, the strobila consists of numerous very narrow segments, whose breadth :length equals 9 :1. After male maturity the length increases more rapidly, and at female maturity the ratio is 7 :1; while in proglottids with ripe eggs it varies from 2 :1 to 1 :1, as the posterior end of the strobila is approached. In final segments from which the eggs have been extruded the length may be considerably greater than the breadth. The genital pore opens unilaterally at about the middle of the margin.

The longitudinal musculature is somewhat similar to that described by Cohn (1902a, p. 572). The outer series consists of a ring of numerous small bundles, while the inner contains fewer but much larger bundles. The ventral canal, though narrow, is much wider than the dorsal vessel. Both are situated deeply in the medulla. In ripening segments transverse vessels are recognisable. Lying dorsolaterally from each ventral canal is the main nerve The sex ducts pass above both excretory vessels and also the nerve, to open on the right-hand side of the strobila.

There is a single transversely elongate or rounded narrow testis, lying in the middle of the segment. A short vas deferens passes away from the gland to enter the vesicula seminalis, which is a relatively large, thin-walled structure lying laterally from the testis, and becoming narrowed as it extends outwards above the excretory vessels. It continues as the slightly coiled vas deferens which penetrates the short cirrus-sac, the latter being only .045 mm. long. This organ is also small in *A. crassirostris*. The cirrus is short and relatively thick. Male maturity is reached at a time when the female glands are still in a rudimentary stage.

The bilobed ovary* is transversely elongate, whilst just behind it lies the

* The ovary may be much more distinctly bilobed than is indicated in the figure. In such case the ovarian bridge is relatively long and narrow.

rounded vitellarium. The vagina travels inward from the female pore (which is postero-ventral to the male aperture) below and behind the vas deferens, and more or less parallel to it. The course may be sinuous. The inner part widens to serve as a receptaculum seminis.

The uterus appears first as a transverse tube, but eventually fills the medulla, part coming to lie below the cirrus-sac. The greater part of the strobila contains eggs, while ripe eggs occur in a relatively considerable number of segments. The eggs are similar in shape to those of *A. filum*, there being usually a distinct thickening of the shell at each pole. The eggs measure .057 mm. by .042 mm., while the dimensions of the oncosphere are .034 by .025 mm., the hooklets being .015 mm. long.

The various species of *Aploparaksis* from charadriiform birds approach one another very closely. *A. australis* seems to me to be nearer *A. filum* and *A. pubescens* (*A. hirsuta*) than to any of the others (Clerc, 1902a, p. 573), but differs from the former mainly in being only a quarter or a third of the length and in possessing a very short cirrus-sac. A full account of *A. pubescens* is not available to me. *A. crassirostris* (Krabbe, 1869, p. 314; Clerc, 1902a, p. 572) differs from our species in regard to the characters of the rostellum and of the eggs, as well as in the size of the rostellar hooks. *A. pseudofilum* resembles it in nearly all particulars, but lacks the polar thickenings of the egg shells. *A. penetrans* Clerc (1902b, p. 658) has characteristic hooks. A detailed account of *A. brachyphallos* Krabbe is not available (Fuhrmann, 1906).

17. *Diploposthe laevis* (Bloch), Jacobi.

A few fragments of this interesting species were taken from the whistling duck, *Dendrocygna arcuata* Cuvier. It is now definitely recorded from Queensland for the first time, and is the only entozoon as yet known from this host, though the parasite enjoys a wide geographical distribution, being known to occur in many anseriform birds in the Northern Hemisphere. Specimens from *Aythya australis* were described by Krefft (1871, p. 215), under the name *Taenia tuberculata*, which has been shown (Johnston, 1912, p. 4), to be a synonym of this species.

18. *Acanthotaenia tidswelli* Johnston.

An immature fragment of an *Acanthotaenia* from the intestine of *Varanus varius* Shaw, is most probably referable to the above species, which is known (Johnston, 1909, p. 103) to occur in this lizard. In company with it were several specimens of a small species of *Bothridium* (*Solenophorus*).

19. *Dibothriocephalus felis* (Creplin).

Several specimens from a cat and also others from a kitten. Not previously recorded from Queensland.

20. *Bothridium pythonis* var. *parva* var. nov.

(Plate xvi., Fig. 33; Plate xvii., Figs. 34-37.)

