TROPICAL DISEASES RESEARCH FUND.

REPORT

OF THE

ADVISORY COMMITTEE FOR THE TROPICAL DISEASES RESEARCH FUND

For the Year 1914.

(*For Report for* 1913 *see* [*Cd.* 7261] *March*, 1914.)

Presented to both Houses of Parliament by Command of His Majesty.
April, 1915.

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REPORT

OF THE

ADVISORY COMMITTEE

FOR THE

TROPICAL DISEASES RESEARCH FUND

For the Year 1914.

REPORT.

THE Advisory Committee for the Tropical Diseases Research Fund was constituted by the Secretary of State for the Colonies in July, 1904. It is now composed as follows:—

The Right Honourable Sir J. West Ridgeway, G.C.B., G.C.M.G., K.C.S.I., P.C., LL.D. (Chairman).
Sir Thomas Barlow, Bart., K.C.V.O., M.D., F.R.S.
Sir John Rose Bradford, K.C.M.G., M.D., F.R.S.
Surgeon-General Sir David Bruce, C.B., F.R.S., A.M.S.
Surgeon-General Sir R. Havelock Charles, G.C.V.O., M.D., I.M.S. (retd.)
Mr. F. C. Drake.
Sir Patrick Manson, G.C.M.G., M.D., F.R.S.
Mr. H. J. Read, C.B., C.M.G.
Lieutenant-Colonel Sir Ronald Ross, K.C.B., F.R.S.
Mr. J. A. C. Tilley.
Mr. A. C. C. Parkinson (Secretary).

The revenue of the Tropical Diseases Research Fund for the year 1914 was made up as follows:—

Contribution from the Imperial Government		£1,000
Contribution from the Government of India		500
Making a total of		£1,500

Contributions from the Dominion and Colonial Governments:—

Commonwealth of Australia	£200	
Nigeria	400	
Gold Coast	200	
East Africa Protectorate	200	
Ceylon	100	
Hong Kong	100	
Malay States	100	
Straits Settlements	100	
British Guiana	100	
Jamaica	100	
Trinidad	100	
Gambia	100	
Sierra Leone	100	
Fiji	100	
Zanzibar	100	
British Honduras	50	
Grenada	50	
Leeward Islands	25	
St. Vincent	20	
Making a total of		£2,245
In all a total of		£3,745

The expenditure of the year was made up as follows:—

To the London School of Tropical Medicine	£1,450
To the Liverpool School of Tropical Medicine	1,200
To the University of London	850
To the University of Cambridge	750
Making a total of ...	£4,250

The excess of expenditure over income was met, as in the previous year, by drawing on the accumulated balance of the Fund, which was thus reduced to about £750.

After consulting the Advisory Committee the Secretary of State addressed a circular despatch early in the year to the Governments which contribute to the Fund. In this despatch Mr. Harcourt pointed out that the period of five years for which grants had been promised by those Governments in 1909, at the instance of his predecessor, had now expired. Since 1909, as shown by the Annual Reports issued by the Advisory Committee, the work carried on with the assistance of grants made from the Fund had steadily increased, and there could be no doubt of the great importance and value of the investigations which were rendered possible by the existence of the Fund. He accordingly asked that the contributions might be continued for the further period of five years. The proposal was accepted by the Governments concerned, thus ensuring the continuance of the work for a further period of five years. The Committee have learnt with particular satisfaction that the Government of the Commonwealth of Australia have decided to invite the Commonwealth Parliament to continue the grant of £200 made on behalf of the Northern Territory of Australia.

Of the grant (£1,450) to the London School of Tropical Medicine, £1,200 was expended in respect of the salaries, and the maintenance of the laboratories, of the teachers and investigators of helminthology, protozoology, and entomology; and £250 was given as a contribution towards the investigation of schistosomiasis carried out by Dr. R. T. Leiper in the Far East. A preliminary report by Dr. Leiper is printed in Appendix IV.; from this it appears that he has obtained important results, bearing not only on the disease which he was studying in China and Japan, but also, indirectly, on bilharzia disease—a disease which is prevalent in Africa and tropical America, and which has been reported from Australia, Cyprus, and India.

Of the grant (£1,200) to the Liverpool School of Tropical Medicine, £500 was spent on the research work on trypanosomiasis at the research laboratories of the School, £250 on research work on parasitology and helminthology, £250 on research work on entomology, and £200 on research work on malaria.

Of the grant to the University of London (£850) £750 was expended in paying the salary of the Professor of Protozoology, whose post was established in the year 1906 by means of a grant from the Fund and whose tenure of office was extended for another period of five years in 1911. On the application of the University a further sum of £100 was granted as a contribution towards the salary of the Scientific Assistant to the Professor, Dr. H. M. Woodcock.

Of the grant to the University of Cambridge (£750) £100 was paid in respect of the Research Studentship in Medical Entomology established in 1907 by means of a grant from the Fund, £100 was paid towards the salary of an Assistant to the Quick Professor, £100 towards the payment of an helminthologist to work in the Quick Laboratory, £50 towards the salary of a demonstrator in medical entomology, and £100 for the general purposes of the Quick Laboratory. A special grant of £300 was made towards the expenses of sending the Assistant to the Professor, Dr. E. Hindle, to Uganda and Nyasaland for the purpose of carrying out research work there. Owing to the outbreak of war the expedition has been postponed, but the sum of £300 will remain earmarked for this work.

The Committee were consulted on various matters during the year by the Secretary of State, including the question of the terms of the Lepers Ordinance of Trinidad and the Jamaica Law, No. 19 of 1914, relating to yaws.

The Committee append to the report the statistics received from certain Colonies and Protectorates with regard to mosquito-borne diseases, which are supplied in accordance with the request contained in the Secretary of State's circular despatch of the 20th of December, 1910, which is reprinted for convenience of reference. The Committee have observed with satisfaction that the reports have, on the

whole, been prepared with much care, and they desire to call special attention to the valuable reports supplied by Hong Kong, Zanzibar, and the Straits Settlements.

The Committee also append reports of the work done at the London and Liverpool Schools of Tropical Medicine for the year November, 1913, to October, 1914; the reports of the Professor of Protozoology in the University of London and of his Assistant for the year ended June, 1914; reports on work done at various Colonial Laboratories which have been sent in accordance with the request made by the Secretary of State for the Colonies in December, 1906; and a report by Professor Nuttall on the work done in the Quick Laboratories. The Committee desire again to record their sense of the importance of the work in which the Colonial Laboratories are now engaged.

In the Appendix will also be found an interesting and valuable report by Dr. Louis W. Sambon on *Dermatobia hominis* in the West Indies, where he has recently been conducting inquiries.

It was arranged early in the year that a resumé of the Annual Report of the Gordon College Research Laboratories at Khartoum should be included in future in this report, and the Committee have accordingly appended a resumé for which they are indebted to the Director of the Wellcome Tropical Research Laboratories.

The reports from the Laboratory maintained by the Governments of the West African Dependencies at Yaba and from the Laboratory maintained by the Government of the East Africa Protectorate at Nairobi are not reprinted, as they are published separately by these Governments.

The Committee would not wish me to conclude this report without an expression of their regret at the loss of the services of Dr. A. Berriedale Keith, who has acted as Secretary since the Committee was appointed, and of their appreciation of the efficiency and zeal with which he invariably discharged his duties.

WEST RIDGEWAY.

A. C. C. PARKINSON,
Secretary.
30th March, 1915.

APPENDIX I.

Reports on Anti Malarial Measures in the Crown Colonies and Protectorates, &c.

CIRCULAR DESPATCH FROM THE SECRETARY OF STATE FOR THE COLONIES.

SIR, Downing Street, 20th December, 1910.

I HAVE the honour to enclose the accompanying copy of a note which has been prepared by Professor Ronald Ross on the subject of the prevention of mosquito-borne diseases in the tropical Colonies and Protectorates.

2. This note has been prepared by Professor Ross at my request, on the recommendation of the Advisory Committee of the Tropical Diseases Research Fund, and the Committee concur in the views expressed in it.

3. I shall be glad, therefore, if, as far as may be found possible and as far as the exigencies of professional duties allow, the statistics suggested in the draft return accompanying the note can be supplied annually by your Government; but if it is found in any case impossible without undue labour to supply the information required, that fact should simply be stated, as it is not my desire to overload the medical or other officers in the territory under your Government with the collection of elaborate statistics. I understand, however, that much of the information should already be available, and that the additional information required, if it can be supplied, will be of great value, both as a record of the state of health in the Colony and as affording a basis for further scientific research.

I have, &c.,
L. HARCOURT.

NOTE BY PROFESSOR RONALD ROSS ON THE PREVENTION OF MOSQUITO-BORNE DISEASES IN THE COLONIES: SUGGESTED RETURN.

1. Towards the end of last year the Advisory Committee invited me to furnish them with my remarks on the various reports which have been sent in by the Colonies for some years past on the subject of mosquito-borne diseases, especially malaria. At that time I had just commenced the compilation of a book on the prevention of malaria in which I hoped to collect in one volume accounts of such work done in many parts of the world; and I therefore asked to be allowed to postpone my remarks on local malaria until this was finished and also until I should have time to complete not a few brief notes, but a detailed exposition on the subject in connexion with each individual malarious British possession.

Unfortunately, my book was not finished until near the end of July, and though I have commenced the compilation of the detailed reports referred to, I have not yet had time, in the midst of much other work, to do more than commence them; but I should like to furnish for the next meeting of the Committee a brief note on the subject, especially regarding a draft return which I should like to submit for their consideration.

2. As shown in the report of the Advisory Committee for 1907,* Lord Elgin asked the Colonies for reports on the prevention of mosquito-borne diseases, and many such reports have been submitted since then. I have, of course, studied them all with care, and my general conclusion regarding them is that the details of the information required have not always been understood—a thing which is scarcely to be wondered at in connexion with such a new subject. It may, therefore, be suggested that a special form, containing headings for all such details, may be sent to each Colony to be filled in every year. The draft which I enclose is meant merely for consideration, and may require alterations. I will now explain why the various headings are inserted.

3. It seems to me best to approach the prevention of disease not so much from its humanitarian as from the economical point of view. Disease always causes a large expenditure of money, both to the people of a Colony and directly to the Government, and mosquito-borne disease is especially a source of such

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* [Cd. 3992] March, 1908.

expense, owing to its wide and permanent endemicity, both among the populace and among Government servants. In fact, the prevention of disease should be looked upon economically as being a kind of insurance against the useless expenditure caused by such maladies; and a return of the kind proposed should aim at giving figures which will enable us to estimate both the cost of the disease and the cost of the preventive measures. Such a return will, however, have the advantage not only of being a permanent record on such points, but of indicating many of the steps which may be taken in the line of scientific and methodical prevention.

4. I have therefore endeavoured to include in my proposed draft headings which will deal with all the more important items. Headings 2, 3, 4, and 5 explain themselves. Headings 6 and 7 will enable us to compute the amount of sickness due to the mosquito-borne diseases compared with the total amount of sickness and death. Heading 8 will give information regarding the medical and sanitary staff of the Colony. Heading 9 (schools) will furnish very useful information regarding the sickness amongst children and also regarding the possibility of utilizing schools for prophylaxis amongst the scholars. Similar information will be given by heading 10 in connexion with estates employing indentured labour. Headings 11 and 12 will supply necessary facts regarding revenue and expenditure of the Colony Heading 13 will distinguish details regarding the urban population. Headings 14 and 15 are arranged in order to give information regarding the malaria mortality by means of Meldrum's law, according to which the excess of the mortality during the malaria months over the mortality during the healthiest month may be roughly ascribed to this disease. Heading 16 gives the rainfall for the purpose of scrutinizing the monthly mortality returns; and heading 17 will furnish detailed information upon the steps which have been taken for prevention.

5. Though I am not yet ready to examine the reports for each malarious Colony, I should like to add one or two notes regarding some of them.

We are much obliged to Sir Allan Perry for his excellent reports for Ceylon during 1907, 1908, and 1909—reports which give a clear picture of the energetic measures being taken there. I note especially the very large estimations of spleen rates. Thus, during 1909 no less than 317,694 children were examined, of which 66,141 were found to be suffering from enlargement of the spleen, showing the immense prevalence of the disease and the cost which it must inflict upon the public at large. I note also the fact that quinine is distributed in the schools, that sanitary instruction is given to school teachers, that pamphlets in the vernacular languages are distributed, that mosquito reduction in small towns is being undertaken, but that mosquito brigades have not yet been established in all of them as suggested by Sir Allan Perry (Advisory Committee's Report for 1909,* page 10). I think, however, that this will only be a question of time, especially as we cannot help observing the interest taken in the matter in Ceylon and also the great expenditure which the disease must entail there.

The report for Mauritius (*ibid* page 12) is not less interesting. Pending the submission of the report of the Royal Commission (1909) the Colony has been able to spend only the small sum of Rs. 6,000 per annum on the preventive measures recommended by me, but it has done so very wisely and with results which appear already to be excellent. The measures have included examination of school children and free grant of quinine to them, similar measures on the estates, a house-to-house spleen census at Port Louis with distribution of quinine, minor mosquito-reduction works in many places, and even some major works. Dr. Bolton, the Medical Officer of the Immigration Department, is now in England, and I have asked him to inform me by letter exactly what has been done—a subject of which he is thoroughly cognizant. I enclose his communication,† which I think may be of interest to the Committee. The eradication of malaria at Phoenix is a noteworthy example of what may be done. When I was there in 1907 a severe epidemic of malaria was raging in the neighbourhood and amongst British troops stationed there. Within one month no less than 71 soldiers were attacked. There were five deaths and, so far as I can remember, some 30 soldiers had to be invalided to England at a cost of over £50 each (I believe). The War Office granted £1,000 for the drainage

* [Cd. 4999], February, 1910. † Not printed.

of the marsh at Phoenix; but it will be observed that the invaliding of the soldiers during one month cost them more than the money which they allotted for assisting the local Government as regards prevention. Since then the drainage of the marsh has been followed by practical obliteration of the disease on the spot—though, of course, soldiers occasionally become affected elsewhere. I am glad to see that the Royal Commission recommend that the system indicated in my report, viz., regular doses of quinine, the use of mosquito-nets, the canalization of streams, and the drainage of swamps, should be carried out as far as the resources of the Colony will permit.

I will reserve remarks upon the reports from the other Colonies until I have had time to study their statistics in full.

RONALD ROSS,
Professor of Tropical Medicine,
University of Liverpool.

8th November, 1910.

Annexure.

(DRAFT) RETURN of Malarial Fever, Blackwater Fever, Yellow Fever, Filariasis, and Dengue during the year from the 1st January to the 31st December (1910).

1. Name of Colony.
2. Total area.
3. Estimated population :—
   (*a*) Total.
   (*b*) Europeans.
   (*c*)
   (*d*) Other races.
   (*e*)
4. Births during the year :—
   Total births.
5. Deaths during the year :—
   (*a*) Total deaths.
   (*b*) Deaths ascribed to fever.
   (*c*) Deaths ascribed to blackwater fever.
   (*d*) Deaths ascribed to yellow fever.
6. Government hospitals :—
   (*a*) Number of such hospitals.
   (*b*) Totals, during year { admissions. / deaths.
   (*c*) Malarial fever { admissions. / deaths.
   (*d*) Blackwater fever { admissions. / deaths.
   (*e*) Yellow fever { admissions. / deaths.
   (*f*) Filarial diseases { admissions. / deaths.
   (*g*) Dengue { admissions. / deaths.
7. Government dispensaries :—
   (*a*) Number of such dispensaries.
   (*b*) Total attendances during year.
   (*c*) Attendances for malaria.
   (*d*) Attendances for filarial diseases.
   (*e*) Attendances for dengue.
8. Medical Service :—
   (*a*) Number of Government Medical Officers.
   (*b*) Number of special Health Officers.
   (*c*) Number of other registered practitioners.

Appendix I.

REPORTS ON ANTI-MALARIAL MEASURES IN THE CROWN COLONIES AND PROTECTORATES, &c.

9. Schools :—
   (*a*) Number of Government and State-Aided Schools.
   (*b*) Number of scholars registered in these schools.
   (*c*) Percentage of daily attendances.
10. Estates employing indentured labour :—
   (*a*) Number of such.
   (*b*) Number of indentured labourers employed.
   (*c*) Number of hospitals and dispensaries on such estates.
   (*d*) Total deaths among such labourers.
   (*e*) Deaths ascribed to malaria.
   (*f*) Total admissions and attendances at hospitals and dispensaries.
11. Estimated revenue of Colony :—
   Total during year.
12. Estimated expenditure of Colony :—
   (*a*) Total during year.
   (*b*) Annual medical and sanitary expenditure.
   (*c*) Upkeep of Government hospitals and dispensaries.
   (*d*) Total salaries and allowances of medical officers.
   (*e*) Total annual sanitary expenditure.
13. Towns under Municipalities or Town Councils :—
   (*a*) Number of such.
   (*b*) Total population.
   (*c*) Total revenues.
   (*d*) Total medical and sanitary expenditure.
14. Table of deaths by districts :—

District	Area.	Population.	Total Deaths.												
			January.	February.	March.	April.	May.	June.	July.	August.	September.	October.	November.	December.	Total.
Total															

15. Table of deaths in the principal towns :—

Town.	District where situated.	Population of Town.	Total Deaths.												
			January.	February.	March.	April.	May.	June.	July.	August.	September.	October.	November.	December.	Total.
Total															

16. Rainfall during the year :—

Where observed.	District.	Rainfall.												
		January.	February.	March.	April.	May.	June.	July.	August.	September.	October.	November.	December.	Total.
Total														

17. Additional information to be given if possible on the following points :—

(*a*) Is there any legislation in force against the breeding of mosquitoes in premises? Numbers of notices, convictions, and warnings during the year.

(*b*) Number of children examined for enlarged spleen. Where was this done? Percentage affected. Does kala-azar exist?

(*c*) Number of persons examined for filarial diseases. Where was this done? Percentage affected.

(*d*) Any large works for surface drainage of towns or reclamation of marshes. Approximate cost.

(*e*) Numbers of men employed in towns and villages for petty anti-mosquito works. Approximate cost.

(*f*) Amount of Government quinine sold or distributed gratis during the year. Agencies employed.

(*g*) Is quinine distributed regularly in the schools?

(*h*) Measures taken against these diseases on estates employing indentured labour.

(*i*) Any steps taken regarding the housing of the poor.

(*j*) Any exceptional increase or decrease of these diseases recently noticed.

(*k*) Any other remarks on the subject.

No. 1.

WINDWARD ISLANDS : ST. VINCENT.

RETURN OF MALARIAL FEVER, BLACKWATER FEVER, YELLOW FEVER, FILARIASIS, AND DENGUE DURING THE YEAR FROM 1ST APRIL, 1911, to 31ST MARCH, 1912.

(Received 21st January, 1914.)