Several specimens of a comparatively small species of *Bothridium*, allied to

B. pythonis Blainville (syn. *Solenophorus megalocephalus* Creplin), were taken from the intestine of the common monitor lizard, *Varanus varius* Shaw.

The longest example measures 43 millimetres in length by 2.3 mm. in breadth, but some were obtained, which were only a few millimetres long. Owing to the relatively large size of the bothria, the scolex appears as a very prominent organ, which in the largest specimen available measures 3 mm. in its dorso-ventral diameter, each bothrium being approximately 1.5 mm. in width by 2.5 mm. in length. The shape is somewhat similar to that figured by Monticelli (1891, Fig. 1a and 1d) from specimens taken from pythons. I have compared the parasite from *Varanus* with some in my possession from *Python variegatus* and *Python spilotes* from New South Wales, and from *P. molurus* (from Melbourne Zoological Gardens, collected by Mr. A. S. Le Souef). The scolex is much smaller than in examples from pythons, and, moreover, has a different general form, but this may be the result of muscular contraction. The parasites from *P. molurus* possess a scolex similar to that figured by Monticelli in his figure 1e, while those from *P. variegatus* and *P. spilotes* have the same shape as that indicated in his Fig. 3, which also refers to a specimen from *P. spilotes.** The bothria are long and cylindrical in the parasites from Australian pythons.

It seems to me quite probable that Baird's *B. arcuatum* may be a distinct species. The cestodes from *Varanus* and those from *Python* appear very different when placed side by side. The internal structure does not, however, show any very distinct difference from that figured by Roboz (1882, copied by Braun, 1897, Pl. 53, Fig. 12), and by Monticelli as occurring in *B. pythonis*. The general form of the segments, the position of the genital and uterine apertures, and the arrangement of the muscular and excretory systems are similar.

The longitudinal muscles form a very strong and relatively wide ring, within which are the well-developed transverse fibres. Dorso-ventral fibres are also readily recognisable. The ventral excretory canal is much larger than the dorsal vessel, which lies above and somewhat laterally from it. Transverse vessels connect the ventral ducts. Lying on the same plane as, and laterally from, the latter are the prominent longitudinal nerves.

The testes consist of numerous vesicles (.033 mm. in diameter), rather larger than the vitelline follicles, and lying in the medulla, extending laterally beyond the nerve cord and the excretory canals of each side. The vas deferens becomes a coiled tube lying beside and above the cirrus-sac. The latter is large and rounded (.22 mm. in diameter). The male and female apertures open at about the same level into a short genital cloaca, through which the cirrus may be protruded. The ovary appears as a compact bilobed organ situated in the posterior region of the segment. Its lobed wings project dorso-laterally. Lying between and behind the lobes is the large round shell gland, perforated by the narrow fertilising duct.

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*Monticelli (1891) re-examined Baird's type (1865, p. 52) of *B. arcuatum* from the Australian python and synonymised it (p. 15) with *Solenophorus megalocephalus*, i.e., *B. pythonis*.

Vitelline follicles occur abundantly in the dorsal and ventral cortical parenchyma (diameter .016 to .025 mm). The common vitello-duct travels forwards from the posterior portion of the segment to enter the shell gland ventrally.

The course of the vagina as it passes back from the female pore to cross the ovary is somewhat sinuous. After becoming narrowed it enters the shell gland, and then bends ventrally to pass forwards below the ovary as the uterus. The latter is at first a short narrow tube terminating at the uterine opening, which lies in the median line at about midway between the common genital pore and the posterior border of the proglottid. In ripening segments, the uterus becomes greatly enlarged and somewhat convoluted to form a swollen thin-walled sac occupying the middle of the proglottid, and extending dorsally, posteriorly and anteriorly, so as to overlie the cirrus-sac, vagina, ovary (in part), and shell gland.

The differences between this lacertilian parasite and *B. pythonis* are not very marked, and for the present I prefer to consider the former as a variety of the latter, though it is likely that a more detailed study will show that not only *B. parvum*, but also *B. arcuatum*, are specifically distinct from *B. pythonis*.

It is of interest to meet with the genus *Bothridium* in Varanidae, as the genus *Duthiersia* is the representative of the *Bothridiinae* (*Solenophorinae*) which usually occurs in monitors.

21. *Sparganum* sp.