1.	Name of Colony	St. Vincent.
2.	Total area	150·3 square miles.
3.	Estimated Population :—	
	(a) Total	43,117 (at 31st March, 1912).
	(b) Europeans ... }	Information not available.
	(c) Other races ... }	
4.	Births during the year :—	
	Total births	1,790
5.	Deaths during the year :—	
	(a) Total deaths	914
	(b) Deaths ascribed to fever...	7
	(c) „ „ blackwater fever	Nil
	(d) „ „ yellow fever	Nil

6. Government Hospitals :—	
(a) Number of such hospitals	2 (Colonial Hospital, Kingstown, and Casualty Hospital, Georgetown).
(b) Totals during the year— admissions	1,023
deaths	56
(c) Malarial fever—admissions	34
deaths ...	4
(d) Blackwater fever— admissions ...	Nil
deaths ...	,,
(e) Yellow fever—admissions	Nil
deaths ...	,,
(f) Filarial diseases— admissions ...	17
deaths ...	1
(g) Dengue—admissions ...	Nil
deaths ...	,,

General.

7. Government Dispensaries :—	
(a) Number of such dispensaries	5
(b) Total attendances during the year	17,346*
(c) Attendances for malaria	278
(d) Attendances for filarial diseases	83
(e) Attendances for dengue...	Nil
8. Medical Service :—	
(a) Number of Government Medical Officers ...	7
(b) Number of Special Health Officers	By law each Medical Officer is Health Officer in his district.
(c) Number of other registered practitioners ...	16, of whom only two reside in the Colony.
9. Schools :—	
(a) Number of Government and state-aided schools	26†
(b) Number of scholars registered in these schools	4,475 (at 31st March, 1912).
(c) Percentage of daily attendances	2,193 (*average* attendance).
10. Estates employing indentured labour	Nil
11. Estimated revenue of Colony:— Total during year	£31,076
12. Estimated expenditure of Colony :—	
(a) Total during year ...	£31,886
(b) Annual medical and sanitary expenditure ...	£5,015

* These figures represent the number of *cases*, each of which may have been *attended* two or three times. Attendances cannot be given.

† These are the elementary schools fully recognized. Besides a number of private schools, there are a few other "aided" elementary schools in regard to which no statistics are available. There are also two recognized secondary schools, in regard to which statistics cannot be given.

	(c) Upkeep of Government hospitals and dispensaries	£3,335
	(d) Total salaries and allowances of Medical Officers	£1,802
	(e) Total annual sanitary expenditure	£12
13.	Towns under Municipalities or Town Councils:—	
	(a) Number of such ...	6
	(b) Total population ...	7,682 (3,264 males and 4,415 females), according to census of 1911.
	(c) Total revenues (for *1911*)	£2,183 15 0
	(d) Total medical and sanitary expenditure (*1911*) ...	£264 5 0
14.	Table of deaths by Districts ...	See annexed Table.
15.	Table of deaths in the principal towns	,,
16.	Rainfall during the year ...	,,
17.	Additional information to be given, if possible, on the following points:—	
	(a) Is there any legislation in force against the breeding of mosquitoes in premises?	Yes, in the Public Health Ordinance, 1910, sections 9 and 19, sub-section (3).
	Number of notices, convictions and warnings during the year	Nil
	(b) Number of children examined for enlarged spleen. Where was this done? Percentage affected.	No systematic examination was carried out.
	Does Kala-azar exist? ...	One case diagnosed.
	(c) Number of persons examined for filarial diseases. Where was this done? Percentage affected.	No systematic examination was carried out.
	(d) Any large works for surface drainage of towns or reclamation of marshes.	No
	Approximate cost	Nil
	For Specific Purposes.	
	(e) Numbers of men employed in towns and villages for petty anti-mosquito works.	In Kingstown there is a Sanitary Inspector continuously employed at £36 per annum. When necessity exists therefor others are taken on temporarily. In addition the Government employs a man to inspect the environs of Kingstown for stagnant water, etc., regularly. Elsewhere in the Colony, such Inspectors are only employed when necessary.
	Approximate cost.	

(f) Amount of Government quinine sold or distributed gratis during the year	About 4½ lbs.
Agencies employed ...	Hospitals and Dispensaries.
(g) Is quinine distributed regularly in the schools?	No. Unnecessary.
(h) Measures taken against these diseases on estates employing indentured labour ...	No indentured labour.
(i) Any steps taken regarding the housing of the poor	None.
(j) Any exceptional increase or decrease of these diseases recently noticed	No.
(k) Any other remarks on the subject?	No.

14. TABLE OF DEATHS BY DISTRICTS :—

District.	Area.	Population.	Total Deaths.												
			April.	May.	June.	July.	August.	September.	October.	November.	December.	January.	February.	March.	Total.
First District	—	—	20	27	25	27	30	21	32	27	25	27	24	21	306
Second do.	—	—	37	49	56	52	49	53	43	42	44	49	48	39	561
Third do.	—	—	5	—	—	4	4	4	7	5	7	4	2	5	47
Total			62	76	81	83	83	78	82	74	76	80	74	65	914

15. TABLE OF DEATHS IN THE PRINCIPAL TOWNS :—

Town.	District where Situated.	Population of Town.	Total Deaths.												
			April.	May.	June.	July.	August.	September.	October.	November.	December.	January.	February.	March.	Total.
Kingstown...	First	4,300	8	16	16	14	16	13	13	10	13	14	8	15	161
Calliaqua	Second... ...	551	1	2	1	1	1	1	1	1	1	1	—	1	12
Georgetown	do.	431	2	1	3	1	1	1	—	2	1	2	1	—	15
Layou	do.	441	1	2	3	2	1	1	—	—	1	2	—	—	13
Barrouallie	do.	1,240	3	—	2	1	—	1	—	—	—	2	—	1	10
Chateaubelair	do.	719	—	—	—	6	2	3	—	1	—	—	2	1	15
Total			15	21	25	25	21	20	19	14	16	21	11	18	226

N.B.—The above population is according to Census of 1911.

16. RAINFALL DURING THE YEAR 1911-12:—

Where observed.	District.	Rainfall.												
		April, 1911.	May.	June.	July.	August.	September.	October.	November.	December.	January, 1912	February.	March.	Total.
														Inches.
Botanic Station (200ft.) ...	Leeward (South) ...	5·27	11·04	14·96	11·52	14·04	21·81	9·32	10·03	6·45	6·61	3·93	4·09	119·07
Agricultural School ...	do. do. ...	3·98	8·78	13·10	12·81	11·87	19·28	9·24	9·06	4·82	7·17	2·17	3·95	106·23
Georgetown	Windward (North) ...	6·03	14·32	5·62	6·06	8·95	9·93	5·65	7·26	5·09	5·12	1·62	0·85	76·50
Ratho Mill	do. (South) ...	2·90	9·13	8·70	8·72	8·85	12·94	6·08	6·61	3·04	3·02	0·57	1·13	71·69
Bequia	Grenadines (North) ...	1·77	5·51	6·19	7·17	8·63	9·15	5·06	9·34	2·59	3·34	1·76	1·22	61·73
Peter's Hope	Leeward (Middle) ...	2·11	8·02	14·15	12·64	14·20	13·22	5·67	7·64	3·64	6·07	1·52	3·28	92·16
Villa Point	Windward (South) ...	1·63	7·60	10·67	8·63	6·79	13·61	8·55	8·55	2·21	2·88	1·39	2·22	74·73
	Total ...	23·69	64·40	73·39	67·55	73·33	99·94	49·57	58·49	27·84	34·21	12·96	16·74	602·11

APPENDIX I.

REPORTS ON ANTI-MALARIAL MEASURES IN THE CROWN COLONIES AND PROTECTORATES, &c.

WINDWARD ISLANDS: ST. VINCENT.

RETURN OF MALARIAL FEVER, BLACKWATER FEVER, YELLOW FEVER, FILARIASIS, AND DENGUE DURING THE YEAR FROM 1ST APRIL, 1912, to 31st MARCH, 1913.

(Received 21st January, 1914.)

1.	Name of Colony	St. Vincent.
2.	Total area	150·3 square miles
3.	Estimated Population:—	
	(a) Total	44,434 (at 31st March, 1913).
	(b) Europeans	Information not available.
	(c) Other races	
4.	Births during the year:—	
	Total births	1,678
5.	Deaths during the year:—	
	(a) Total deaths	878
	(b) Deaths ascribed to fever ...	11
	(c) „ „ „ blackwater fever	Nil
	(d) „ „ „ yellow fever	Nil
6.	Government Hospitals:—	
	(a) Number of such hospitals...	2 (Colonial Hospital, Kingstown, and Casualty Hospital, Georgetown).
	(b) Totals during the year—	
	admissions	816
	deaths	46
	(c) Malarial fever—admissions	30
	deaths ...	1
	(d) Blackwater fever—	
	admissions	Nil
	deaths ...	„
	(e) Yellow fever—admissions	Nil
	deaths ...	„
	(f) Filarial diseases—	
	admissions	24
	deaths ...	1
	(g) Dengue—admissions ...	Nil
	deaths	„
General.		
7.	Government Dispensaries:—	
	(a) Number of such dispensaries	5
	(b) Total attendances during the year	18,079*
	(c) Attendances for malaria ...	339
	(d) Attendances for filarial diseases	78
	(e) Attendances for dengue ...	Nil
8.	Medical Service:—	
	(a) Number of Government Medical Officers ...	7
	(b) Number of Special Health Officers.	By law each Medical Officer is Health Officer in his district.
	(c) Number of other registered practitioners.	19, of whom only two reside in the Colony.

* These figures rpresent the numbers of *cases*, each of which may have been *attended* two or three times. Attendances cannot be given.

9.	Schools:—	
	(a) Number of Government and state-aided schools ...	26*
	(b) Number of scholars registered in these schools ...	4,458
	(c) Percentage of daily attendances	2,186
10.	Estates employing indentured labour	Nil
11.	Estimated revenue of Colony:— Total during year	£34,393
12.	Estimated expenditure of Colony:—	
	(a) Total during year	£33,772
	(b) Annual medical and sanitary expenditure ...	£5,257
	(c) Upkeep of Government hospitals and dispensaries	£3,383
	(d) Total salaries and allowances of Medical Officers	£1,904
	(e) Total annual sanitary expenditure	£64
13.	Towns under Municipalities or Town Councils:—	
	(a) Number of such	6
	(b) Total population ...	7,682 (3,264 males and 4,415 females), according to census of 1911.
	(c) Total revenues (for *1912*) ...	£2,019 3 0
	(d) Total medical and sanitary expenditure (*1912*) ...	£316 5 0
14.	Table of deaths by Districts ...	See annexed Table.
15.	Table of deaths in the principal towns	,,
16.	Rainfall during the year ...	,,
17	Additional information to be given, if possible, on the following points:—	
	(a) Is there any legislation in force against the breeding of mosquitoes in premises?	Yes, in the Public Health Ordinance, 1910, sections 9 and 19, sub-section (3).
	Number of notices, convictions and warnings during the year.	17 (12 convictions, 3 dismissals, 1 withdrawn, 1 warned).
	(b) Number of children examined for enlarged spleen. Where was this done? Percentage affected.	No systematic examination was carried out.
	Does Kala-azar exist? ...	No cases diagnosed.
	(c) Number of persons examined for filarial diseases. Where was this done? Percentage affected?	No systematic examination was carried out.

* These are the elementary schools fully recognized. Besides a number of private schools, there are a few other "aided" elementary schools in regard to which no statistics are available. There are also two recognized secondary schools, in regard to which statistics cannot be given.

(d) Any large works for surface drainage of towns or reclamation of marshes	No.
Approximate cost	Nil.
For Specific Purposes.	
(e) Numbers of men employed in towns and villages for petty anti-mosquito works.	In Kingstown there is a Sanitary Inspector continuously employed at £36 per annum. When necessity exists therefor others are taken on temporarily. In addition the Government employs a man to inspect the environs of Kingstown for stagnant water, etc., regularly. Elsewhere in the Colony such Inspectors are only employed when necessary.
Approximate cost.	
(f) Amount of Government quinine sold or distributed gratis during the year	4 lbs. 3½ oz.
Agencies employed	Hospitals and Dispensaries.
(g) Is quinine distributed regularly in the schools? ...	No. Unnecessary.
(h) Measures taken against these diseases on estates employing indentured labour	No indentured labour.
(i) Any steps taken regarding the housing of the poor	None.
(j) Any exceptional increase or decrease of these diseases recently noticed	No.
(k) Any other remarks on the subject?	No.

14. TABLE OF DEATHS BY DISTRICTS :—

District.	Area.	Population.	Total Deaths.												
			April.	May.	June.	July.	August.	September.	October.	November.	December.	January.	February.	March.	Total.
First District	—	—	31	26	15	25	26	17	20	25	22	26	16	21	270
Second do.	—	—	50	63	57	52	49	38	37	50	51	53	32	41	573
Third do.	—	—	2	4	3	4	7	—	1	4	4	3	2	1	35
Total			83	93	75	81	82	55	58	79	77	82	50	63	878

15. TABLE OF DEATHS IN THE PRINCIPAL TOWNS :—

Town.	District where Situated.	Population of Town.	Total Deaths.												
			April.	May.	June.	July.	August.	September.	October.	November.	December.	January.	February.	March.	Total.
Kingstown...	First	4,300	22	11	9	17	18	10	9	11	15	15	10	13	160
Calliaqua	Second... ...	551	1	3	1	1	—	1	4	4	1	1	—	—	17
Georgetown	do.	431	1	3	—	3	—	2	2	3	1	2	1	1	19
Layou	do.	441	—	—	2	—	1	—	1	1	2	2	1	—	10
Barrouallie	do.	1,240	1	2	1	4	2	2	1	—	2	3	—	—	18
Chateaubelair	do.	719	3	3	—	—	4	—	3	1	1	1	1	2	19
Total			28	22	13	25	25	15	20	20	22	24	13	16	243

N.B.—The above population is according to Census of 1911.

16. RAINFALL DURING THE YEAR 1912-13:—

Where observed.	District.	Rainfall.												
		April, 1912.	May.	June.	July.	August.	September.	October.	November.	December.	January, 1913.	February.	March.	Total.
														Inches.
Botanic Station (200ft.) ...	Leeward (South) ...	4·45	2·72	6·28	8·79	9·59	6·35	11·51	10·91	11·93	11·05	4·29	7·08	94·90
Agricultural School ...	do. do. ...	3·48	1·85	5·80	7·30	9·23	4·91	10·37	10·51	10·44	9·71	3·18	4·28	81·01
Georgetown	Windward (North) ...	4·24	2·47	4·58	5·93	3·72	3·70	7·91	11·45	9·17	7·96	2·09	6·89	70·11
Ratho Mill	do. (South) ..	2·22	0·64	3·80	6·16	6·63	2·93	9·05	9·87	8·04	8·40	2·65	1·72	62·11
Bequia	Grenadines (North) ...	1·14	1·53	2·75	7·33	6·05	2·35	9·16	7·74	8·51	3·27	2·46	1·92	54·21
Peter's Hope	Leeward (Middle) ...	0·92	1·53	5·47	10·40	8·85	3·54	8·45	8·79	—	4·22	1·81	5·08	59·06
Villa Point	Windward (South) ...	2·66	1·33	4·12	6·23	7·31	2·81	9·30	3·96	7·36	8·34	1·87	2·78	58·07
	Total ...	19·06	12·07	32·75	52·14	51·38	26·59	65·75	63·23	55·45	52·95	18·35	29·75	479·47

APPENDIX I.

REPORTS ON ANTI-MALARIAL MEASURES IN THE CROWN COLONIES AND PROTECTORATES, &C.

No. 2.

HONG KONG.

REPORT FOR THE YEAR 1913, ON THE PREVENTION OF MOSQUITO-BORNE DISEASES.

(Received 26th March, 1914.)

1. Hong Kong.
2. Area:—
   Island of Hong Kong, 32 square miles.
   Kowloon, 16 square miles.
   New territories, 356 square miles (not included under any of the following statistics—wholly agricultural).
3. Census population, 20th May, 1911:—

Europeans	10,708
East Indians	4,066
Chinese and Malays	354,739
Mixed and coloured	3,608
	373,121
Estimated population to 30th June, 1912	398,520

4. Births:—

Non-Chinese	339
Chinese	3,392

5. Total deaths 8,435

Deaths ascribed to malarial fever	290
Deaths ascribed to blackwater fever	0
Deaths ascribed to yellow fever	0

6. (*a*) Civil Hospital (Government):—

Total admissions for the year	2,793
Total deaths for the year	178
Malarial fever, admissions	236
do. deaths	3
Blackwater fever, admissions	0
do. deaths	0
Yellow fever, admissions	0
do. deaths	0
Filarial diseases, admissions	2
do. deaths	0
Dengue, admissions	12
do. deaths	0

(*b*) Victoria Hospital (Government):—

Total admissions for the year	224
Total deaths for the year	8
Malarial fever, admissions	43
do. deaths	0
Blackwater fever, admissions	0
do. deaths	0
Yellow fever, admissions	0
do. deaths	0
Filarial diseases, admissions	0
do. deaths	0
Dengue, admissions	6
do. deaths	0

No other Government hospitals except the Infectious Diseases and the Maternity Hospitals.

The following hospitals are supported by voluntary contributions:—

(*c*) Tung Wah Hospital (Chinese):—

Total admissions for the year	4,706
Total deaths for the year	1,274
Malarial fever, admissions	145
do. deaths	68
Blackwater fever, admissions	0
do. deaths	0
Yellow fever, admissions	0
do. deaths	0
Filarial diseases, admissions	0
do. deaths	0
Dengue, admissions	0
do. deaths	0

(*d*) Alice Memorial and Affiliated Hospitals (for Chinese):—

Total admissions for the year	1,634
Total deaths for the year	114
Malarial fever, admissions	25
do. deaths	2
Blackwater fever, admissions	0
do. deaths	0
Yellow fever, admissions	0
do. deaths	0
Filarial diseases, admissions	1
do. deaths	0
Dengue, admissions	0
do. deaths	0

(*e*) Kwong Wah Hospital (for Chinese) Kowloon:—

Total admissions for the year	1,352
Total deaths for the year	441
Malarial fever, admissions	59
do. deaths	24
Blackwater fever, admissions	0
do. deaths	0
Yellow fever, admissions	0
do. deaths	0
Filarial diseases, admissions	0
do. deaths	0
Dengue, admissions	0
do. deaths	0

There are no Government dispensaries, but there are native (Chinese) dispensaries supported by voluntary contributions, and in charge of Chinese doctors trained in Western medicine.

Returns herewith:—

(*a*) Number of such dispensaries	8
(*b*) Total attendances during the year (new cases only)	56,356
(*c*) Attendances for malaria (new cases)	3,610
(*d*) Attendances for filarial diseases	0
(*e*) Attendances for dengue	0
8. Number of Government Medical Officers	11
Number of special Health Officers (including 2 for the Port)	4
Number of other registered practitioners (inclusive of military and naval medical officers)	45
9. Schools:—	
(*a*) Number of Government schools	14
Number of State-aided schools	50
(*b*) Number of scholars registered in Government schools	2,692

APPENDIX I.

REPORTS ON ANTI MALARIAL MEASURES IN THE CROWN COLONIES AND PROTECTORATES, &c.

Number of scholars registered in State-aided schools 5,367
(c) Average daily attendance in Government schools 2,262
Average daily attendance in State-aided schools... 4,198
10. Estates employing indentured labour ... ... none
11. Estimated revenue of the Colony $7,851,860.00
12. Estimated expenditure of the Colony :—
(a) Total 8,544,906.00

(b) Annual medical expenditure $238,489.00
Annual sanitary expenditure 337,346.00

Total $575,835.00
(c) Upkeep of Government Hospitals.
Salaries (including Bacteriological Institute) $93,847.00
Upkeep :—
Hospitals 78,693.00
Bacteriological Institute 2,928.00

Total ... $175,468.00

(d) Total salaries and allowances of Medical Officers (including Sanitary Department and Bacteriological Institute) $78,387.00
(e) Total annual sanitary expenditure 337,346.00
13. No town under municipal control.

14. TABLE OF DEATHS BY DISTRICTS.

	Population 1913 (including Army and Navy)			Total deaths.											
	Area in square miles.	Chinese.	Non-Chinese.	January	February	March	April	May	June	July	August	September	October	November	December	Total
Victoria and Peak	4½	239,260	10,560	687	267	401	393	468	665	651	550	550	504	380	466	5682
Villages of Hong Kong	27½	15,180	970	19	18	25	38	36	26	14	30	23	25	27	25	306
Kowloon ...	16	68,500	3,810	97	91	106	86	81	119	139	147	107	153	145	132	1403
Harbour ...	—	53,870	3,120	77	39	56	66	74	79	106	147	98	100	90	112	1044
Totals ...	48	376,810	21,460	580	415	588	583	659	889	910	874	778	782	642	735	8435

15. Victoria is the only town, and the figures are given in the foregoing table.

16. MONTHLY TABLE OF RAINFALL.

Where observed.	January.	February.	March.	April.	May.	June.	July.	August.	September.	October.	November.	December.	Total in inches.
Kowloon Royal Observatory	1·025	2·390	6·945	2·175	9·300	16·035	15·050	10·565	14·570	3·550	0·740	1·385	83·780

17. (a) No further legislation has been introduced to prohibit the breeding of mosquitoes; a copy of the by-law in force was sent with the report for 1910.* During the past year 437 notices were served, calling upon householders to cease the breeding of mosquitoes in their premises, but it was not necessary to institute any prosecutions in connexion therewith.

* No. 2 in Appendix I. to [Cd. 6024.]

(*b*) It has not yet been possible to make any systematic spleen examinations of children outside the various hospitals, for reasons given in the previous reports. Kala-azar does not exist in the Colony.

(*c*) Filarial disease is uncommon in Hong Kong; frequent blood examinations are made in all the hospitals in search of these parasites.

(*d*) The training of nullahs in the vicinity of the City is still in progress, and during 1913 the sum of $18,140 was spent on this work. The total length of trained nullahs and cement channels built since the commencement of anti-malarial works in the Colony is 11·6 miles.

(*e*) The staff consists of 21 trained British inspectors, who give their whole time to sanitary work, five rural police who act also as sanitary inspectors, a storekeeper, and 664 interpreters, foremen, artisans, bullock-drivers, scavengers, bargemen, and coolies, whose whole time is occupied in house-cleansing and scavenging, disinfection, clearing brushwood and collecting receptacles for water from the hillsides and waste lands in the neighbourhood of dwellings, in oiling pools, and other sanitary and anti-malarial works.

(*f*) The amount of quinine issued free during the year was as follows:—

	oz.
Government hospitals	2,200
Tung Wah Hospital	·162
Kwong Wah Hospital	74
Alice Memorial and Affiliated Hospitals ...	427
Public dispensaries	553
Total ...	3,416

(*g*) Quinine has been regularly distributed to certain schools in the most malarious part of the Colony.

(*h*) There are no estates employing indentured labour.

(*i*) The question of housing is dealt with in the Public Health and Buildings Ordinance—a copy of which was sent with the report for 1910.

(*j*) The total deaths from malaria during the past five years have been as follows:

1909	1910	1911	1912	1913
422	591	338	432	290

This represents a ratio per 1,000 of population of:

1·2	1·7	0·9	1·1	0·7

The ratio per 1,000 of admissions to hospital for malaria among the British troops during the past five years has been as follows:—

1909	1910	1911	1912	1913
138·4	177·0	125·5	84·0	42·5

while among the Indian troops the ratios were:—

1909	1910	1911	1912	1913
54·3	89·8	31·8	83·2	83·9

As explained in previous reports, the military figures constitute probably the most accurate test of the progress of our anti-malarial works, since they comprise that portion of the population which is under constant medical supervision; even these figures are, however, liable to some fluctuation, depending on the healthiness or otherwise of the last station occupied by the troops. The civilian figures are liable to far more violent fluctuations on account of the changing nature of the native population; there is a daily ebb and flow of nearly 4,000 Chinese between Hong Kong and the mainland of China, and, in addition, the Colony has been liable of late to periodical inroads of large numbers of people, who have been disturbed by the political unrest prevailing in that country. During 1911 and 1912 some 40,000 to 50,000 people sought refuge in Hong Kong during the rebellion which led to the establishment of the republic, and in 1913 a further influx of a like number of persons occurred during the months of July, August, and September, in consequence of renewed political disturbances.

That the malarial figures show so marked a reduction, in spite of these adverse circumstances is, I think, a matter for congratulation, and, were it possible to take into account the increase of population which is the result of these temporary incursions, the improvement would be found to be more marked than it appears at first sight. The demand for housing accommodation during the past two years has been abnormal, and no less than 335 new dwellings were completed during 1913.

Special classes are held in all the schools of the Colony for instruction in hygiene, which includes a description of the part played by mosquitoes in the spread of malaria, and mosquito larvæ in jars covered with mosquito netting are supplied to all the schools, on application, for demonstration purposes.

A considerable quantity of literature on this subject—both in English and Chinese—is also distributed yearly to the community.

FRANCIS CLARK, M.D., M.R.C.P., D.P.H.,
Medical Officer of Health.

24th February, 1914.

No. 3.

BRITISH SOLOMON ISLANDS PROTECTORATE.

REPORT FOR THE YEAR 1912 ON THE PREVENTION OF MOSQUITO-BORNE DISEASES.

(Received 4th May, 1914.)

1.	Name of Colony: British Solomon Islands Protectorate.		
2.	Total area: 9,500,000 acres.		
3.	Estimated population:—		
	(*a*) Total		150,443
	(*b*) Europeans		307
	(*c*) Natives		150,000
	(*d*) Other races		136
4.	Births during the year:—		
	(*a*) Europeans		0
	(*b*) Natives		Not known
5.	Deaths during the year:—		
	(*a*) Total deaths		8 (Among non-native population). Not known among native population
	(*b*) Deaths ascribed to fever		4
	(*c*) Deaths ascribed to blackwater fever ...		1
	(*d*) Deaths ascribed to yellow fever ...		0
6.	Government hospitals:—		
	(*a*) Number of such hospitals ... ... (A temporary building made of leaf, and is for natives only)		1
	(*b*) Totals during the year.	Admissions ...	35
		Deaths ...	3
	(*c*) Malarial fever.	Admissions ...	5
		Deaths ...	0
	(*d*) Blackwater fever.	Admissions ...	0
	(*e*) Yellow fever.	„ ...	0
	(*f*) Filarial diseases.	„ ...	0
	(*g*) Dengue.	„ ...	0
7.	Government dispensaries		0
8.	Medical service:—		
	(*a*) Number of Government Medical Officers		1
	(*b*) Number of Special Health Officers ...		0
	(*c*) Number of other registered practitioners		3
9.	Government and State-aided schools ...		0
10.	Estates employing indentured labour:—		
	(*a*) Number of such		117
	(*b*) Number of indentured labourers employed		3,683

(*c*) Number of hospitals and dispensaries on such estates ... ... Not known
(*d*) Total deaths among such labourers ... 99 (reported)
(*e*) Deaths ascribed to malaria ... ... Not known
(*f*) Total admissions and attendances at hospitals and dispensaries ... ... Not known

11. Estimated revenue of Colony:—
Total during the year ... ... £19,580 (financial year)

12. Estimated expenditure of Colony:—
(*a*) Total during the year ... ... £22,987 (financial year)
(*b*) Annual medical and sanitary expenditure £520
(*c*) Upkeep of Government hospitals and dispensaries £110
(*d*) Total salaries and allowances of Medical Officers £410
(*e*) Total annual sanitary expenditure ... nil

13. Towns under Municipalities or Town Councils 0

14. Table of deaths by districts ... ... Not known

15. Table of deaths in the principal towns ... No towns

16. Rainfall during the year:—

Where observed. Tulagi.	
January	14·03
February	6·27
March	9·36
April	6·81
May	6·24
June	7·88
July	4·14
August	7·08
September	5·53
October	10·57
November	8·13
December	4·30
Total	90·36 inches

17. Additional information to be given, if possible, on the following points:—
(*a*) Is there any legislation in force against the breeding of mosquitoes in premises? No.
(*b*) Number of children examined for enlarged spleen. None.
Does kala-azar exist? No known cases.
(*c*) Number of persons examined for filarial diseases. No systematic examination.
(*d*) Any large works for surface drainage of towns or reclamation of marshes. None.
(*e*) Number of men employed in towns and villages for petty anti-mosquito works. None.
(*f*) Amount of Government quinine sold or distributed gratis during the year. Quinine distributed gratis to Government Officials only and to natives employed by the Government. Amount: 6,000 5-grain tabloids (approximate) and about 30 ounces Pulv: Quin. distributed gratis.
(*g*) Is quinine distributed regularly in the schools? There are no Government schools.
(*h*) Measures taken against these diseases on estates employing indentured labour. As far as is known the use of mosquito nets.
(*i*) Any steps taken regarding the housing of the poor. No poor to be housed.
(*j*) Any exceptional increase or decrease of these diseases recently noticed. No marked changes.

G. C. M. DAVIES,
Government Medical Officer.

Tulagi,
1st December, 1913.

APPENDIX I.

REPORTS ON ANTI-MALARIAL MEASURES IN THE CROWN COLONIES AND PROTECTORATES, &c.

No. 4.

BRITISH SOLOMON ISLANDS PROTECTORATE.

REPORT FOR THE YEAR 1913 ON THE PREVENTION OF MOSQUITO-BORNE DISEASES.

(Received 4th May, 1914.)

1. Name of Colony: British Solomon Islands Protectorate.
2. Total area: 9,500,000 acres.
3. Estimated population:—
   - (*a*) Total 150,475
   - (*b*) Europeans 320
   - (*c*) Natives 150,000
   - (*d*) Other races 155
4. Births during the year:—
   - (*a*) European 0
   - (*b*) Half-caste 2
   - (*c*) Native ... ... Not known
5. Deaths during the year:—
   - (*a*) Total deaths ... ... 13 (European and other races.) Among the natives: Not known.
   - (*b*) Deaths ascribed to fever 7
   - (*c*) Deaths ascribed to blackwater fever ... 1
   - (*d*) Deaths ascribed to yellow fever ... 0
6. Government hospitals:—
   - (*a*) Number of such hospitals 1
   - (*b*) Totals during the year. Admissions ... 16 (Since the opening of new hospital six months ago)
   - Deaths ... 1
   - (*c*) Malarial fever. Admissions ... 4
   - Deaths ... 0
   - (*d*) Blackwater fever. Admissions ... 0
   - (*e*) Yellow fever. „ ... 0
   - (*f*) Filarial diseases. „ ... 0
   - (*g*) Dengue. „ ... 0
7. Government dispensaries 0
8. Medical service:—
   - (*a*) Number of Government Medical Officers 1
   - (*b*) Number of Special Health Officers ... 0
   - (*c*) Number of other registered practitioners 3
9. Government and State-aided schools ... 0
10. Estates employing indentured labour:—
    - (*a*) Number of such 129
    - (*b*) Number of indentured labourers employed 4,400 (approximate)
    - (*c*) Number of hospitals and dispensaries on such estates ... ... Not known
    - (*d*) Total deaths among such labourers ... 85 (approximate)
    - (*e*) Deaths ascribed to malaria ... ... Not known
    - (*f*) Total admissions and attendances at hospitals and dispensaries ... ... Not known
11. Estimated revenue of Colony:—
    Total during the year ... ... £21,211 (financial year)
12. Estimated expenditure of Colony:—
    - (*a*) Total during the year ... ... £21,080 8s. 4d. (financial year)
    - (*b*) Annual medical and sanitary expenditure £596 8s. 4d.
    - (*c*) Upkeep of Government hospitals and dispensaries ... ... £171 0s. 0d.

(*d*) Total salaries and allowances of Medical Officers ... ... £425 8s. 4d.

(*e*) Total annual sanitary expenditure.

13. Towns under Municipalities or Town Councils 0

14. Table of deaths by districts ... ... Not known

15. Table of deaths in the principal towns ... No towns

16. Rainfall during the year:—

Where observed. Tulagi.	
January	17·46
February	4·30
March	14·77
April	8·37
May	7·89
June	7·12
July	8·31
August	5·29
September	7·76
October	4·94
November	1·94
December	3·00
Total	91·15 inches

17. Additional information to be given, if possible, on the following points:—

(*a*) Is there any legislation in force against the breeding of mosquitoes in premises? No.

(*b*) Number of children examined for enlarged spleen. None.
Does kala-azar exist? No known cases.

(*c*) Number of persons examined for filarial diseases. No systematic examination.

(*d*) Any large works for surface drainage of towns or reclamation of marshes. None.

(*e*) Number of men employed in towns and villages for petty anti-mosquito works. None.

(*f*) Amount of Government quinine sold or distributed gratis during the year. Quinine distributed gratis to Government Officials only and to natives employed by the Government.—Amount: 5-grain tabloids No. 6300, and about 24 ounces Pulv: Quin. distributed gratis.

(*g*) Is quinine distributed regularly in the schools? There are no Government schools.

(*h*) Measures taken against these diseases on estates employing indentured labour. As far as is known the use of mosquito nets.

(*i*) Any steps taken regarding the housing of the poor. None.

(*j*) Any exceptional increase or decrease of these diseases recently noticed. No marked changes.

G. C. M. DAVIES,
Government Medical Officer.

Tulagi,
5th January, 1914.

No. 5.

UGANDA.

RETURN OF STATISTICS ON THE SUBJECT OF THE PREVENTION OF MOSQUITO-BORNE DISEASES FOR THE YEAR ENDING 31ST DECEMBER, 1913.

(Received 23rd May, 1914.)

1. *Name of Colony.*
Uganda Protectorate.

2. *Total Area.*
117,681 square miles (taken from Census Return, April, 1911).

Appendix I.

REPORTS ON ANTI-MALARIAL MEASURES IN THE CROWN COLONIES AND PROTECTORATES, &c.

3. *Estimated Population.*	
Europeans	823
Asiatics	3,110
Natives	2,889,561
Total	2,893,494
4. *Births.*	
Europeans	26
Asiatics	13
Natives	36,284
Total	36,323
5. *Deaths.*	
Europeans	9
Asiatics	39
Natives	32,612
Total	32,660
Deaths attributed to fever :—	
Europeans	—
Others	5,313
Total	5,313
Deaths attributed to blackwater fever :—	
Europeans	2
Others	10
Total	12
Deaths attributed to yellow fever :—	
Europeans	Nil
Others	Nil
6. *Government Hospitals.*	
(*a*) Number	13
(*b*) Admissions :—	
Europeans	40
Asiatics and Natives	1,873
Total	1,913
(*c*) Malarial Fevers :—	
Admissions :—	
Europeans	18
Asiatics and Natives	205
Total	223
Deaths :—	
Europeans	Nil
Asiatics and Natives	5
Total	5

(*d*) Blackwater fever :—

Admissions :—	
Europeans	Nil
Asiatics and Natives	4
Total	4
Deaths :—	
Europeans	Nil
Asiatics and Natives	1
Total	1
(*e*) Yellow fever	no cases
(*f*) Filarial diseases	5
(*g*) Dengue fever	Nil

7. *Government Dispensaries.*

(*a*) Number of dispensaries	19
(*b*) Total attendances during year	112,624
(*c*) Total attendances for malaria	6,426
(*d*) Total attendances for filarial diseases	39
(*e*) Total attendances for dengue fever	19

8. *Medical Service.*

(*a*) Number of Government Medical Officers :—

1 Principal Medical Officer.
1 Deputy Principal Medical Officer.
1 Medical Sanitary Officer, and
18 Medical Officers.

In addition to above there are three Medical Officers employed on sleeping sickness investigations and four Medical Officers, including three temporary, for dealing specially with venereal diseases.

(*b*) Number of Special Health Officers :—

The Medical Sanitary Officer.

(*c*) Number of other registered practitioners	4

9. *Schools.*

(*a*) Number of Government and State-aided schools :—

There are no Government or specially State-aided schools. Annual educational grants are made to three missionary societies and certain special grants for scholarships, &c.

Number of schools	202
(*b*) Number of scholars registered	26,197
(*c*) Percentage of daily attendance	62·93

10. *Estates Employing Indentured Labour.*

There is no indentured labour on estates in this Protectorate.

11. *Estimated Revenue*	£222,256

12. *Estimated Expenditure.*

(*a*) Total during the year	£291,011
(*b*) Annual medical and sanitary expenditure	£12,728
(*c*) Upkeep of Government hospitals and dispensaries	£7,810
(*d*) Total salaries and allowances to Medical Officers	£10,148
(*e*) Total annual sanitary expenditure:— Sanitary service in permanent stations ...	£1,755
Upkeep of stations	£3,192

13. *Towns under Municipalities or Town Councils.*

None, but the following stations were under control of Local Sanitary Committees, consisting of the District Commissioner, the Medical Officer, and the District Engineer, viz.: Entebbe, Kampala, Jinja, Mbale, Mbarara, Hoima, and Masindi.

14. *Table of Deaths by Districts.*

(Attached).

15. *Table of Deaths in Principal Towns.*

Not obtainable.

16. *Rainfall.*

(Table attached).

17. *Additional Information.*

(*a*) Rules are in force at Entebbe, Kampala, Jinja and Mbale under the Township Ordinance giving powers to authorized persons to enter premises for the purpose of seeing that rules under the Ordinance are duly performed and observed, and also others imposing penalties on persons failing to keep their water receptacles free from mosquito larvæ.

Notices, Warnings, Convictions.

Station.	No. of Notices.	No. of Warnings.	No. of Convictions.
Entebbe	78	Nil.	Nil.
Kampala	58	Nil.	Nil.
Jinja	70	Nil.	Nil.
Total	206	Nil.	Nil.

(*b*) *Number of children examined for enlarged spleen.* No record.

(*c*) *Number of persons examined for filarial diseases.* No record.

(*d*) *Any large work for surface drainage of town or reclamation of marshes.*

The work of drainage of swamps in or adjacent to the stations of Kampala, Masindi, Hoima, Mbale and Bukakata have been continued during the year and drainage of marsh-land at Entebbe begun.