An imperfectly preserved larval cestode from the tissues surrounding the intestine of a brown snake,*Diemenia textilis* D.&B., may be placed under the collective genus *Sparganum*. It measures a centimetre in length by 1.4 mm. in breadth. There is a small slit at one end. Segmentation is imperfect. The longitudinal musculature is seen to consist of numerous bundles.

22. *Gigantorhynchus moniliformis* (Bremser).

Specimens of this echinorhynch, which has not been previously recorded from Queensland, were taken from the Norway rat, *Mus decumanus* Pall. The name *G. hirudinaceus* probably is correct for this species.

23. *Gigantorhynchus asturinus*, n.sp.

(Plate xvii., Figs. 38-41.)

A few echinorhynchs were collected from the intestine of a white hawk, *Astur novaehollandiae* Gmelin. Nearly all of them are in a more or less coiled condition, and all exhibit a strongly-marked series of annulations. The female worms may reach a length of 40 mm., the males being smaller, measuring about 23 mm. The general breadth of each is from .3 to .4 mm., though the anterior end may sometimes be slightly wider. The posterior end of each sex is concave, the gonopore thus lying in a depression.

The proboscis or rostellum is a more or less rectangular organ, .60 mm. long and .38 mm. in maximum width, the anterior portion being rounded off, and rather narrower than the basal. The hooks project backwardly as very sharp slender

thorns lying parallel to the surface of the rostellum. They are arranged in numerous rows. The proboscis sheath has a length of about 1.2 mm.

The testes are relatively large, elongate glands, situated anteriorly, not far from the proboscis sheath. The glands slightly overlap. The vasa deferentia are very long ducts, terminating in the large vesicula seminalis or ejaculatory duct near the posterior extremity of the worm. Beyond this the duct becomes narrowed, and surrounded by the cement glands, almost immediately beyond which it enters the folded copulatory bursa. There appears to be a small penis projecting into the latter.

The female apparatus is of the usual echinorhynch type the uterine bell leading into the uterus whose proximal extremity is swollen, and marked off from the more tubular portion which follows. The uterine walls become somewhat thickened and folded in the lower part of its course. The duct terminates in a slightly widened vagina, which opens to the exterior.

Ripe eggs are about .045 mm. long by .023 mm. wide.

REFERENCES TO LETTERING.

a.s., accessory sacculus; b., bothrium; c., cirrus; c.s., cirrus-sac; c.b., cavity of bothrium; c.g., cement glands; d.e.v., dorsal excretory vessels; d.v.m., dorso-ventral muscle; e., egg; e.c., egg capsule; e.p., excretory pore; e.v., excretory vessel; g.c., genital cloaca; g.p., genital pore; h., hook; l., lemniscus; l.m., l.m.l., l.m. 2, longitudinal muscles; m.b., male bursa; n., longitudinal nerve; ov., ovary; p.s., proboscis sheath; r., rostellum; r.c., rostellar sac; r.s., receptaculum seminis; s., sphincter muscle surrounding genital cloaca; s.g., shell gland; s.l., suspensory ligament; t., testis; t.e.v., transverse excretory vessel; tr. m., transverse muscle; u., uterus; u.b., uterine bell; u.a., uterine aperture; u.d., uterine duct; v., vagina; v.d., vas deferens; v.e.v., ventral excretory vessels; v.g., vitelline gland; v.s., vesicula seminalis; vt. d., vitelline duct.

All figures except No. 5 have been drawn with the aid of a Zeiss camera lucida. Figs. 33, 34, 35, 37, 38, 39, 40 and 41 have been drawn to the scale indicated in Fig. 42; Figs. 1-4, 6-9, 11-14, 16, 18-22, 25-27, 29, 30, 32 and 36 to that indicated in Fig. 43; while Figs. 10, 15, 17, 23, 24, 28, and 31 have been drawn to the same scale as Fig. 44.

LITERATURE.

1865 Baird, *Ann. Mag. Nat. Hist.*, (3), 16, 1865, p. 52.

1897 Braun, Vermes in Bronn's Tierreich.

1902a Clerc, *Zool. Anz.*, 25, 1902, pp. 569-575.

1902b Clerc, *Zool. Anz.*, 25, 1902, pp. 658-664.