(*e*) *Number of men employed in towns and villages for petty anti-mosquito work.*

"Anti-Malarial Gangs" of from 6 to 12 men have been employed at all principal stations. These gangs were supplemented by the station staffs.

(*f*) *Amount of Government quinine sold or distributed gratis during the year. Agencies employed.*

5 gr. tabloids and tablets	73,100
Quinine in powder	180 lbs. 14 ozs.

Agencies employed—Government Dispensaries.

(*g*) *Is quinine distributed regularly in schools?*
No. Only in certain schools when children have fever.

(*h*) *Measures taken against these diseases.*
Employment of anti-mosquito gangs in townships, periodical inspection of compounds for empty tins, broken bottles, clearing of rain-gutters, &c., clearance of long grass, planting of short "French" grass, inspection of water vessels for larvæ, improved gauze wire protection of houses, instruction of Military and Police in anti-mosquito work and the distribution of anti-mosquito literature and reclamation of swamps. No measures taken outside township.

(*i*) *Housing of the poor.*
No measures.

(*j*) *Any exceptional increase or decrease of these diseases recently noticed.*
There has been a marked increase in the number of blackwater fever cases (particularly at Kampala).

(*k*) Any further information which may become available will be embodied in the Annual Medical and Sanitary Report for 1913.

A. D. P. HODGES,
Principal Medical Officer, Uganda Protectorate.

Entebbe, Uganda.
23rd April, 1914.

RETURN SHOWING DEATHS AMONG EUROPEANS, ASIATICS, AND NATIVES, EACH MONTH DURING 1913, BY DISTRICTS.

District.	Area in Square Miles.	Population.	January.	February.	March.	April.	May.	June.	July.	August.	September.	October.	November.	December.	Total.
Buganda	21,366	696,688	1,066	1,021	902	1,006	948	1,014	1,077	1,185	1,014	956	933	892	12,014
Eastern Province	32,022	1,110,189	553	586	686	609	489	671	817	798	704	636	728	615	7,892
Bunyoro	8,244	130,922	332	369	396	476	727	488	626	577	598	491	424	565	6,019
Toro	5,760	115,041	178	139	136	149	220	338	258	255	188	201	169	166	2,397
Ankole	4,353	266,790	255	288	269	307	379	368	364	364	524	291	418	414	4,241
S. S. Camp	—	—	10	12	7	4	15	6	11	8	8	8	3	4	96
Unadministered Areas, etc.	45,936	570,021	1	*	*	*	*	*	*	*	*	*	*	*	1
Totals	117,681	2,889,561	2,395	2,415	2,396	2,551	2,778	2,885	3,153	3,187	3,036	2,583	2,675	2,656	32,660

* Returns of native deaths not available.

COMPARATIVE RAINFALL STATEMENT, SHOWING THE MONTHLY RAINFALL FOR THE YEAR 1913 OF 48 LOCALITIES OF THE UGANDA PROTECTORATE.

Month.	Entebbe.		Nimule.		Jinja.		Mbarara.		Masaka.		Gondokoro.		Fort Portal.		Butiaba.		Masindi.		Gulu.		Kampala.		Mbale.	
	In.	No. of days.	In.	No. of days.	In.	No. of days.	In.	No. of days.	In.	No. of days.	In.	No. of days.	In.	No. of days.	In.	No. of days.	In.	No. of days.	In.	No. of days.	In.	No. of days.	In.	No. of days.
January	0·63	7	Nil	Nil	0·61	4	0·10	1	1·35	6	Nil	Nil	1·38	4	0·84	2	0·57	2	0·15	1	2·37	8	0·01	1
February	7·32	15	4·24	4	5·11	9	2·13	12	1·40	10	5·82	2	4·08	10	0·52	1	3·84	9	3·63	10	3·95	15	3·07	11
March	9·51	15	1·12	1	3·27	13	3·14	13	2·08	11	0·21	2	5·32	7	1·62	3	3·36	9	1·83	6	7·68	15	4·14	4
April	12·71	25	6·28	10	8·15	18	1·80	5	6·58	16	3·41	12	6·24	17	3·25	8	5·34	13	7·13	21	10·16	24	9·81	23
May	10·64	26	7·56	10	8·01	20	2·24	10	4·59	17	3·16	9	5·83	20	3·21	6	5·48	14	6·85	23	5·06	20	6·54	28
June	0·97	10	5·68	6	0·80	5	1·65	4	0·93	8	2·78	7	6·27	16	3·95	9	11·54	11	5·86	13	2·17	13	7·55	18
July	3·22	6	6·83	5	2·81	3	0·28	2	0·59	2	2·15	7	0·48	3	0·23	4	2·44	8	4·32	19	2·61	11	3·87	17
August	1·41	6	3·83	3	1·46	4	0·10	2	0·54	4	2·66	7	2·08	7	2·06	8	6·68	13	5·86	15	0·83	7	2·02	11
September...	1·71	5	0·34	1	3·23	8	0·39	4	1·37	4	1·65	4	5·20	11	2·16	6	4·65	6	0·46	6	3·50	8	1·62	8
October	4·42	13	4·58	5	3·44	11	3·48	12	1·57	10	1·66	10	10·54	20	4·76	10	5·42	14	7·66	22	1·78	20	4·58	14
November	0·90	11	6·86	4	2·19	11	4·21	14	3·19	15	0·84	5	5·56	15	4·13	9	4·43	13	3·39	12	2·72	20	2·30	13
December	2·98	10	Nil	Nil	2·45	6	1·41	6	0·89	6	Nil	Nil	0·15	1	0·51	4	1·25	5	1·65	3	2·77	12	1·68	7
Total	56·42	149	47·32	49	41·53	112	20·93	85	25·08	109	23·84	65	53·08	131	27·34	70	55·00	122	48·79	151	45·60	173	47·19	155

Month.	Mubendi.		Budo.		Bukona.		Namenage.		Nabieso.		Kumi.		Hoima.		Namukekera.		Nabumali.		Iganga.		Butiti.		Bukumi.	
	In.	No. of days.	In.	No. of days.	In.	No. of days.	In.	No. of days.	In.	No. of days.	In.	No. of days.	In.	No. of days.	In.	No. of days.	In.	No. of days.	In.	No. of days.	In.	No. of days.	In.	No. of days.
January	1·01	5	2·53	5	0·68	4	0·22	1	Nil	Nil	Nil	Nil	0·40	2	1·87	4	0·04	1	1·53	2	0·61	7	2·63	7
February	6·08	11	3·92	10	5·24	13	2·68	4	4·16	5	6·48	7	5·07	12	2·43	9	2·33	15	4·20	8	4·16	12	1·10	4
March	4·85	9	7·34	12	4·78	14	1·75	4	4·70	5	3·93	8	3·25	13	1·96	10	5·98	21	8·07	10	4·13	8	2·75	7
April	5·77	15	8·69	22	8·60	17	4·96	9	3·73	8	5·74	12	5·92	20	5·26	16	11·52	25	6·56	7	3·38	13	5·68	13
May	2·87	9	3·83	13	8·46	28	4·77	10	6·04	10	12·49	20	4·38	21	2·17	—	6·98	29	11·21	17	3·28	16	4·20	10
June	4·73	9	1·57	4	4·78	15	2·53	4	8·12	7	7·58	16	6·35	15	1·50	8	3·66	23	2·71	6	1·78	10	1·80	7
July	1·44	4	0·92	4	3·68	11	1·27	4	2·25	6	4·76	12	4·01	12	0·45	3	3·57	19	2·55	6	3·02	8	1·69	6
August	4·22	7	2·27	6	2·92	12	2·77	7	2·60	4	5·56	7	8·15	16	2·15	8	1·75	21	1·99	7	2·10	7	1·98	5
September...	5·53	11	2·48	5	1·73	10	2·80	6	1·36	3	0·80	3	4·05	13	2·98	5	1·37	11	3·99	7	2·32	10	4·24	11
October	5·06	16	2·65	9	5·87	18	5·32	8	10·25	11	7·63	14	7·85	14	6·07	18	2·11	18	5·09	15	5·01	16	4·08	14
November	1·75	8	3·99	8	3·44	15	2·56	7	3·92	9	5·06	10	4·17	16	2·45	12	2·89	18	2·97	7	3·32	12	1·97	10
December	0·58	6	2·95	7	2·51	8	1·36	3	Nil	Nil	0·17	1	1·65	6	3·64	7	1·90	8	1·68	6	1·89	11	0·95	2
Total	48·89	110	48·14	105	52·69	165	32·99	67	47·13	68	60·20	110	55·25	160	32·93	100	44·10	209	52·55	98	35·00	130	33·07	96

Month.	Rubaga.		Ngora.		Kisubi.		Kivuvu.		Kawalongojo.		Magigye.		Nandere.		Moniko.		Keritia.		Bombo.		Bwavu.		Bugalla Island (*Sesse*).	
	In.	No. of days.	In.	No. of days.	In.	No. of days.	In.	No. of days.	In.	No. of days.	In.	No. of days.	In.	No. of days.	In.	No. of days.	In.	No. of days.	In.	No. of days.	In.	No. of days.	In.	No. of days.
January	2·54	5	Nil	Nil	1·15	4	1·21	2	1·76	6	0·28	2	0·46	3	2·49	6	2·45	6	0·07	1	4·24	10	3·49	11
February	5·71	9	3·38	6	4·80	12	5·23	11	5·01	13	3·67	8	4·73	12	3·48	7	4·37	14	4·22	11	6·23	14	7·35	18
March	9·23	11	3·58	8	6·85	11	6·72	13	6·27	13	4·95	10	4·90	11	4·94	11	5·91	14	2·20	7	6·78	12	—	—
April	9·08	16	8·79	16	15·12	21	7·15	19	—	—	5·98	17	5·82	17	7·02	15	9·61	19	2·57	14	8·79	18	—	—
May	4·18	11	8·22	19	10·04	19	5·43	18	3·45	23	4·85	16	7·88	18	6·29	17	7·42	16	2·52	17	4·74	19	—	—
June	1·27	4	10·44	12	0·55	5	2·43	7	2·35	11	2·03	8	3·02	13	0·50	3	0·13	1	0·22	6	2·25	16	—	—
July	1·11	—	3·18	—	2·91	9	2·36	6	Nil	Nil	1·37	5	2·48	10	2·40	7	2·08	8	1·21	9	4·70	5	—	—
August	1·31	4	2·12	—	0·71	5	1·17	5	3·15	11	0·77	5	2·33	10	2·97	6	1·97	5	1·25	9	1·26	7	—	—
September...	3·88	8	1·98	—	1·72	5	3·88	10	4·47	11	3·24	11	2·43	11	3·41	11	5·46	8	2·36	10	3·19	8	—	—
October	1·47	8	7·46	—	2·15	9	4·10	14	6·20	17	4·34	19	5·48	15	3·88	13	5·55	14	3·94	16	3·81	20	—	—
November	2·46	14	4·60	—	4·10	4	2·02	13	2·68	10	2·95	14	2·81	12	5·73	15	4·29	10	1·40	10	2·50	13	—	—
December	2·21	8	0·06	1	2·29	7	4·61	13	3·57	10	2·23	11	1·74	10	4·25	10	4·43	9	2·20	8	2·58	9	—	—
Total	44·45	98	53·81	62	52·39	111	46·26	131	38·91	125	36·61	126	44·08	142	47·36	121	53·67	119	24·16	118	51·02	151	10·84	29

Month.	Sango Bay.		Mvuba.		Kakumiro.		Bunyaruguru.		Katigondo.		Kabyaza.		Kadoma		Kitumbuzi.		Kitalya.		Masindi Port.		Lugombe.		Nambeya (*Bulemezi*).	
	In.	No. of days.	In.	No. of days.	In.	No. of days.	In.	No. of days.	In.	No. of days.	In.	No. of days.	In.	No. of days.	In.	No. of days.	In.	No. of days.	In.	No. of days.	In.	No. of days.	In.	No. of days.
January	—	—	—	—	1·71	4	1·37	6	1·62	6	—	—	—	—	1·15	3	—	—	0·08	1	0·23	1	—	—
February	1·34	7	—	—	2·85	9	4·19	17	4·88	15	—	—	—	—	6·22	13	—	—	1·79	9	2·15	6	—	—
March	6·45	7	—	—	3·91	9	3·90	11	4·16	12	—	—	—	—	5·80	12	—	—	6·76	15	4·42	8	—	—
April	14·02	17	—	—	7·16	20	7·26	23	5·80	18	—	—	—	—	7·74	16	—	—	3·44	16	6·44	11	—	—
May	11·20	20	4·38	8	2·12	11	8·63	24	6·22	18	—	—	—	—	10·90	29	—	—	3·89	14	4·10	13	—	—
June	1·74	4	—	—	—	—	2·60	12	1·81	5	2·77	10	4·02	11	6·52	15	—	—	5·29	9	4·18	7	—	—
July	Nil	Nil	—	—	1·29	8	2·78	6	0·50	2	2·57	19	1·65	8	1·34	7	1·78	7	3·43	7	—	—	—	—
August	0·39	2	—	—	2·48	9	1·30	7	1·03	2	2·53	9	3·06	13	3·19	9	2·88	9	0·96	4	—	—	—	—
September...	1·21	3	—	—	4·37	9	4·25	14	0·58	5	4·76	12	1·04	10	0·68	6	4·73	9	1·24	5	—	—	—	—
October	2·73	7	—	—	6·49	15	7·25	17	2·41	10	3·58	13	4·92	17	5·77	15	7·65	14	—	—	—	—	—	—
November	4·14	12	—	—	3·13	13	4·33	10	3·69	9	4·51	23	4·59	16	3·60	16	3·15	13	—	—	—	—	3·69	17
December	3·55	4	—	—	0·14	2	0·67	4	1·56	7	1·92	10	2·24	11	2·15	9	2·68	9	—	—	—	—	2·18	8
Total	46·77	83	4·38	8	35·65	109	48·53	151	34·26	109	22·64	96	21·52	86	55·06	150	22·87	61	26·88	80	21·52	46	5·87	25

W. R. RUTTER,
Chief Forestry Officer.

APPENDIX I.

REPORTS ON ANTI-MALARIAL MEASURES IN THE CROWN COLONIES AND PROTECTORATES, &c.

No. 6.

SOUTH AFRICA.

THE HIGH COMMISSIONER to THE SECRETARY OF STATE.

(Received 26th May, 1914.)

SIR, High Commissioner's Office, Cape Town, 9th May, 1914.

I HAVE the honour to enclose, for your information, copies of despatches from the Resident Commissioner, Swaziland, and the Administrator, Southern Rhodesia, on the subject of mosquito-borne diseases.

I have, &c.,
GLADSTONE,
High Commissioner.

Enclosure 1 in No. 6.

Resident Commissioner's Office, Mbabane, Swaziland,
MY LORD, 2nd January, 1914.

WITH reference to Your Excellency's despatch of 19th January, 1911, on the subject of the prevention of mosquito borne diseases, I have the honour to state that no reliable statistics can be furnished in regard to Swaziland, as required by the Circular despatch from the Right Honourable the Secretary of State for the Colonies, dated 20th December, 1910. Very few Europeans live in the low malarial areas and amongst the natives the disease is endemic, and, in ordinary years, takes a mild form. Births and deaths of natives are not registered in Swaziland.

2. Pamphlets and posters dealing with the cause and prevention of malaria have been distributed amongst the European population, and both European and native schools have been supplied with cards and pamphlets bearing on these subjects. A supply of quinine and other medicines is kept at each station and is issued free to natives on application; they do not, however, avail themselves of this as a rule.

I have, &c.,
R. T. CORYNDON,
Resident Commissioner.

His Excellency
The Right Honourable
Viscount Gladstone, P.C., G.C.M.G.,
High Commissioner for South Africa.

Enclosure 2 in No. 6.

MY LORD, Administrator's Office, Salisbury, 29th April, 1914.

WITH reference to Your Lordship's despatch of the 6th March, I have the honour to transmit a report on the subject of mosquito-borne diseases in Southern Rhodesia for the year 1913.

I also enclose a series of the literature* which has been distributed by the Medical Department in the course of the educational campaign which is being conducted.

I have, &c.,
W. H. MILTON,
Administrator.

His Excellency
The High Commissioner,
Cape Town.

MOSQUITO-BORNE DISEASES, SOUTHERN RHODESIA, 1913.

MALARIA, blackwater fever, and dysentery were responsible for 79 deaths, or 24·23 per cent. of the total.

The mortality from mosquito-borne diseases, so far as they affect Europeans, was confined to malaria and blackwater fever. There were 30 deaths registered as caused by malaria, and 34 from blackwater, compared with 22 from malaria and 36

* Not reprinted.

from blackwater in 1912. In 1912, out of the total deaths recorded, 6·45 per cent. were due to malaria and 10·56 per cent. to blackwater, whilst in 1913 out of the total deaths registered 9·20 per cent. were due to malaria and 10·46 to blackwater. A better conception of the mortality from these causes can, however, be gained by comparison of the mortality rates with the population.

	Malaria.		Blackwater.	
	Deaths.	Death Rate per cent. of Population.	Deaths.	Death Rate per cent. of Population.
1912 ...	22	0·08 per cent.	36	0·13 per cent.
1913 ...	30	0·09 per cent.	34	0·11 per cent.

The mortality from these diseases has remained nearly stationary for two years, whilst the rural, or most exposed, section of the community, have been increasing, presuming a relative decrease. In the absence of definite statistics as to the increase in the rural population we are not in a position to show to what extent this decrease has occurred.

Malaria.—There were 779 persons admitted to hospital in Southern Rhodesia during 1913 suffering from malaria, of which 13 died, giving a case mortality of 1·67 per cent., as compared with 770 cases in 1912 and 6 deaths, with a case mortality of 0·78 per cent. The largest number of admissions was at Umtali, where 263 Europeans were admitted during the year; a large proportion of these, however, were not resident in Southern Rhodesia, but came from the adjacent Portuguese territory. There were 241 native admissions with 5 deaths, a case mortality of 2·07 per cent.

These hospital admissions in no way represent the malarial incidence in the country generally, as the larger proportion of cases of malaria are treated in their own homes or on the veldt, and frequently without medical intervention of any sort or description.

Blackwater.—There were 57 admissions on account of blackwater fever as compared with 60 in 1912. Of these 14 died, giving a mortality rate of 24·56 per cent., somewhat lower than in the former year, when the mortality rate was 28·33 per cent. Four cases of blackwater fever in natives were notified, but with one exception these were Asiatics and not indigenous natives of South Africa. The one case of blackwater fever in an indigenous native was reported from Gwanda, he being a native of Nyasaland. Blackwater fever in indigenous natives is so rarely met with as to be considered almost non-existent.

The following table is of interest, showing, as it does, the prevalence of blackwater in relation to the population during the last ten years. It will be noted that, though the morbidity varies little, there has been a decided reduction in the case incidence in relation to the population during the last three years as compared with the first four years of this decennial period.

RETURN SHOWING THE CASE INCIDENCE OF BLACKWATER FEVER AMONG EUROPEANS, AS TAKEN FROM THE HOSPITAL ADMISSIONS FOR THE YEARS 1904-13.

Year.	Estimated Population.	Number of Cases.	Case Mortality Rate per cent.	Case Incidence Rate per 1,000 of the Population.
1904	12,623	38	23·68	3·01
1905	12,596	61	16·39	4·84
1906	14,524	73	23·28	5·03
1907	14,007	57	22·80	4·07
1908	14,640	41	29·27	2·80
1909	Not estimated.	75	24·00	—
1910	" "	75	22·66	—
1911	23,606	39	17·95	1·65
1912	26,896	60	28·33	2·23
1913	30,344	57	24·56	1·88

Appendix I.

Reports on anti-malarial measures in the Crown Colonies and Protectorates, &c.

The relation of malaria and blackwater fever both to each other and to the rainfall is graphically shown in the chart appended. The height of the blackwater curve follows some 30 days after the height of the malarial, which latter reached its maximum in May and dropped away very rapidly in June and July. The relation of the malarial curve to the rainfall is even more interesting. Commencing to rise some 30 days after the advent of the early rains, it reached the maximum in May, approximately three months after the highest rainfall and almost following on the cessation of the rains, when the pools and water-courses ceased to be washed with torrential storms and mosquito larvæ had a chance to develop into the adult mosquito.

Both malaria and blackwater fever have, in the course of the year, aroused a considerable amount of public interest and anxiety, especially in the Mazoe, Lomogundi, and Abercorn districts. This is only to be expected when we consider the forward movement which has taken place in the last two or three years in the settlement of rural districts where malaria and its sequelæ are most rife, and where new settlers are especially exposed to infection.

There has been the usual flood of letters in the papers, criticisms of the Administrative methods, and suggestions of quaint cures and nostrums. Many of these communications to the Press were calculated to do infinite harm, as they were written largely by ignorant persons to an ignorant people; at the same time it must be admitted that the awakening of public interest in questions so vitally concerned with the beneficial occupation of the country could not be otherwise than a blessing. Attention was thereby directed to the most recent theories and the results of scientific research into the cause and prevention both of malaria and blackwater, and it has been possible to demonstrate to the thinking portion of the population how mosquito-borne diseases can not only be combated, but can easily, efficiently, and economically be prevented.

This campaign of education has been strenuously pushed forward by the Administration during the year. Lectures have been given, articles inserted in the local Press, and pamphlets widely distributed, dealing with these diseases and their prevention. The country was specially fortunate in the visits of two such eminent authorities as Sir Patrick Manson, G.C.M.G., late Medical Adviser to the Colonial Office, and General Gorgas, the Chief Sanitary Officer of the Panama zone.

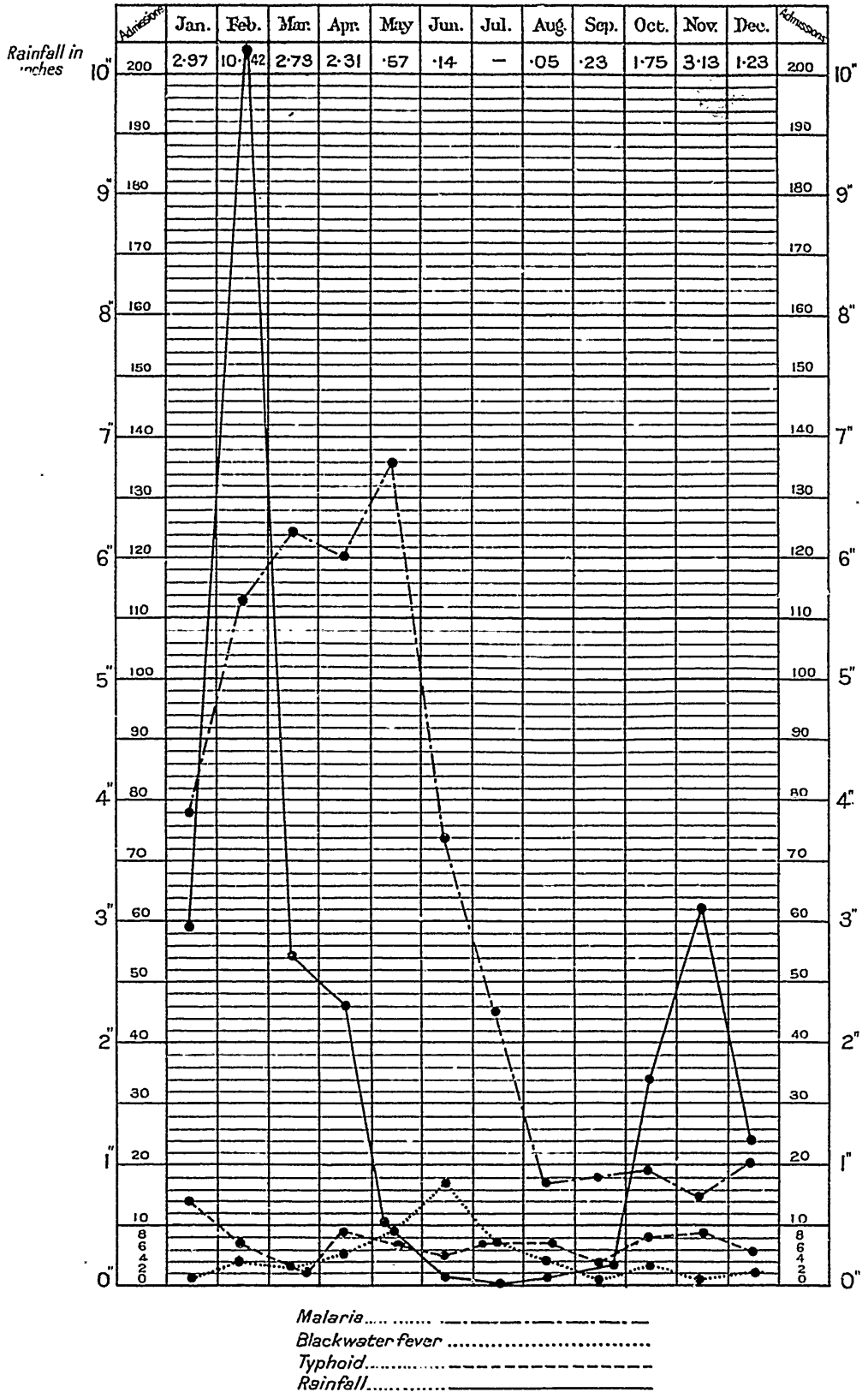
Sir Patrick Manson, who was on a private visit to the country, kindly addressed the people in Bulawayo, and copies of his lecture have been printed and widely distributed. General Gorgas, who came to Johannesburg at the end of 1913, at the request of the Transvaal Chamber of Mines, to advise on health and sanitation in native mine compounds, was asked by this Administration to extend his visit to Southern Rhodesia, and to advise this Administration especially with regard to the prevention of malaria and blackwater.

General Gorgas, it is true, did not arrive in Southern Rhodesia till February, 1914, but, as his visit was in reality a continuation of the scheme of general education of the public in matters relating to the health of the community, and the breaking down if possible of popular prejudices, it is convenient here to refer to the conclusions he arrived at as a result of his investigations on the spot. These were embodied in a report to the Administration which, as well as being published in the Press, was printed in pamphlet form and widely distributed. In advising the Administration as to the methods to be adopted by the Government for the prevention of mosquito-borne diseases, General Gorgas was most insistent on the value of education, and in this connexion the following extract is taken from his report:

"The Government should continue the present campaign of education. Over such a large area of country no sanitary work can be successful against malaria till the people believe in its efficiency. Education is the great means for bringing this about." An opinion frequently expressed and given particular publicity to in some quarters was that in blackwater we had a disease which was peculiar to this country, and that little was known about its cause or prevention. The remarks, both of General Gorgas and of Sir Patrick Manson, should go far to dispel this popular fallacy.

Attention was drawn in the report for 1912 to the necessity for special research into local diseases affecting both Europeans and natives. This matter is now receiving the attention of the Administration, and it is hoped that a special research

CHART SHEWING NUMBER OF CASES OF MALARIA, TYPHOID, & BLACKWATER FEVER, ADMITTED TO HOSPITALS, WITH RAINFALL IN RHODESIA DURING YEAR ENDED 31ST DECEMBER, 1913.



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scholar may shortly be appointed to work on the human diseases occurring in this country, which will include the study of blackwater.

It is sincerely to be hoped, however, that the public will not make this an excuse for waiting idly for the problematical results of such research when they have at hand simple and effective methods for preventing the diseases which trouble them.

Residents in rural districts are most affected with malaria and blackwater, as is to be expected, little malaria occurring in urban areas. The parts of the country most affected were apparently the rich valleys and areas where the altitude was under 3,500 feet, though both malaria and blackwater were met with in practically every district. What is required in this connexion is an entomological survey of the country with special reference to the distribution of the various varieties of anophelines found and their relationship to malaria and blackwater. Such a survey would also help to throw light on the cause and the consequent prevention of these diseases in particular localities. As districts, however, become more populated, as land comes under cultivation, and as persons acquire both the means and the common sense to erect houses constructed in conformity with climatic conditions, there is little doubt that both malaria and blackwater will tend to disappear.

No. 7.

SOUTH AFRICA.

THE HIGH COMMISSIONER to THE SECRETARY OF STATE.

(Received 18th December, 1914.)

High Commissioner's Office, Pretoria,
25th November, 1914.

SIR,

WITH reference to Lord Gladstone's despatch of 9th May,* I have the honour to enclose, for your information, a copy of a despatch from the Administrator, Northern Rhodesia, on the subject of mosquito-borne diseases.

I have, &c.,
BUXTON,
High Commissioner.

Enclosure in No. 7.

Administrator's Office, Livingstone, Northern Rhodesia,
9th November, 1914.

MY LORD,

WITH further reference to Your Lordship's despatch of 13th October, on the subject of mosquito-borne disease, I now have the honour to forward, for Your Lordship's information, a copy of report for the year ending 31st March, 1914.

I have, &c.,
L. A. WALLACE,
Administrator.

His Excellency
The High Commissioner for South Africa,
Pretoria.

MOSQUITO-BORNE DISEASES.

REPORT FOR YEAR ENDING 31ST MARCH, 1914.

THE only diseases coming under this heading in Northern Rhodesia are malaria, blackwater fever, and filariasis.

Of these the first named is by far the most common, both in Europeans and natives. Blackwater fever is confined to Europeans. Although occasionally odd cases have been reported in natives, no definite diagnosis of such has been made by medical officers. The ratio of blackwater to malaria in cases coming under treatment in Europeans was, during the past year, as 1 to 7·5, but it must be understood that, whereas practically all cases of blackwater within reach of medical aid

* No. 6.

come under treatment, only a relatively small proportion of malaria, representing the more severe attacks, do likewise.

Filariasis has not been noticed in any Europeans, but it is fairly common amongst natives.

Malaria Prophylaxis.—The European population use quinine very regularly as a prophylactic, and a scheme is under consideration for the supply of this drug by the Administration at lowest possible rates.

Amongst certain sections of natives in Government employment—prisons, schools, etc.—quinine is also used, but not amongst the general population, although free medical treatment is accorded every native applying for same.

In connexion with this report certain questions are asked and such as are applicable to this territory are answered below:—

1. Name of Colony: Northern Rhodesia.
2. Total area: 290,000 square miles.
3. Estimated population: (*a*) Europeans, 2,300; (*b*) Natives, 900,000.
4. Births during year: Europeans, 44.
5. Deaths during year: (*a*) Total deaths, 43; (*b*) Ascribed to malaria, 6; (*c*) Ascribed to blackwater, 14.
6. Number of Government Hospitals: (*a*) European, 3; (*b*) Native, 12.

European Hospitals.

—	Admissions.	Malaria.	Deaths.	Blackwater.	Deaths.	Deaths from all Causes.
Livingstone	171	68	1	11	2	6
Broken Hill	61	27	Nil	5	Nil	Nil
Fort Jameson ..	11	2	Nil	2	Nil	Nil

The following figures show the number of natives coming under treatment in hospitals at different stations in Northern Rhodesia:—

—	Numbers Treated.	Malaria.	Deaths.	Filariasis.	Deaths from all Causes.
Livingstone	277	37	4	—	46
Broken Hill	272	17	Nil	14	22
Ndola	461	85	Nil	—	8
Bwana M'Kubwa ...	1,284	124	Nil	—	21
Mpika...	169	7	Nil	—	2
Kawambwa	191	46	1	—	4
Fort Jameson ...	109	7	Nil	—	12
Fundu	601	1	Nil	—	5

It will be seen that, out of 324 cases treated, six deaths occurred, a case mortality of 1·85 per cent. It must be borne in mind that a native rarely seeks treatment for malaria unless it is of a very severe type.

8. *Medical Service*: Number of Government medical officers, 18; number of other registered practitioners, 5 (?).

9. *European Schools*, 1: Average daily attendance, 12; number of scholars registered, 15.

Native Schools: One state-aided. There is a large number of native schools under the direction of various mission societies. No figures are available from these.

10. Estates employing indentured labour:—
Mining companies employing indentured labour, 2.
Number of hospitals on such estates, 2.
Number of labourers employed, approximately 800.
Total deaths among such labourers, figures unavailable.
Deaths ascribed to malaria, not known.
Total admissions to hospitals, 1,284 at one.
Total admissions to hospitals for malaria, 124 at one.

11. Total revenue, £127,299; estimated expenditure, £189,068.
12. Upkeep of Government hospitals and dispensaries, £7,312; total salaries and allowances of medical officers, £8,682.
13. Towns under municipalities or town councils, 2.
14. Total population (European): approximately, 2,300.
15. Total population (native): approximately, 900,000.
16. Local regulations are in force to prevent the breeding of mosquitoes in townships. Kala azar is not known to exist.

No. 8.

LEEWARD ISLANDS.

RETURNS OF MALARIAL FEVER, BLACKWATER FEVER, YELLOW FEVER, FILARIASIS, AND DENGUE DURING THE YEAR FROM THE 1ST JANUARY TO THE 31ST DECEMBER, 1913.

(Received 26th May, 1914.)

ANTIGUA.

1.	Name of Colony	Antigua.
2.	Total area	108 sq. miles.
3.	Estimated population:—	
	(*a*) Total	31,184 (as at 1st January, 1913)
	(*b*) Europeans	1,013 (census, 1911)
	(*c*)	
	(*d*) Other races	31,252 (census, 1911)
	(*e*)	
4.	Births during the year:—	
	Total births	1,078
5.	Deaths during the year:—	
	(*a*) Total deaths	779
	(*b*) Deaths ascribed to fever	13
	(*c*) Deaths ascribed to blackwater fever	None
	(*d*) Deaths ascribed to yellow fever	None
6.	Government hospitals:—	
	(*a*) Number of such hospitals	1
	(*b*) Totals, during year admissions	1,057
	deaths ...	126
	(*c*) Malarial fever admissions	10
	deaths ..	2
	(*d*) Blackwater fever admissions	—
	deaths ...	—
	(*e*) Yellow fever admissions	—
	deaths ...	—
	(*f*) Filarial diseases admissions	13
	deaths ...	2
	(*g*) Dengue admissions	—
	deaths ...	—

7. Government dispensaries:—
   (*a*) Number of such dispensaries
   (*b*) Total attendances during year
   (*c*) Attendances for malaria
   (*d*) Attendances for filarial diseases
   (*e*) Attendances for dengue
   — None.

8. Medical Service:—
   (*a*) Number of Government Medical Officers ... 6
   (*b*) Number of special Health Officers ... —
   (*c*) Number of other registered practitioners ... 2

9. Schools:—
   (*a*) Number of Government and State-aided Schools 27
   (*b*) Number of scholars registered in these schools 6,063
   (*c*) Percentage of daily attendances ... ... 52·3

10. Estates employing indentured labour:—
   (*a*) Number of such... ...
   (*b*) Number of indentured labourers employed ...
   (*c*) Number of hospitals and dispensaries on such estates ... ...
   (*d*) Total deaths among such labourers ... ...
   (*e*) Deaths ascribed to malaria
   (*f*) Total admissions and attendances at hospitals and dispensaries ...
   — No such estates.

11. Estimated revenue of Colony:—
   Total during year 1912-13 ... ... £53,489 9 8

12. Estimated expenditure of Colony:—
   (*a*) Total during year 1912-13 ... ... £53,193 7 7
   (*b*) Annual medical and sanitary expenditure 9,839 10 3
   (*c*) Upkeep of Government hospitals and dispensaries 7,505 15 9
   (*d*) Total salaries and allowances of Medical Officers 1,620 0 0
   (*e*) Total annual sanitary expenditure ... 478 12 7

13. Towns under Municipalities or Town Councils:—
   (*a*) Number of such ... ... One
   (*b*) Total population 7,910
   (*c*) Total revenues £2,044 18 9
   (*d*) Total medical and sanitary expenditure ... 930 18 5

Appendix I.

REPORTS ON ANTI-MALARIAL MEASURES IN THE CROWN COLONIES AND PROTECTORATES, &c.

14. Table of deaths by districts: —

District.	Area. Square miles.	Population.	Total Deaths.												
			January.	February.	March.	April.	May.	June.	July.	August.	September.	October.	November.	December.	Total.
St. John ...	28·33	14,175	87	39	49	44	19	25	40	22	26	47	34	38	470
St. Mary ...	22·110	4,276	7	6	2	6	3	4	7	4	4	5	2	10	60
St. Paul ...	18·421	4,317	11	7	4	11	2	2	6	6	4	4	5	10	72
St. Philip ...	17·1	2,972	9	3	7	3	4	1	3	7	4	8	4	8	61
St. Peter ...	12·630	2,827	14	8	4	4	2	1	3	6	4	5	—	8	59
St. George ...	9·240	2,827	9	2	—	5	1	5	3	3	2	4	5	7	46
Barbuda ...	62·0	871	1	1	—	—	—	1	1	1	4	1	1	—	11
Total ...	170·155	32,265	138	66	66	73	31	39	63	49	48	74	51	81	779

15. Table of deaths in the principal towns:—

Town.	District where Situated.	Population of Town.	Total Deaths.												
			January.	February.	March.	April.	May.	June.	July.	August.	September.	October.	November.	December.	Total.
City of St. John	Parish of St. John	7,910	62	26	36	34	13	20	35	16	21	37	28	29	357

16. Rainfall during the year:—

Where Observed.	District.	Rainfall.												
		January.	February.	March.	April.	May.	June.	July.	August.	September.	October.	November.	December.	Total.
Botanic Station ...	St. John's ...	4·24	1·79	2·85	1·12	10·76	1·75	2·43	5·04	3·47	4·10	3·64	2·80	43·99

17. Additional information to be given if possible on the following points:—

(*a*) Is there any legislation in force against the breeding of mosquitoes in premises?—Yes.

Numbers of notices, convictions, and warnings during the year?—Not known.