1903 Clerc, *Rev. Suisse Zool.*, 2, 1903, pp. 241-368.*

1900 Diamare, *C. Bakt., Orig.*, 28, 1900, pp. 846-850.

1901 Diamare, *C. Bakt., Orig.*, 30, 1901, pp. 369-373.

1901a Fuhrmann, *C. Bakt., Orig.*, 29, 1901, p. 757.

1901b Fuhrmann, *Zool. Anz.*, 24, 1901, p. 271.

1902 Fuhrmann, *C. Bakt., Orig.*, 32, 1902, p. 122.

1905 Fuhrmann, *Zool. Jahrb., Syst.*, 22, 1905, pp. 303-320.

1906 Fuhrmann, *C. Bakt., Orig.*, 41, 1906, p. 352.

1907 Fuhrmann, *C. Bakt., Orig.*, 45, 1907, p. 516.

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* Not available.

1908 Fuhrmann, *Zool. Jahrb., Syst.*, Suppl. X., (1), 1908.
1911 Fuhrmann, *Abh. Senckbg. Naturf. Ges. Frankfurt a M.*, 34, 1911, pp. 251-266.
1909 Johnston, *Proc. Roy. Soc. New South Wales*, 43, 1909, pp. 103-116.
1910 Johnston, *Proc. Roy. Soc. New South Wales*, 44, 1910, pp. 84-122.
1911a Johnston, *Proc. Linn. Soc. New South Wales*, 36, 1911, pp. 58-80.
1911b Johnston, *Proc. Linn. Soc. New South Wales*, 36, 1911, pp. 47-57.
1911c Johnston, *Proc. Roy. Soc. Queensland*, 1911, p. 233.
1912 Johnston, *Rec. Austr. Museum, Sydney*, 9, (1), 1912, pp. 1-35.
1869 Krabbe, *Bidrag*, etc., *Fuglenes Baendelorme* (also in *Dansk. Vid. Selsk. Skr. Naturw., Afd.*, 5, 8, 1869, pp. 249-368).
1871 Krefft, *Trans. Ent. Soc. New South Wales*, 2, 1871, pp. 206-232.
1888 Linstow, *Entozoa* in *Challenger Rep. Zool.*, 23, 1888.
1891 Monticelli, *Mem. R. Accad. Sci. Torino*, (2), 41, 1891.
1882 Roboz, *Z. f. wiss. Zool.*, 37, 1882, pp. 263-285.
1856 Wedl., *Sitzb. Akad. Wiss., Wien. Math.-nat. Kl.*, 18, pp. 5-27.

PLATE XV.

CITTOTAENIA TACHYGLOSSI.

Fig. 1.—Scolex.
Fig. 2.—Segment showing genitalia.
Fig. 3.—End of strobila, showing excretory pore; genitalia abnormal.

DAVAINEA CACATUINA.

Fig. 4.—Scolex.
Fig. 5.—Hook from sucker (sketch).
Fig. 6.—Part of strobila (sexually mature).
Fig. 7.—Segment with egg capsules.

DAVAINEA CONOPOPHILAE.

Fig. 8.—Scolex.
Fig. 9.—Segment.
Fig. 10.—Egg.

ANOMOTAENIA ASYMMETRICA.

Fig. 11.—Segment.

ANOMOTAENIA ACCIPITRIS.

Fig. 12.—Scolex.
Figs. 13, 14.—Segments.
Fig. 15.—Egg.

BANCROFTIELLA GLANDULARIS.

Fig. 16.—Segment, from *Herodias timoriensis.*
Fig. 17.—Hooks, from *Herodias timoriensis.*

PLATE XVI.

BANCROFTIELLA GLANDULARIS.

Fig. 18.—Scolex, from *Herodias timoriensis.*

BANCROFTIELLA ARDEAE.

Fig. 19.—Segment (dorsal aspect).

CYCLORCHIDA OMALANCRISTROTA.

Fig. 20.—Scolex.
Fig. 21.—Segment.

HYMENOLEPIS IBIDIS.

Fig. 22.—Scolex.
Fig. 23.—Segments (sexual, seen from dorsal surface).
Fig. 24.—Segments (ripe, seen from ventral surface).

HYMENOLEPIS TERRAEREGINAE.

Fig. 25.—Segments (at male maturity, dorsal).
Fig. 26.—Segments (at female maturity, ventral).

APLOPARAKSIS AUSTRALIS.