(*b*) Number of children examined for enlarged spleen. Where was this done? Percentage affected. Does kala-azar exist?—No.

(*c*) Number of persons examined for filarial diseases. Where was this done? Percentage affected.—25: at the Hospital and Training School at night. 16 per cent.

(*d*) Any large works for surface drainage of towns or reclamation of marshes. Approximate cost?—No.

(*e*) Numbers of men employed in towns and villages for petty anti-mosquito works. Approximate cost.—28 Sanitary Inspectors. £187 approximate cost.

(*f*) Amount of Government quinine sold or distributed gratis during the year. Agencies employed.—£15. Police Stations and Ministers.

(*g*) Is quinine distributed regularly in the schools?—No.*

* It is intended to introduce the distribution of quinine in primary schools from 1st April, 1914.

(*h*) Measures taken against these diseases on estates employing indentured labour?—No such estates.
(*i*) Any steps taken regarding the housing of the poor?—No.
(*j*) Any exceptional increase or decrease of these diseases recently noticed. —No.
(*k*) Any other remarks on the subject. ———.

ST. KITTS-NEVIS.

1. Colony of the Leeward Islands (Presidency of St. Kitts-Nevis).
2. Total area:—St. Kitts, 65 square miles. Nevis, 50 square miles. Anguilla, 35 square miles. Total, 150 square miles.
3. Estimated population:—(*a*) Total, 44,279. (*b*) Europeans, 1,580. (*c*) Other races, 42,699.
4. Births during the year:—1,706.
5. Deaths during the year:—

(*a*) Total deaths	1,138
(*b*) Deaths ascribed to fever	16
(*c*) Deaths ascribed to blackwater fever	Nil
(*d*) Deaths ascribed to yellow fever	Nil

6. Government hospitals:—

(*a*) Number of hospitals ...	3
(*b*) Totals during the year admissions	984
deaths ...	142
(*c*) Malarial fever admissions	5
deaths ...	3
(*d*) Blackwater fever admissions	Nil
deaths ...	„
(*e*) Yellow fever admissions	Nil
deaths ...	„
(*f*) Filarial diseases admissions	61
deaths ...	5
(*g*) Dengue admissions	Nil
deaths ...	„

7. Government dispensaries:—

(*a*) Number of such dispensaries	4
(*b*) Total attendances during the year	Not known
(*c*) Attendances for malaria	None
(*d*) Attendances for filarial diseases ...	Not known
(*e*) Attendances for dengue	None

8. Medical Service:—

(*a*) Number of Government Medical Officers ...	9
(*b*) Number of Special Health Officers	None
(*c*) Number of other registered practitioners ...	None

9. Schools :—
   (*a*) Number of Government and State-aided schools 52
   (*b*) Number of scholars registered in these schools 9,000
   (*c*) Percentage of daily attendances ... ... 50 per cent.
10. Estates employing indentured labour ... ... None
11. Estimated revenue of the Presidency ... £52,349
12. Estimated expenditure do. ... £59,844
   (*b*) Annual medical and sanitary expenditure ... £3,527
   (*c*) Upkeep Government hospitals and dispensaries ... £5,042
   (*d*) Total salaries and allowances of Medical Officers £2,340
   (*e*) Total annual sanitary expenditure £1,186
13. Towns under Municipalities or Town Councils :—
   (*a*) Number of such ... 1
   (*b*) Total population ... 8,000
   (*c*) Total revenues £2,400
   (*d*) Total medical and sanitary expenditure ... £5,600
14. Table of deaths by districts :—

District.	Area. Square Miles.	Population.	Total Deaths.												
			January.	February.	March.	April.	May.	June	July.	August.	September.	October.	November.	December.	Total.
St. Kitts ...	65	26,583	67	68	50	57	73	70	53	65	59	59	56	67	744
Nevis ...	50	13,335	51	21	24	16	27	16	20	12	40	31	29	29	316
Anguilla ...	35	4,361	3	10	7	8	7	6	4	5	6	8	7	6	77
Total ...	—	—	121	99	81	81	107	92	77	82	105	98	92	102	1,137

15. Table of deaths in the principal towns :—

Town.	District.	Population.	Total Deaths.												
			January.	February.	March.	April.	May.	June.	July.	August.	September.	October.	November.	December.	Total.
Basseterre ...	St. Kitts...	—	26	27	22	37	35	39	20	26	25	23	23	27	330
Charlestown ...	Nevis ...	—	10	5	3	7	12	1	5	2	19	5	3	6	78
Total ...	—	—	36	32	25	44	47	40	25	28	44	28	26	33	408

16. Rainfall during the year :—

Where Observed.	District.	Rainfall.												
		January.	February.	March.	April.	May.	June.	July.	August.	September.	October.	November.	December.	Total.
Botanic Station, Basseterre	St. Kitts	6·67	4·06	2·94	2·04	5·05	0·82	1·97	3·19	4·73	3·93	4·28	3·95	43·63
" " Charlestown	Nevis	7·18	1·96	4·14	0·81	4·47	2·23	1·77	4·92	3·50	3·89	4·41	3·36	42·64
Wall Blake	Anguilla	2·87	1·62	2·15	2·94	3·05	1·65	3·62	1·91	3·36	6·07	2·25	4·73	36·20

17. Additional information to be given if possible on the following points:—
(*a*) Is there any legislation in force against the breeding of mosquitoes in premises?—Yes.
Number of notices, convictions and warnings during the year.—Several.
(*b*) Number of children examined for enlarged spleen.—No systematic examination.
Does kala-azar exist?—No.
(*c*) Number of persons examined for filarial diseases.—No systematic examination.
(*d*) Any large works for surface drainage of towns or reclamation of marshes?—Annual work.
Approximate cost.—£100 per annum.
(*e*) Numbers of men employed in towns or villages for petty anti-mosquito works.—10.
Approximate cost.—£140.
(*f*) Amount of Government quinine sold or distributed gratis during the year.—None.
Agencies employed.—Government distributions.
(*g*) Is quinine distributed regularly in the schools?—No.
(*h*) Measures taken against these diseases on estates employing indentured labour.—No such estates.
(*i*) Any steps taken regarding the housing of the poor?—
(*j*) Any exceptional increase or decrease of these diseases recently noticed?—None.
(*k*) Any other remarks on the subject.—Malaria not being endemic in the Presidency, no gratis distribution of quinine has been found necessary.

W. H. FRETZ,
Senior Medical Officer.

St. Kitts,
31st March, 1914.

DOMINICA.

1.	Name of Colony	Presidency of Dominica.
2.	Total area	304⅔ sq. miles.
3.	Estimated population:—	
	(*a*) Total	35,242
	(*b*) European	399
	(*c*)	
	(*d*) Other races	21,361 (black); 12, 103 (coloured)
	(*e*)	
4.	Births during the year:—	
	Total births	1,223
5.	Deaths during the year:—	
	(*a*) Total deaths	—
	(*b*) Deaths ascribed to fever	852
	(*c*) Deaths ascribed to black-water fever	—
	(*d*) Deaths ascribed to yellow fever	—

6. Government hospitals:—

(a) Number of such hospitals. Two.

		Roseau Hospital.			Portsmouth.
		In-patients.	Out-patients.	Total.	Total.
(b) Totals during year	admissions ...	832	796	1,628	136
	deaths	75	0	75	10
(c) Malarial fever	admissions ...	72	61	133	7
	deaths	4	0	4	0
(d) Blackwater fever	admissions ...	1	0	1	0
	deaths	0	0	0	0
(e) Yellow fever	admissions ...	0	0	0	0
	deaths	0	0	0	0
(f) Filarial diseases	admissions ...	2	0	2	4
	deaths	0	0	0	0
(g) Dengue	admissions ...	0	0	0	0
	deaths	0	0	0	0

7. Government dispensaries:—

(a) Number of such dispensaries	17
(b) Total attendances during year	9,826
(c) Attendances for malaria	841
(d) Attendances for filarial diseases ...	5
(e) Attendances for dengue	Nil

8. Medical service:—

(a) Number of Government Medical Officers ...	4
(b) Number of special Health Officers ...	3
(c) Number of other registered practitioners ...	1

9. Schools:—

(a) Number of Government and State-aided schools	20 primary, 1 secondary, 5 aided—26
(b) Number of scholars registered in these schools	Primary 5,504, secondary 39—5,543
(c) Percentage of daily attendances	Primary 42 %, secondary 95 %

10. Estates employing indentured labour:—

(a) Number of such	Nil.
(b) Number of indentured labourers employed ...	
(c) Number of hospitals and dispensaries on such estates	
(d) Total deaths among such labourers	
(e) Deaths ascribed to malaria	
(f) Total admissions and attendances at hospitals and dispensaries	

11. Estimated revenue of Presidency:—

Total during year	£42,067 0 0

12. Estimated expenditure of Presidency:—

(a) Total during year	47,774 0 0
(b) Annual medical and sanitary expenditure	2,036 0 0

(*c*) Upkeep of Government hospitals and dispensaries £2,496 0 0
(*d*) Total salaries and allowances of Medical Officers 1,568 0 0
(*e*) Total annual sanitary expenditure ... 344 0 0

13. Towns under Municipalities or Town Councils:—
(*a*) Number of such ... ... One (Roseau Town Board)
(*b*) Total population 6,700
(*c*) Total revenues £1,402 1 4
(*d*) Total medical and sanitary expenditure 476 8 3

14. Table of deaths by Districts:—

District.	Area. Square miles.	Population.	Total Deaths.												
			January.	February.	March.	April.	May.	June.	July.	August.	September.	October.	November.	December.	Total.
E	101⅝	15,957	50	50	47	35	48	47	39	42	38	32	34	27	489
F	73	9,775	14	13	20	10	11	17	16	10	8	17	10	13	159
G	129⅝	9,121	27	24	15	12	12	13	10	20	20	19	14	18	204
Total ...	—	—	91	87	82	57	71	77	65	72	66	68	58	58	582

15. Table of deaths in the principal towns:—

Town.	District where Situated.	Population of Town.	Total Deaths.												
			January.	February.	March.	April.	May.	June.	July.	August.	September.	October.	November.	December.	Total.
Roseau... ...	E	6,621	37	39	29	22	31	29	23	22	14	13	19	13	291
Portsmouth ...	G	1,023	6	7	5	3	3	4	0	4	5	5	4	4	50
Total		7,644	43	46	34	25	34	33	23	26	19	18	23	17	341

16. Rainfall during the year:—

Station.	January.	February.	March.	April.	May.	June.	July.	August.	September.	October.	November.	December.	Total.
Antrim Valley ...	10·71	4·00	11·39	3·36	7·48	7·15	10·88	21·00	10·36	10·93	6·69	5·53	109·48
Batalie	2·74	1·49	3·00	1·70	0·56	2·89	2·50	16·31	3·65	4·19	3·15	1·90	44·08
Bellevue	19·24	5·31	14·74	8·36	14·71	10·74	13·32	24·85	15·89	20·81	15·77	9·63	173·37
Blenheim	11·49	2·69	6·94	8·06	9·49	8·63	6·83	19·96	14·98	12·01	18·67	6·02	125·77
Botanic Gardens ...	7·48	2·32	7·29	1·57	3·46	3·49	7·57	10·93	8·39	10·40	4·28	2·72	69·90
Canefield	5·68	1·90	5·74	1·54	3·12	3·75	6·68	14·90	8·16	9·37	4·06	2·66	67·56
Castleacre	10·95	3·33	11·74	3·47	6·58	7·72	10·53	24·04	12·88	15·47	6·00	4·53	117·24
Castle Bruce ...	8·76	1·92	4·52	12·04	8·28	6·02	8·58	21·71	11·80	20·94	19·45	6·33	130·35
Concord	14·83	3·81	9·03	14·44	10·29	9·72	8·93	25·17	15·69	25·42	22·98	7·64	167·05
Corlet	23·05	4·92	16·39	10·52	11·48	12·78	15·12	29·27	19·54	28·22	21·19	10·66	208·14
Everton	11·01	1·97	9·44	2·14	7·13	6·39	11·10	19·58	21·95	14·52	8·52	5·71	119·46
Gleau Manioc ...	27·51	6·79	26·14	18·95	22·74	13·74	23·12	39·70	21·28	26·57	33·91	11·36	271·81
Goodwill	7·46	2·62	7·12	1·58	3·00	3·28	6·68	9·80	7·58	11·29	4·64	2·89	67·94
Governor	11·96	3·99	8·70	14·18	9·64	10·77	8·41	22·76	15·70	17·38	21·54	7·57	152·60
Hampstead	9·28	2·59	6·00	7·73	6·13	6·13	5·63	15·83	12·95	10·01	15·23	3·33	100·92
Hatton Garden ...	8·91	2·01	3·98	12·29	8·99	6·69	5·13	21·05	10·65	18·47	15·57	4·70	118·44
Hillsborough ...	6·61	2·50	5·16	2·35	3·09	4·65	6·05	16·03	6·22	7·09	4·96	3·61	68·32
Kinellan	16·58	5·66	15·92	8·00	7·91	9·46	12·73	23·30	16·07	9·77	16·60	7·07	151·07
La Haut	9·26	2·70	8·43	3·64	6·98	5·58	9·45	14·19	10·37	13·24	7·34	4·17	95·35
Lisdara	20·02	4·78	18·11	10·81	14·14	10·11	12·02	19·94	12·00	24·67	19·24	5·06	170·90
Londonderry ...	6·29	1·86	3·42	11·75	5·26	5·47	5·29	17·88	10·82	11·75	14·48	4·84	99·11
Melville Hall ...	8·90	2·67	5·02	11·54	6·85	6·50	5·33	21·15	11·25	14·65	16·11	4·72	114·69
Moore Park... ...	11·86	2·34	6·53	9·65	6·20	6·68	5·97	16·25	15·35	10·78	17·90	4·97	114·48
Morne Bruce ...	8·61	2·54	7·68	1·89	3·69	4·05	7·83	10·89	8·34	10·47	3·88	2·81	72·68
Picard	10·70	2·19	7·22	3·12	5·46	6·07	5·40	15·84	7·13	8·99	9·52	4·85	86·49
Pte. Mulatre ...	13·85	2·55	3·75	4·13	11·42	2·74	5·46	22·73	11·18	16·98	15·95	9·00	119·74
Rosalie	11·26	4·99	4·50	11·57	13·40	8·06	8·81	26·58	11·97	19·81	19·12	5·68	145·75
Shawford	14·76	3·06	19·78	8·19	10·92	12·29	14·59	27·80	16·20	13·69	13·38	3·83	158·49
Snug Corner ...	14·98	2·30	14·99	7·40	9·78	9·38	12·38	20·60	16·32	16·32	11·72	6·62	142·74
Soufrière	6·92	2·41	2·16	2·39	2·46	3·27	5·51	13·41	10·49	10·61	5·75	4·07	69·45
St. Aroment ...	10·01	1·78	11·16	2·57	4·67	5·13	8·29	15·35	10·16	8·71	4·79	2·61	85·23
Wall House... ...	2·95	1·45	3·50	1·77	3·02	5·27	7·28	12·93	8·70	7·80	2·55	2·25	59·47
Woodford Hill ...	8·08	1·95	4·88	12·24	7·20	5·09	4·95	16·37	10·76	14·54	14·64	3·19	103·89

Mean Rainfall,	33	Stations ...	118·09 inches.
„ „	12	Leeward Coast Stations	75·49 „
„ „	3	Windward „ „	131·94 „
„ „	12	Inland Stations	161·03 „
„ „	6	La Soye Coast Stations	110·47 „

17. Additional information to be given if possible on the following points:—

(*a*) Is there any legislation in force against the breeding of mosquitoes in premises?—Yes. Roseau Town Board Regulations.

Numbers of notices, convictions, and warnings during the year: Convictions 3.

(*b*) Number of children examined for enlarged spleen.—1,000, District "D."

Where was this done?—At dispensaries.

Percentage affected.—60 per cent.

Does kala-azar exist?—No.

(*c*) Number of persons examined for filarial diseases.——

Where this was done?——.

Percentage affected.—Unknown.

(*d*) Any large works for surface drainage of towns or reclamation of marshes.—No.

Approximate cost.—Nil.

(*e*) Numbers of men employed in towns and villages for petty anti-mosquito works.—None specially employed. Town Constables perform this duty in conjunction with ordinary sanitary duties.

(*f*) Amount of Government quinine sold or distributed gratis during the year.—9,755 grains.
Agencies employed.—Police stations.
(*g*) Is quinine distributed regularly in the schools?—No.
(*h*) Measures taken against these diseases on estates employing indentured labour.—No such estates.
(*i*) Any steps taken regarding the housing of the poor.—No.
(*j*) Any exceptional increase or decrease of these diseases recently noticed.—
(*k*) Any other remarks on the subject.——

MONTSERRAT.

Following headings in draft return.

1. Montserrat.
2. 32½ square miles.
3. Population (1911):—
   (*a*) Total 12,196
   (*b*) Europeans 140
   (*d*) Black and coloured ... 12,056
4. Births 364
5. Deaths 216
   None caused by malaria, yellow fever, blackwater fever or dengue.
6. Government hospitals:—
   (*a*) One.
   (*b*) Admissions 130
   Deaths 5
   (*c*)-(*g*) No admissions for malaria, filariasis, blackwater fever, yellow fever or dengue.
7. Government dispensaries:—
   (*a*) Four.
   (*b*) Number of patients ... 2,500
   Number of attendances 3,676
   (*c*) Attendances for malaria None.
   (*d*) „ „ filariasis 8
   (*e*) „ „ dengue None.
8. Medical Service:—
   (*a*) Two Government Medical Officers.
   (*b*) One of these is Health Officer.
   (*c*) No other registered practitioners.
9. Schools:—
   No Government schools.
   (*a*) State-aided schools ... 14
   (*b*) Number of scholars ... 3,115
   (*c*) Percentage of daily attendances ... ... 50 %
10. No indentured labour.
11. Revenue of Presidency, 1912-13 ... ... £11,343 0 0
12. Expenditure of Presidency, 1912-13 ... 10,688 7 3
    (*b*) Annual medical and sanitary expenditure 1,260 0 0
    (*c*) Upkeep of hospitals and dispensaries ... 308 10 0
    (*d*) Salaries and allowances of Medical Officers 530 0 0
    (*e*) Annual sanitary expenditure 187 0 0
13. No towns under Municipal or Town Councils.

Appendix I.

REPORTS ON ANTI-MALARIAL MEASURES IN THE CROWN COLONIES AND PROTECTORATES, &c.

14. Table of deaths by Districts :—

Parishes.	Population.	Total Deaths.												
		January.	February.	March.	April.	May.	June.	July.	August.	September.	October.	November.	December.	Total.
St. Anthony	4,573	12	8	9	10	5	11	11	7	5	6	4	2	90
St. Patrick	819	—	1	—	2	—	2	—	1	—	1	1	1	9
St. Peter	3,545	5	6	5	1	6	3	5	4	4	4	4	5	52
St. George	3,259	3	3	5	4	11	2	10	3	6	6	5	7	65
Total	12,196	20	18	19	17	22	18	26	15	15	17	14	15	216

The town of Plymouth is situated in St. Anthony.

15. Table of deaths in principal town :—

Town.	District where Situated.	Population (1911).	Total Deaths.												
			January.	February.	March.	April.	May.	June.	July.	August.	September.	October.	November.	December.	Total.
Plymouth	Parish of St. Anthony	1,534	1	2	1	2	1	3	2	3	1	1	0	0	17

16. Rainfall :—

Where Observed.	District.	Rainfall.												
		January.	February.	March.	April.	May.	June.	July.	August.	September.	October.	November.	December.	Total.
Botanic Station ...	St. Anthony ..	8·13	2·95	5·82	3·79	9·21	1·59	2·78	4·88	2·99	7·03	7·77	5·62	62·51

Average for the Island (21 stations) 56·18 inches.

17. (*a*) No anti-mosquito regulations in force.
(*b*) No systematic examination for enlarged spleen in children. No kala-azar.
(*c*) No systematic examination for filaria.
(*d*) No works for surface drainage, beyond the town gutters and field drains on estates, but the sloping surface gives natural drainage. One swamp on the island not drained.
(*e*) No men employed for anti-mosquito work.
(*f*) No quinine sold or distributed generally.
(*i*) In certain cases paupers are boarded out at public expense.
(*j*) No increase or decrease of above diseases.
(*k*) Of these diseases, filariasis only is known, and that occurs with moderate frequency.

J. C. McPHERSON,
Senior Medical Officer.

No. 9.

NYASALAND.

RETURN OF MALARIAL FEVER, BLACKWATER FEVER, YELLOW FEVER, FILARIASIS, AND DENGUE, FROM 1ST JANUARY, TO THE 31ST DECEMBER, 1913.

(Received in Colonial Office, 7th July, 1914.)

1. *Name of Colony*: Nyasaland.
2. *Total area*: 39,801 square miles.
3. *Estimated population*:
   - (*a*) Total 1,065,097
   - (*b*) Europeans 798
   - (*c*) Asiatics 387
   - (*d*) Africans 1,063,912
4. *Births during the year*:
   - (*a*) Europeans 25
   - (*b*) Asiatics 1
   - (*c*) Africans. No record.
5. *Deaths during the year*:
   - (*a*) Europeans 7
   - (*b*) Asiatics 4
   - (*c*) Africans. No record.

   Deaths ascribed to fever 2
   „ „ „ blackwater fever ... 1
   „ „ „ yellow fever ... ... nil
6. *Government hospitals*:
   - (*a*) Number of such hospitals... 8
   - (*b*) Totals during year: Admissions, 521; deaths, 33.
   - (*c*) Malarial fever: Admissions, 56; deaths, 2.
   - (*d*) Blackwater fever: Admissions, 7; deaths, 1.
   - (*e*) Yellow fever: Admissions, nil; deaths, nil.
   - (*f*) Filarial diseases: Admissions, nil; deaths, nil.
   - (*g*) Dengue:
7. *Government dispensaries*:
   - (*a*) Number of such dispensaries 8
   - (*b*) Total attendances during year 12,984
   - (*c*) Attendances for malaria 701
   - (*d*) „ „ filarial diseases ... 3
   - (*e*) „ „ dengue ... ... nil
8. *Medical Service*:
   - (*a*) Number of Government Medical Officers 11
   - (*b*) „ „ special Health Officers ... nil
   - (*c*) „ „ other registered practitioners 14
9. *Schools*:
   - (*a*) Number of schools 1,768
   - (*b*) Number of scholars registered in these schools 132,960
   - (*c*) Percentage of daily attendances. (No record; average number in attendance 87,608)
10. *Estates employing indentured labour* ... ... nil
11. *Estimated revenue of Colony*:
    Total during year £178,272
12. *Estimated expenditure of Colony*:
    - (*a*) Total during year £166,360
    - (*b*) Annual medical and sanitary expenditure £9,507
    - (*c*) Upkeep of Government hospitals and dispensaries £191
    - (*d*) Total salaries and allowances of Medical Officers £7,391

(*e*) Total annual sanitary expenditure. (No record; prisoners are largely employed for clearing of bush and scrub, and for petty anti-mosquito measures).

13. *Towns under municipalities or Town Councils*:
(*a*) Number of such 4
(*b*) Total population 3,306
(*c*) Total revenues ... ...about £500
(*d*) Total medical and sanitary expenditure. No separate record.

14. *Table of deaths by districts*: No record.

15, 16. See tables attached.

17. *Additional information*:
(*a*) Is there any legislation in force against the breeding of mosquitoes in premises? Yes.
Number of notices, convictions, and warnings during the year: Notices, 18; convictions, 5; warnings, 3.
(*b*) Number of children examined for enlarged spleen, 1,823.
Where was this done?—At Port Herald, Chiromo, Mlanje, Blantyre, and Karonga.
Percentage affected:

Port Herald	50·9
Chiromo	34·6
Mlanje	46·0
Blantyre	31·0
Karonga	29·6
Mean	38·42

Kala-azar has, so far, not been found to exist.
(*c*) Number of persons examined for filarial diseases—111
Where was this done?—At Chiromo.
Percentage affected.—27·9.
(*d*) Any large works for surface drainage of towns or reclamation of marshes?—No.
(*e*) Numbers of men employed in towns and villages for petty anti-mosquito works.—No reliable record; at Government stations prisoners are generally employed on such work, but there are no organized mosquito brigades.
(*f*) Amount of Government quinine sold or distributed gratis during the year.—None; but natives applying for quinine at the dispensaries are supplied.
(*g*) Is quinine distributed regularly in the schools?—No.
(*h*) Measures taken against these diseases on estates employing indentured labour.—There are no indentured labourers.
(*i*) Any steps taken regarding the housing of the poor?—None necessary.
(*j*) Any exceptional increase or decrease of these diseases recently noticed?—As compared with last year there has been an increase of 199 cases of malaria, and a decrease of 4 cases of blackwater fever.

H. HEARSEY,
Principal Medical Officer,
Nyasaland.

APPENDIX I.

REPORTS ON ANTI-MALARIAL MEASURES IN THE CROWN COLONIES AND PROTECTORATES, &c.

15.—TABLE OF DEATHS IN THE PRINCIPAL TOWNS.

Town.	District where Situated.	Population of Town.	Total Deaths.											
			January.	February.	March.	April.	May.	June.	July.	August.	September.	October.	November.	December.	Total.
Port Herald...	Lower Shire	460	1	—	—	—	—	—	—	—	—	—	—	1	2
Mlanje ...	Mlanje ...	120	1	—	—	—	—	—	—	—	—	—	—	—	1
Blantyre ...	Blantyre ...	1,295	—	2	1	—	—	1	—	—	—	—	1	—	5
Zomba ...	Zomba ...	1,204	3	2	6	7	2	1	2	3	1	1	1	4	33
Fort Johnston	South Nyasa	227	—	—	—	1	—	—	1	—	—	—	—	—	2
Total			5	4	7	8	2	2	3	3	1	1	2	5	43

16.—RAINFALL DURING THE YEAR.

Where Observed.	District.	Rainfall.												
		January.	February.	March.	April.	May.	June.	July.	August.	September.	October.	November.	December.	Total Inches.
Port Herald...	Lower Shire	6·46	3·05	4·08	2·16	1·37	1·60	0·43	—	—	0·55	2·31	2·41	24·42
Chiromo ...	Ruo ...	4·99	7·18	4·97	2·87	1·04	1·07	0·15	0·09	—	—	1·55	5·15	29·06
Neno... ...	West Shire	9·57	9·07	10·86	3·04	1·58	1·24	0·07	—	—	0·78	3·79	4·09	44·09
Mlanje ...	Mlanje ...	16·15	5·56	26·27	13·74	7·28	4·88	0·80	2·38	0·16	1·23	2·83	6·58	87·86
Blantyre ...	Blantyre ...	10·74	4·24	5·67	5·12	0·65	0·67	0·11	0·05	0·16	1·23	4·73	3·94	37·31
Zomba ...	Zomba ...	8·87	6·04	13·24	4·67	2·66	0·70	—	—	0·26	1·52	9·13	4·64	51·73
Ncheu ...	Upper Shire	9·53	6·09	10·22	1·67	0·55	—	—	—	—	0·56	3·66	3·20	35·48
Fort Johnston	South Nyasa	8·19	9·57	8·60	1·50	0·11	—	-	—	—	0·21	3·82	8·19	40·19
Karonga ...	North Nyasa	5·14	5·98	9·67	4·55	2·47	0·63	—	—	—	—	0·20	10·97	39·61

No. 10.

SOUTHERN NIGERIA.

RETURN OF MALARIAL FEVER, BLACKWATER FEVER, YELLOW FEVER, FILARIASIS AND DENGUE, DURING THE YEAR FROM THE 1ST JANUARY TO THE 31ST DECEMBER, 1913.

(Received 10th August, 1914.)

1. Name of Colony: Southern Nigeria.
2. Total area: 79,880 square miles.
3. Estimated population: 8,660,962, estimated as 5 per cent. increase on 1912
   (*a*) Total, 8,660,962.
   (*b*) Europeans, 1,589 (resident population).
   (*c*)
   (*d*) Other races, 99 Asiatics.
   (*e*)
4. Births during the year:—
   Total births, no records.
5. Deaths during the year:—No reliable records.
   (*a*) Total deaths, ——.
   (*b*) Deaths ascribed to fever, 286.
   (*c*) Deaths ascribed to blackwater fever, 6.
   (*d*) Deaths ascribed to yellow fever, 11.

Appendix I.

REPORTS ON ANTI-MALARIAL MEASURES IN THE CROWN COLONIES AND PROTECTORATES, &c.

6. Government hospitals:—
   (*a*) Number of such hospitals, 51.
   (*b*) Totals, during year { admissions, 9,514. deaths, 663.
   (*c*) Malarial fever ... { admissions, 1,289. deaths, 18.
   (*d*) Blackwater fever { admissions, 28. deaths, 6.
   (*e*) Yellow fever ... { admissions, 41. deaths, 9.
   (*f*) Filarial diseases ... { admissions, 15. deaths, —.
   (*g*) Dengue ... ... { admissions, —. deaths, —.
7. Government dispensaries:—
   (*a*) Number of such dispensaries, 46.
   (*b*) Total attendances during year, 176,827.
   (*c*) Attendances for malaria, 11,217.
   (*d*) Attendances for filarial diseases, 63.
   (*e*) Attendances for dengue, —.
8. Medical service:—
   (*a*) Number of Government Medical Officers, 84.
   (*b*) Number of special Health Officers, 3.
   (*c*) Number of other registered practitioners, 11.
9. Schools:—
   (*a*) Number of Government and State-aided schools, 137.
   (*b*) Number of scholars registered in these schools, 23,022.
   (*c*) Percentage of daily attendances, 73 per cent.
10. Estates employing indentured labour:—
   (*a*) Number of such, 1.
   (*b*) Number of indentured labourers employed, 6.
   (*c*) Number of hospitals and dispensaries on such estates, —.
   (*d*) Total deaths among such labourers, —.
   (*e*) Deaths ascribed to malaria, —.
   (*f*) Total admissions and attendances at hospitals and dispensaries, —.
11. Estimated revenue of Colony:—
   Total during year, £2,719,093.
12. Estimated expenditure of Colony:—
   (*a*) Total during year, £3,018,226.
   (*b*) Annual medical and sanitary expenditure
   (*c*) Upkeep of Government hospitals and dispensaries } £20,102.
   (*d*) Total salaries and allowances of Medical Officers, &c., £56,519.
   (*e*) Total annual sanitary expenditure, £23,220.
13. Towns under Municipalities or Town Councils:—
   (*a*) Number of such, 1.
   (*b*) Total population, 74,893.
   (*c*) Total revenues, £24,530.
   (*d*) Total medical and sanitary expenditure, £22,635.
14. Table of deaths by districts: No reliable records.
15. Table of deaths in the principal towns:—

Town.	District where Situated.	Population of Town.	Total Deaths.												
			January.	February.	March.	April.	May.	June.	July.	August.	September.	October.	November.	December.	Total.
Lagos	—	63,049	161	131	156	156	169	145	195	170	118	128	154	165	1,867
Ebute Metta ...	—	12,403	27	22	30	19	30	28	32	21	20	30	27	25	311
Total	—		188	153	186	175	193	173	227	191	168	158	181	190	2,178

Appendix I.

Reports on anti-malarial measures in the Crown Colonies and Protectorates, &c.

16. Rainfall in inches for 1913:—

Stations.	Rainfall.												
	January.	February.	March.	April.	May.	June.	July.	August.	September.	October.	November.	December.	Total.
Lagos ...	Nil	2·98	1·05	2·95	7·91	16·87	15·57	2·48	5·40	4·72	0·61	0·11	60·65
Ondo ...	Nil	2·70	0·95	5·78	6·90	2·89	6·52	11·30	10·30	6·77	1·08	Nil	55·14†
Ibadan ...	Nil	0·85	*	3·78	2·31	1·77	9·60	11·35	13·63	4·20	1·70	Nil	49·19
Olokemeji	Nil	0·13	2·07	7·07	2·99	5·92	6·74	2·04	5·94	2·91	0·67	0·10	36·58
Badagri ...	Nil	4·43	1·00	2·60	5·93	11·98	18·38	1·99	5·06	7·74	0·53	Nil	59·54†
Epe ...	Nil	1·10	0·65	5·46	6·28	3·14	18·34	"	13·85	6·29	0·60	Nil	55·71
Oshogbo ...	0·05	2·65	1·13	3·38	4·16	7·80	5·13	4·02	10·36	4·05	1·80	Nil	44·53
Oyo ...	Nil	0·37	2·22	2·56	4·19	1·74	7·07	4·21	7·65	4·89	1·69	Nil	36·59
Ebute Metta	Nil	5·06	0·84	2·87	8·84	11·79	19·22	2·92	3·32	6·31	1·79	0·11	63·07
Abeokuta	Nil	0·64	2·90	4·09	5·19	6·20	9·37	4·15	6·28	5·05	0·62	Nil	44·49
Ogbomosho	Nil	0·44	0·09	3·96	7·91	3·21	5·08	5·56	12·60	4·70	0·16	Nil	43·71
Yaba ...	Nil	2·77	0·91	3·13	6·77	7·10	10·91	3·47	4·11	3·85	2·33	0·10	45·45
Forcados...	Nil	7·80	5·56	10·00	20·74	30·09	49·50	41·54	47·99	25·96	4·38	0·40	243·96
Sapele ...	Nil	5·50	0·61	7·00	8·69	14·19	16·91	30·07	13·39	9·44	Nil	0·05	105·85
Benin City	Nil	1·60	0·50	4·96	4·53	7·84	14·60	18·35	13·29	8·14	0·12	1·08	75·01
Onitsha ...	Nil	0·42	1·05	8·39	8·79	6·20	11·97	11·18	10·46	7·18	Nil	0·10	65·74
Warri ...	Nil	2·42	4·25	6·10	8·85	9·57	17·64	32·80	19·60	10·83	0·10	Nil	112·16†
Aboh ...	Nil	1·36	3·25	4·69	7·78	10·81	5·77	25·80	*	6·27	Nil	Nil	65·23†
Udi ...	0·20	0·40	3·10	5·00	10·90	13·70	*	*	*	3·99	Nil	0·03	37·32
Okwoga ...	Nil	0·96	0·90	5·51	5·34	4·28	10·64	10·37	10·76	8·36	Nil	Nil	57·12†
Asaba ...	*	0·64	0·80	5·19	7·19	6·06	*	*	9·57	5·77	Nil	Nil	35·22
Agbor ...	0·05	2·65	1·43	4·80	8·40	11·40	15·65	8·75	12·32	6·90	Nil	Nil	72·35
Bonny ...	Nil	9·58	7·69	7·86	8·34	21·44	30·72	38·10	22·70	21·90	5·02	1·70	175·05
Calabar ...	Nil	2·71	3·23	8·19	14·17	9·00	28·15	21·35	14·86	13·49	9·53	4·16	128·84
Ikot Ekpene	Nil	2·58	3·26	9·71	10·84	13·31	18·57	20·74	11·38	9·62	1·49	Nil	101·50
Ikom ...	Nil	2·89	1·39	6·54	10·09	13·60	11·88	10·68	15·16	15·70	Nil	0·11	88·04
Brass ...	1·02	5·91	4·91	7·57	9·71	25·43	30·67	26·73	30·65	13·36	5·73	0·85	162·54
Degema ...	Nil	2·97	3·19	5·07	8·50	4·72	13·23	24·98	14·98	8·41	1·40	0·46	87·91
Owerri ...	Nil	2·10	1·68	10·50	8·76	6·01	7·79	18·82	13·89	6·65	Nil	0·15	76·35
Opobo ...	Nil	4·68	4·94	11·23	2·94	8·09	26·66	32·16	14·93	8·94	Nil	0·85	115·42
Afikpo ...	Nil	0·80	0·62	4·54	10·65	11·72	8·13	9·12	3·87	6·53	Nil	0·10	56·08
Akassa ...	Nil	13·37	9·01	4·33	4·86	25·79	28·48	30·55	38·04	24·05	5·51	0·42	184·41†
Bende ...	Nil	0·95	1·24	2·81	1·92	4·08	11·24	17·30	9·64	10·72	Nil	*	59·90
Obudu ...	Nil	0·16	0·56	5·17	6·50	9·00	5·68	11·52	14·75	12·09	Nil	Nil	66·43
Okigwi ...	Nil	1·38	1·92	10·97	8·68	13·86	10·31	12·63	12·52	7·11	Nil	0·26	79·14
Abakaliki	Nil	1·27	0·24	9·51	11·65	6·92	11·37	5·72	11·37	9·46	Nil	0·26	67·77

17. Additional information to be given, if possible, on the following points:—

(*a*) Destruction of Mosquitoes Ordinance: Notices, 26,616; convictions, 2,518; warnings, numerous.

(*b*) 15,763 cases were examined at various stations throughout the whole Colony: 64·4 per cent. were normal, 20 per cent. were slightly enlarged, 15 per cent. were enlarged. No kala-azar reported.

(*c*) At Badagry 50 persons were examined, and 40 per cent. were found to be infected.

(*d*) No special large works. Routine reclamation and drainage cost approximately £4,239.

(*e*) 256 men employed at a cost of £3,906.

(*f*) 1,948,230 grains were distributed by dispensaries.

(*g*) No.

(*h*) None.

(*i*) None required.

(*k*) An epidemic of yellow fever occurred during the year; no other exceptional increase or decrease in diseases noted.

R. LAURIE.

26th April, 1914.

* No records available. † Records incomplete.

APPENDIX I.

REPORTS ON ANTI-MALARIAL MEASURES IN THE CROWN COLONIES AND PROTECTORATES, &C.

No. 11.

STRAITS SETTLEMENTS.

RETURN OF MALARIAL FEVER, BLACKWATER FEVER, YELLOW FEVER, FILARIASIS AND DENGUE DURING THE YEAR FROM 1ST JANUARY TO 31ST DECEMBER, 1913.