Fig. 27.—Scolex, lateral view.
Fig. 28.—Rostellum and hooks.
Fig. 29.—Segments (male maturity, ventral)
Fig. 30.—Segment (female maturity, ventral).
Fig. 31.—Eggs.
Fig. 32.—Transv. sect. of segment.

BOTHRIDIUM PARVUM.

Fig. 33.—Young segments.
Fig. 34.—Scolex lateral view.

PLATE XVII.

BOTHRIDIUM PARVUM.

Fig. 35.—Segments, with genitalia.
Fig. 36.—Genitalia.
Fig. 37.—Transverse section of segment.

GIGANTORHYNCHUS ASTURINUS.

Fig. 38.—Anterior end of female.
Fig. 39.—Posterior end of female.
Fig. 40.—Anterior end of male.
Fig. 41.—Posterior end of male.
Figs. 42, 43, 44.—Millimetre drawn to same scales as indicated earlier. (See References to Lettering.)

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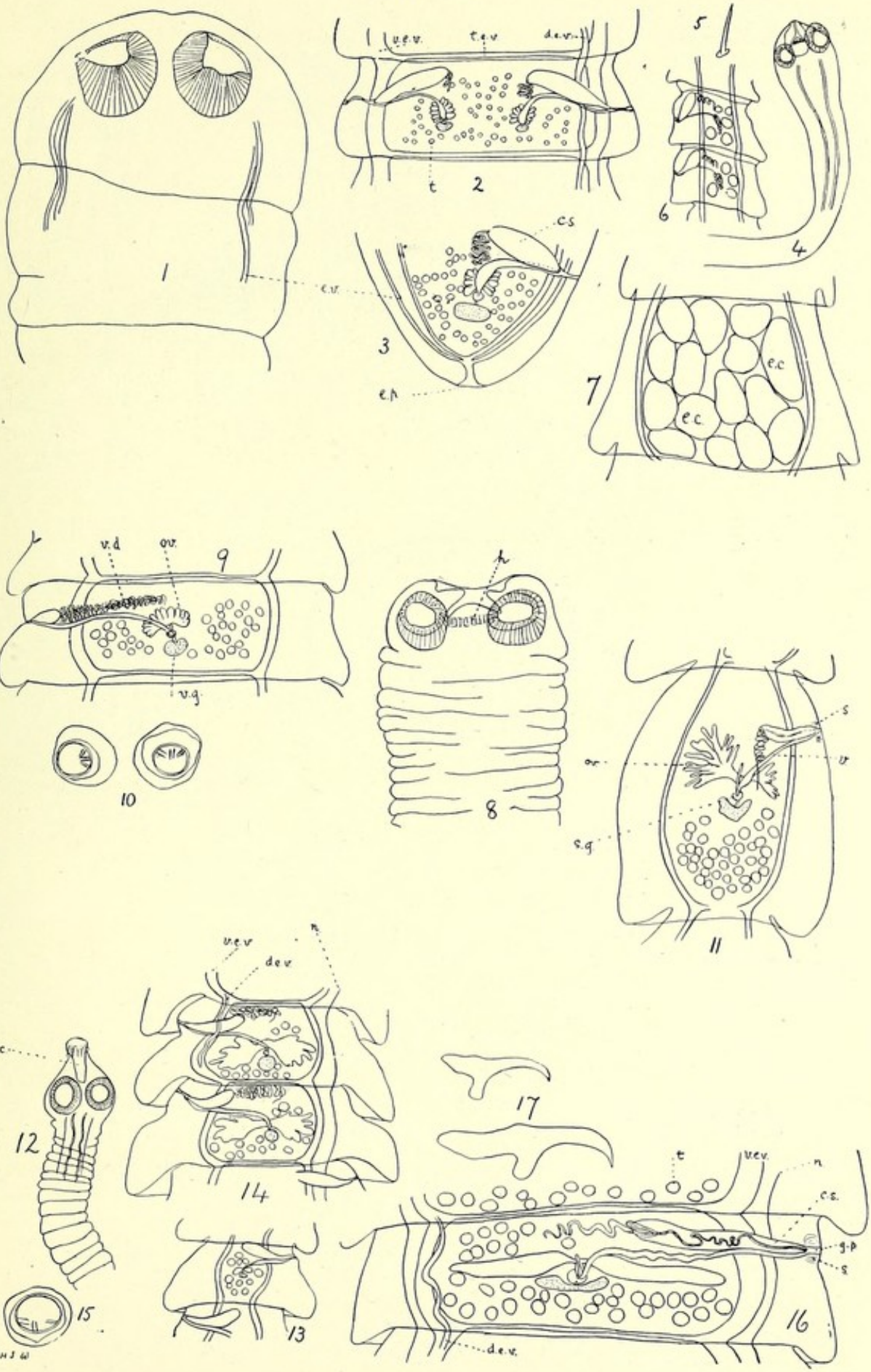
PLATE XV.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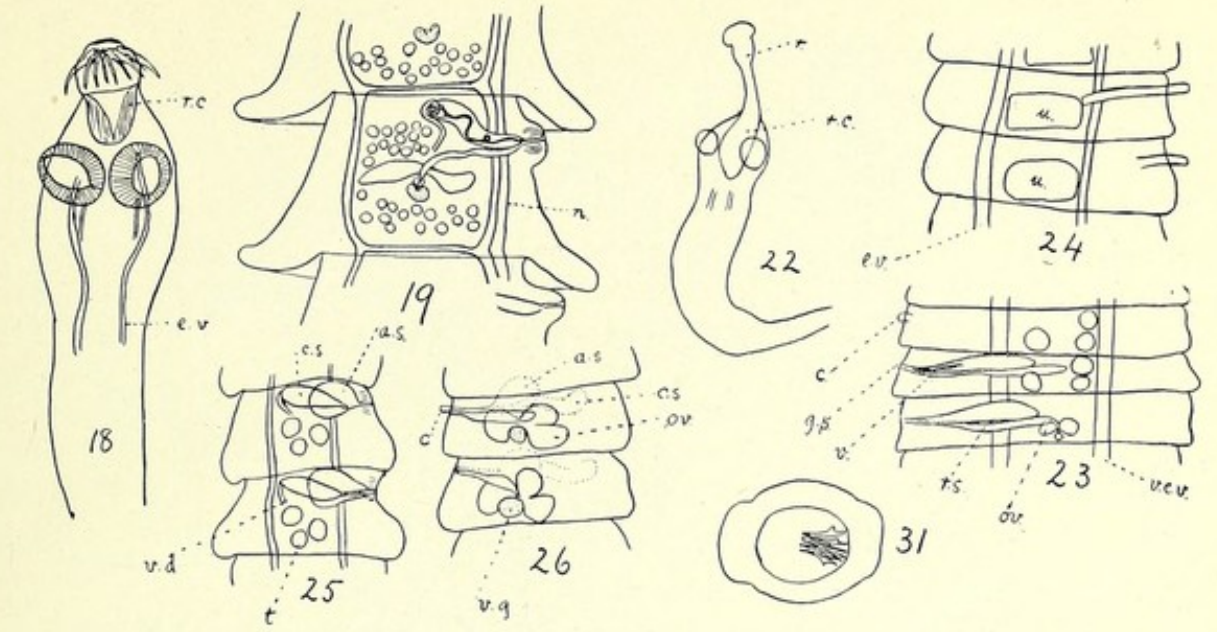
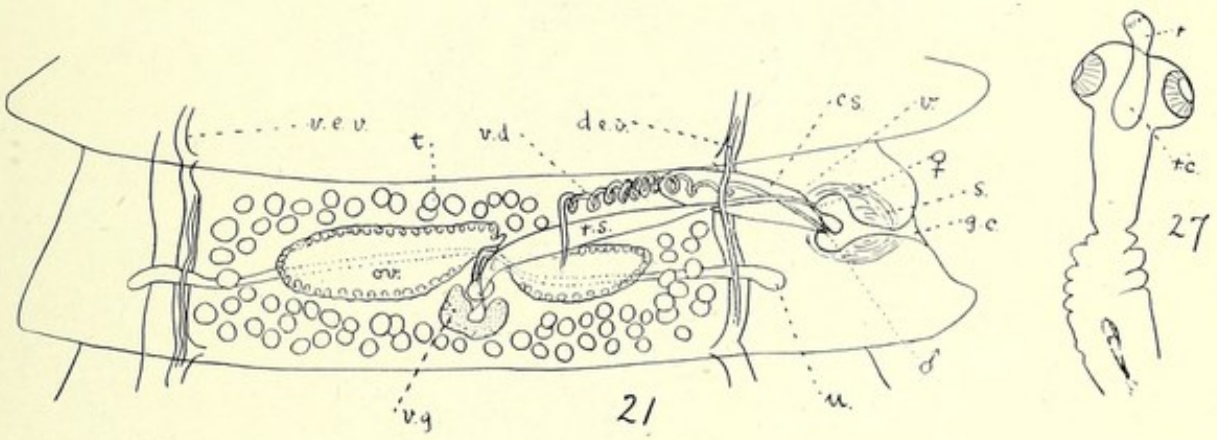
v.g.
10
h.
8
s.
ov.
v.
s.g.
11
v.e.v.
d.e.v.
n.
12
r.c.
14
17
t.
v.e.v.
n.
c.s.
g.p.
s.
16
15
13
d.e.v.
THJ W

PLATE XVI.


r.c
e.v
18
19
n
r
r.c
22
u
u
e.v
24
c.s
a.s
v.d
t
25
a.s
c.s
ov
c
26
v.g
c
g.p
v.
r.s
23
v.e.v
ov
31


v.e.v
t
v.d
d.e.v
c.s
v.
r.s
ov
g.c
s.
♂
u.
v.g
21
r
r.c
27

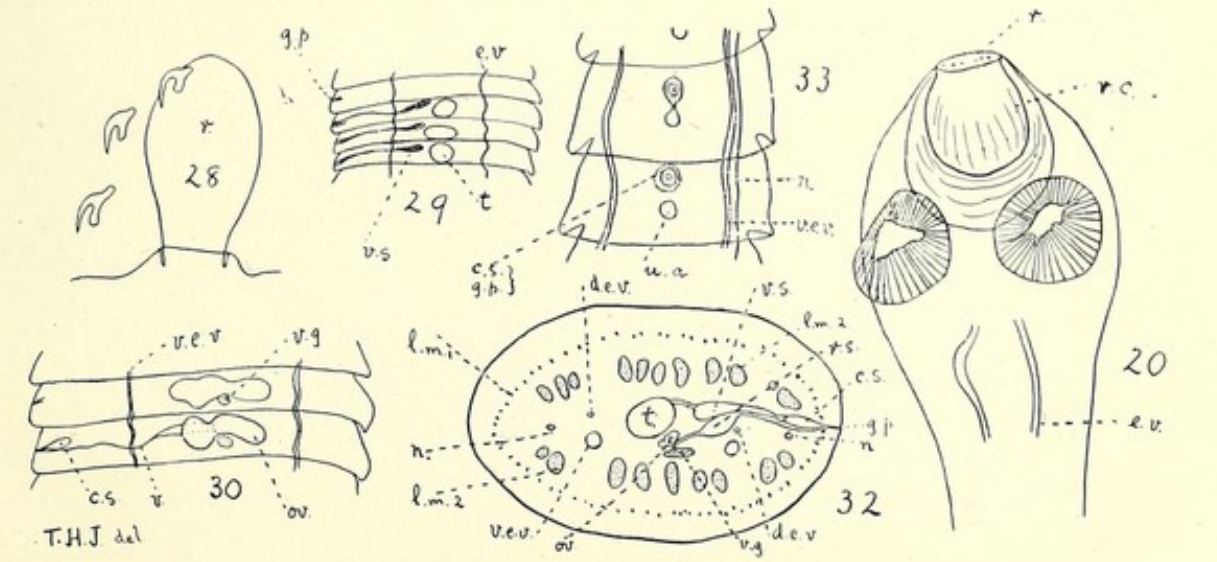
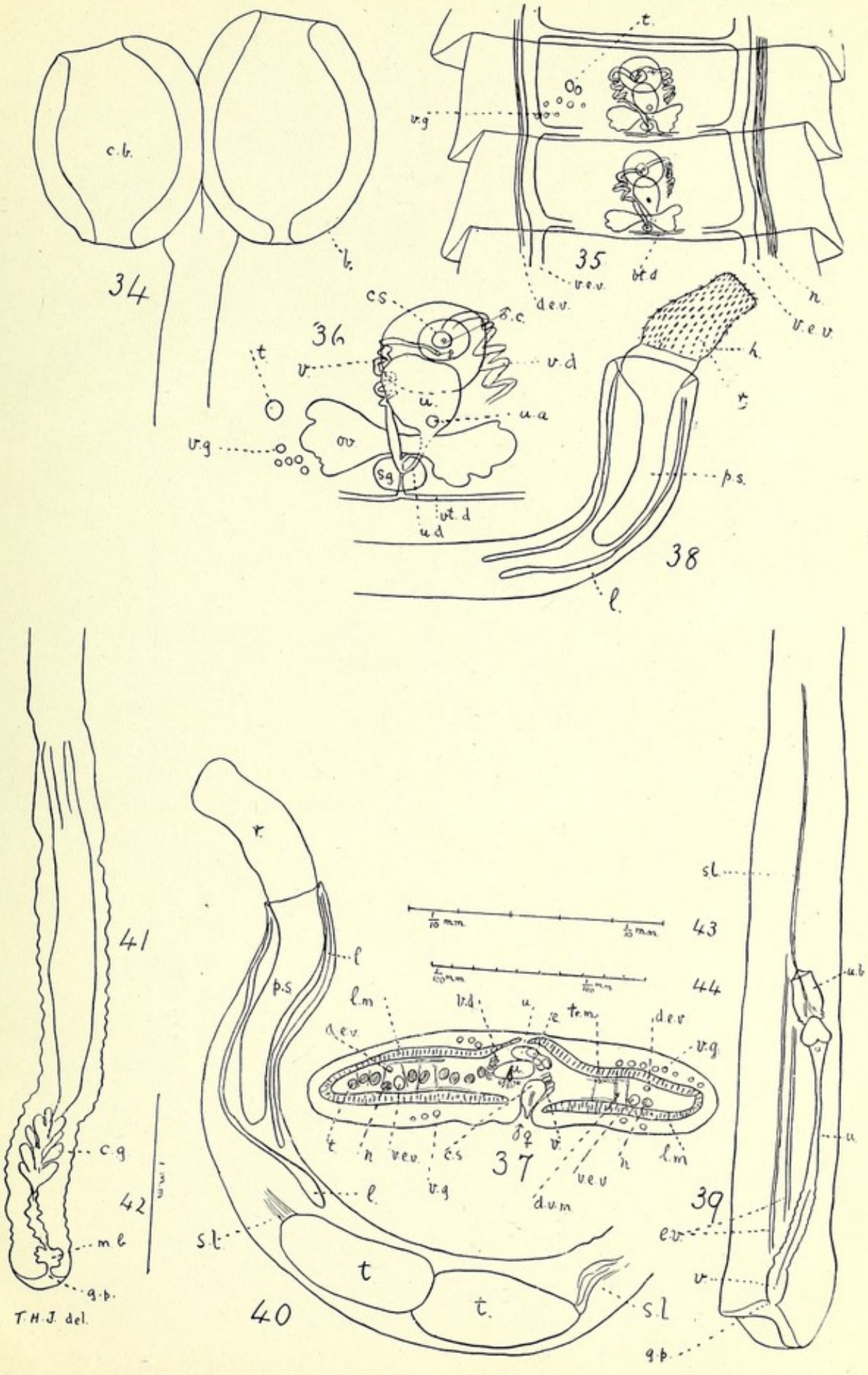

g.p
e.v
r
28
29
t
v.s
33
n.
v.e.v
c.s
g.p
u.a
d.e.v
v.s
l.m.2
r.s
c.s
g.p
n
l.m.2
v.e.v
ov
v.g
d.e.v
32
v.e.v
v.g
c.s
t
ov
30
T.H.J del
r
r.c
20
e.v

PLATE XVII.


c.b.
34
t.
v.g
35
v.e.v
d.e.v
v.t.d
n.
v.e.v
cs
s.c.
36
t
v.
v.d
u.
u.a
ov
v.g
sg
v.t.d
u.d
h.
r.
p.s.
38
l.
41
c.g
42
m.l
g.p.
T.H.J. del.
r.
l
p.s
l.m
v.d
u
t.m
d.e.v
v.e.v
v.g
t
n
v.e.v
c.s
v.g
37
δ♀
v.
v.e.v
d.v.m
n
l.m
l
s.l
t
t.
40
s.l
g.p.
43
44
s.l
u.b
u
39
e.v.
v.