(Received 14th August, 1914.)

1.	Name of Colony: Straits Settlements.	
2.	Total area: 1,560 square miles.	
3.	Estimated population:—	
	(*a*) Total	743,010
	(*b*) Europeans	7,685
	(*c*) Chinese	385,822
	(*d*) Other races	101,199
	(*e*) Malays	248,304
		743,010
4.	Births during the year:—	
	Total births	19,964
5.	Deaths during the year:—	
	(*a*) Total deaths	25,950
	(*b*) Deaths ascribed to fever:—	
	(1) Unspecified fever	4,746
	(2) Malaria	2,878
	(3) Typhoid	104
	(4) Dengue	nil
	(*c*) Deaths ascribed to blackwater fever ...	2
	(*d*) Deaths ascribed to yellow fever... ...	nil
	(*e*) Deaths ascribed to kala-azar	1
6.	Government hospitals:—	
	(*a*) Number of such hospitals	30
	(*b*) Totals during the year:—	
	Admissions	36,840
	Deaths	3,935
	(*c*) Malarial fever:—	
	Admissions	7,864
	Deaths	479
	(*d*) Blackwater fever:—	
	Admissions	2
	Deaths	—
	(*e*) Yellow fever:—	
	Admissions	—
	Deaths	—
	(*f*) Filarial diseases:—	
	Admissions	17
	Deaths	—
	(*g*) Dengue:—	
	Admissions	—
	Deaths	—
7.	Government dispensaries:	
	(*a*) Number of such dispensaries	15
	(*b*) Total attendances during 1913	40,773
	(*c*) Attendances for malaria...	3,963
	(*d*) Attendances for filarial diseases ...	—
	(*e*) Attendances for dengue	77
8.	Medical service:—	
	(*a*) Number of Government Medical Officers	28
	Number of Assistant Surgeons... ...	30

(*b*) Number of special Health Officers:—

Singapore Government		3
Municipal		5
Penang Government		1
Municipal		2
Total		11

The Health Officer in Malacca and Labuan is the Government Medical Officer in each of those places. Provision has been made in the estimates for three Health Officers for the three Settlements, but they have not yet arrived.

(*c*) Number of other registered medical practitioners 119

9. Schools:—

(*a*) Number of Government and State-aided schools:—

Total 226

(*b*) Number of scholars registered ... ...

(*c*) Percentage of daily attendances ...

As to (*b*) and (*c*) please see accompanying statement.

10. Estates employing indentured or free labour:—

(*a*) Number of such:—

Singapore		147 estates
Penang		39 estates
Dindings		
Province Wellesley		
Malacca		35 estates
Total		221

(*b*) Number of coolies employed:—

Singapore	5,663
Penang	14,689
Province Wellesley	
Dindings	
Malacca	17,908
Total	38,260

(*c*) Number of hospitals and dispensaries on such estates:—

Singapore	5
Penang	30
Province Wellesley	
Dindings	
Malacca	38
Total	73

(*d*) Total deaths among such labourers:—

Singapore	5
Penang	295
Province Wellesley	
Dindings	
Malacca	351
Total	651

(*e*) Deaths ascribed to malaria :—

Singapore	1
Penang	12
Province Wellesley	
Dindings	
Malacca	113
Total	126

(*f*) Total admissions and attendances at hospitals and dispensaries :—

Singapore	694
Penang	20,475
Province Wellesley	
Dindings	
Malacca	38,812
Total	59,981

11. Estimated revenue of the Colony :—

The following figures are exclusive of municipalities, for which please see item 13 (*c*) below :—

Colonial revenue	$10,890,368
Hospital Board revenue	149,270
Rural Board revenue	505,453
Education Board revenue	202,170
Total	$11,747,261

12. Estimated expenditure :—

Colonial expenditure	$11,018,114
Hospital Board expenditure	326,157
Rural Board expenditure	810,169
Education Board expenditure	222,670
(*a*) Total, 1913	$12,377,110

(*b*) Annual medical and sanitary expenditure inclusive of salaries :—

Singapore	$1,683,060
Penang	132,562
Malacca	44,132
Labuan	6,730
Total	$1,866,484

(*c*) Upkeep of Government hospitals and dispensaries :—

Singapore	$534,392
Penang	157,575
Malacca	13,615
Labuan	1,956
Total	$707,538

(*d*) Total salaries and allowances of:—

Medical Officers	$142,830
Assistant Surgeons	50,009
	$192,839

(*e*) Total annual sanitary expenditure:—

Singapore	$392,063
Penang	55,843
Malacca	8,167
Labuan	2,847
	$458,920

(The above figures for (*a*), (*b*), (*c*), (*d*), and (*e*) are exclusive of Municipalities.)

13. Towns under Municipalities or Town Councils.

(*a*) Number of such 3

(*b*) Population:—

Singapore	275,043
Penang	102,913
Malacca	21,300
Total	399,256

(*c*) Total revenue estimated:—

Singapore	$3,528,850
Penang	937,417
Malacca	134,207
Total	$4,600,474

(*d*) Total medical and sanitary expenditure under the following headings:—Health Department, Cemeteries, Conservancy, Sewerage and Disposal, Malaria Prevention, Drainage, Pathological Department, Improvement of Insanitary Areas, Isolation Hospital, Back Lanes, Markets, Slaughter Houses, and Water Supply, was:—

For Singapore	$2,096,565
For Penang	59,817
For Malacca	25,477
Total	$2,181,859

14. Table of deaths by district:—

District.	Area. Square miles.	Population.	Total Deaths. January.	February.	March.	April.	May.	June.	July.	August.	September.	October.	November.	December.	Total.
Singapore ...	217	See Section 3 above.	885	689	816	878	978	1,054	1,035	920	988	1,143	984	957	11,327
Penang ...	108		401	341	384	431	507	476	488	458	360	400	408	415	5,069
Province Wellesley	280		297	268	266	299	294	367	368	385	324	302	303	307	3,775
Dindings ...	183		32	29	24	21	22	20	28	29	29	30	21	17	302
Malacca ..	720		447	436	411	449	547	461	415	388	412	422	445	500	5,333
Labuan ...	28		5	9	10	5	16	19	13	13	10	9	20	15	144
Total			2,067	1,767	1,911	2,083	2,364	2,397	2,347	2,193	2,123	2,306	2,181	2,211	25,950

Appendix I.

REPORTS ON ANTI-MALARIAL MEASURES IN THE CROWN COLONIES AND PROTECTORATES, &c.

15. Table of deaths in the principal towns :—

Town.	Population.	Total Deaths.												
		January.	February.	March.	April.	May.	June.	July.	August.	September.	October.	November.	December.	Total.
Singapore ...	275,013	766	594	670	723	842	878	877	758	762	874	829	814	9,387
Penang ...	102,913	301	249	266	302	344	324	334	319	269	280	300	307	3,595
Malacca ...	21,300	48	70	76	69	77	69	70	69	69	75	72	67	831
Total		1,115	913	1,012	1,094	1,263	1,271	1,281	1,146	1,100	1,229	1,201	1,188	13,813

16. Rainfall during the year (mean) :—

Where Observed.	Rainfall.												
	January.	February.	March.	April.	May.	June.	July.	August.	September.	October.	November.	December.	Total.
Singapore.	17·67	7·43	17·12	10·06	7·26	13·96	6·31	3·14	10·62	10·72	14·60	12·18	131·10
Penang ...	4·38	1·61	4·24	6·27	17·41	11·52	5·35	5·74	21·71	19·20	15·98	6·61	120·02
Dindings ..	9·32	5·16	5·13	5·55	9·28	7·20	2·61	0·54	5·68	7·78	8·43	6·53	73·21
Province Wellesley	5·59	1·68	5·82	9·22	13·56	9·75	4·17	4·68	15·90	14·86	14·51	6·18	105·92
Malacca...	5·57	2·09	3·55	5·82	7·08	7·26	4·17	6·35	8·87	10·05	10·37	4·13	75·31
Labuan ...	4·13	1·64	2·51	4·99	16·23	20·46	9·22	5·63	22·99	21·27	16·38	13·85	141·50

17. (*b*) Number of children examined for enlarged spleen, etc. :—

Singapore: 208 children were examined, of whom 30 were found to have enlarged spleen, or 14·42 per cent.

Penang: 4,362 children examined in vernacular schools, etc. Percentage affected, 7·91.

Malacca: 1,593=63·6 per cent. infected. They were examined in all schools and police stations.

Labuan: 105=19·04 per cent. infected. Examined in schools.

(*d*) Any large works for surface drainage, etc :—

Singapore: Reclamation of swamps by filling and by drainage, $10,000; subsoil drainage of malarial swamps, $10,000; anti-malarial works, $5,000.

Penang: Miscellaneous works carried out under this head during the year cost $83,497.

Malacca: A sum of $2,903 was spent in surface drainage, etc.

(*e*) Number of men employed on special anti-mosquito works.

Singapore: 45 men. Cost, $6,946.

Penang: An average of 91 coolies per month were employed within municipal limits. Cost, $13,500.

Malacca: Nil.

Labuan: None except one sanitary inspector.

(*f*) Amount of Government quinine sold or distributed gratis :—

Singapore: 72,000 grains were distributed by the Municipality, gratis.

Penang: 18¾ lbs. distributed at out-door dispensaries and estates (gratis).

Malacca: 20 lbs. 2 ozs.

Labuan: 132 ozs., gratis.

(*g*) Is quinine distributed regularly in the schools?
Singapore: Yes.
Penang: Yes.
Malacca: Yes.
Labuan: No.

(*h*) Measures taken against these diseases on estates:—
The group hospital scheme referred to in my previous report is being enforced and regulations thereunder have been passed. The estate managers are being kept to the requirements of Estate Ordinances in force, referred to in my previous reports. Sanitary lines, wells, and latrines are insisted upon.

(*i*) Any steps regarding the housing of the poor:—
Singapore and Penang: Considerable progress has been made in these municipalities and in many villages by the destruction of insanitary houses and by the provision of back lanes.

(*j*) and (*k*) Any exceptional increase or decrease of these diseases recently noticed:
The year under report was marked by a great decrease in the prevalence of malaria, as compared with 1911, all through the peninsula, and it is impossible to say what effect the measures taken will have on the prevalence of the disease in the next malarial year. Dr. Finlayson finds that the spleen rate among the children at the schools in the Teluk Blanga District progressively decreased until it ultimately reached zero, and it is hoped that this may be an indication that the breeding places of fever-bearing anophelines provided by the streams in the ravines have been successfully dealt with, and that in a district which was the most malarious in town. Malarial fever has, at least for the time, been considerably reduced.

W. GILMORE ELLIS,
Principal Civil Medical Officer,
Straits Settlements.

25th June, 1914.

Enclosure 1, *vide* Question 9.

—	Number of Schools.	Average Enrolment.	Average Attendances.
SINGAPORE.			
English Schools—			
Government schools, boys' and girls'	5	2,270	2,136
Aided " " "	11	5,259	4,947
Vernacular Schools—			
Government schools, boys' and girls'	18	1,263	1,137
Aided " " "	—	—	—
MALACCA.			
English Schools—			
Government schools, boys' and girls'	2	489	461
Aided " " "	6	1,035	965
Vernacular Schools—			
Government schools, boys' and girls'	76	4,800	4,352
Aided " " "	—	—	—
PENANG.			
English Schools—			
Government schools, boys' and girls'	1	253	224
Aided " " "	14	4,990	4,592
Vernacular Schools—			
Government schools, boys' and girls'	90	6,364	5,403
Aided " " "	3	134	111

APPENDIX I.

REPORTS ON ANTI-MALARIAL MEASURES IN THE CROWN COLONIES AND PROTECTORATES, &C.

No. 12.

ZANZIBAR.

THE CHIEF SECRETARY to THE TROPICAL DISEASES RESEARCH FUND.

(Received 20th August, 1914.)

SIR, The Secretariat, Zanzibar, 10th July, 1914.

I AM directed to transmit, for your information, a report by Major Skelton, R.A.M.C., Medical Officer of Health, on the prevention of mosquito-borne diseases during the year 1913.

I have, &c.,
R. H. CROFTON,
Chief Secretary.

Enclosure in No. 12.

Health Office, Zanzibar, 30th June, 1914.

SIR,

I HAVE the honour to forward to you a report for the year 1913 on the prevention of mosquito-borne diseases.

I should be glad if you would forward this report to the Advisory Committee for the Tropical Diseases Research Fund.

From the figures submitted it will be seen that mosquito-borne diseases have been responsible for:—

During	Percentage 1913	1912	1911.
Of the total deaths	24·7	16·7	—
Of the total admissions to hospitals ...	25·6	21·5	25·0
Of the total attendances	6·2	6·5	9·0

The rise in the death-rate percentage from mosquito-borne diseases is due, I think, to the fact that better notification is being obtained in the outlying districts and in Pemba.

The number of deaths from malaria alone in the City of Zanzibar shows a satisfactory fall during 1913 as compared with previous years.

This can be seen from the following table:—

	In Zanzibar City.			
During	1913	1912	1911	1910
Deaths from malaria...	159	171	189	203

This is due to three factors:

(i) The gradual annihilation of anopheline breeding places within the environs of the town. During the past year, as will be seen from a later paragraph in this report, a sum of Rs.19,068 was spent in drainage work on two areas that formerly were constant anopheline distributing centres. A further sum of Rs.10,000 is authorized to be spent on further drainage during the current year.

It is, however, not only in the outskirts of the town that anophelines are discovered breeding, they are unfortunately also found right in the town itself and not infrequently in the European quarter. In fact, anophelines were discovered by the mosquito-brigade on 45 occasions during the period under review, and of these 37 were certainly preventable, and should have been prevented, as they were found in collections of water in private gardens and such like.

(ii) In my report to the Committee for last year reference was made to the proposed formation of a mosquito brigade. This came into being in March, 1913, after the Inspectors had undergone a course of instruction in the habits and life history of the mosquito, its common breeding places, &c., and were able to distinguish the more common larval forms.

The brigade consists of five Inspectors, each of whom has three men under him. The town is divided into five districts, and it is the duty of the District Inspector to pay a weekly visit to each house in his district as near as possible on the same day of the week and at the same hour of the day.

The house and garden is inspected and, if necessary, kerosene oil is poured into the cess-pits.

During 1913 the brigade discovered mosquitoes breeding on 1,001 occasions, of which 74 were in European houses. The following short table shows the fall in the index per 100 houses examined:—

During	Visits of Insections.	Larvæ Found.	Index per 100 Houses.	Rainfall.
March	2,604	136	5·1	9·99
April	3,600	140	3·0	17·59
May	4,665	143	3·08	11·18
June	3,594	34	0·9	0·07
July	4,546	39	0·85	0·31
August	5,492	36	0·67	0·88
September*	6,162	127	2·06	2·58
October	7,828	121	1·54	4·22
November	7,415	113	1·52	3·20
December	7,178	113	1·57	1·80
Total	53,079	1,001	1·88 average.	—

By putting the rainfall alongside the index it will be seen that the fall in the index was not due to dry weather altogether.

I consider that the work of the brigade is a factor contributing to a lowered death-rate from malaria in the town.

(iii) The use of the mosquito nets is, I feel sure, becoming more common amongst not only the better educated Indian communities but also amongst even the better paid Swahili. Servants, no doubt, learn the habit from their masters. Once the use of a net becomes a fashion it is bound to spread rapidly among the Zanzibari.

Very real efforts are being made in malarial education. Weekly lectures on hygiene are given to school teachers, not only to those employed by Government but also to those in the Indian schools.

School children are taken out from time to time for "field work" and are taught to hunt out breeding places for mosquitoes, &c. Small prizes are given for the best collectors. The reasons for this insect-hunting are carefully explained to the children.

In regard to the prevalence of filarial disease in the Islands—elephantiasis, lymph scrotum and filarial abscesses are very common.

Dr. Howard, of the Universities Mission, contributes a note to the Public Health Department's Annual Report for 1913, in which he states that, in series of 227 consecutive cases admitted to his hospital for various complaints, in 49 instances microfilaria nocturna were found. Dr. Howard considers that at least one in five of the native inhabitants of Zanzibar harbour micro-filaria, but that fortunately only a proportion of this number show any symptoms. At the same time, he considers that of the mosquito-borne diseases present filariasis is responsible for the greatest amount of ill-health and sufferings.

I thoroughly agree with Dr. Howard's views, and I think the reason why a larger figure is not found in the column for hospital attendance for filaria is because the disease in its many manifestations is so common that the sufferer will not bother himself to come to hospital for treatment. It can only be hoped that as the result of the work of the mosquito-brigade the index for culex fatigans falls so will the incidence of filarial disease.

I have, &c.,
D. S. SKELTON, Major, R.A.M.C.,
Medical Officer of Health.

The Chief Secretary.

* Inspection extended to the Swahili quarter.

Appendix I.

REPORTS ON ANTI-MALARIAL MEASURES IN THE CROWN COLONIES AND PROTECTORATES, &c.

Report on Mosquito-borne Diseases.

(January 1st—December 31st, 1913.)

1. Name of Protectorate: Zanzibar (including Pemba).
2. Total area of both islands: 1,020 square miles.
3. Estimated population: (Census 1910).
   - (*a*) Total 197,199
   - (*b*) Europeans 234
   - (*c*) Indian and Cingalese 8,305
   - (*d*) Other races 188,660
4. Births during the year:—
   - (*a*) Total births 2,832
5. Deaths during the year:—

Deaths.	Europeans.	Other Races.	Total.
(a) Total deaths	5	4,358	4,382
(b) Deaths ascribed to fever	1	1,077	1,078
(c) Deaths ascribed to blackwater ...	—	—	—
(d) Deaths ascribed to yellow fever ...	—	—	—

6. Hospitals:—

(*a*) Number of hospitals	Government ...	7	
	„ Europeans	1	
	Private (U.M.C.A.) ...	1	
		—	
	Total ...		9

	Government Hospital.		U.M.C.A.		Total.		Grand Total.
	Europeans.	Other Races.	Europeans.	Other Races.	Europeans.	Other Races.	
Total during the year—							
Admissions	21	2,521	30	304	51	2,825	2,876
Deaths	—	75	—	20	—	95	95
Malarial fever—							
Admissions	12	617	30	100	42	717	759
Deaths	—	5	—	—	—	5	5
Blackwater fever—							
Admissions	—	2	—	1	—	3	3
Deaths	—	—	—	—	—	—	—
Yellow fever							
Admissions	—	—	—	—	—	—	—
Deaths	—	—	—	—	—	—	—
Filarial diseases—							
Admissions	—	70	—	—	—	70	70
Deaths	—	4	—	—	—	4	4
Dengue—							
Admissions	—	—	—	—	—	—	—
Deaths	—	—	—	—	—	—	—

7. Dispensaries:—

(*a*) Number of dispensaries	Government ...	8	
	Private Khoja	1	
	U.M.C.A. ...	1	
		—	2
	Total ...		10

Appendix I.

REPORTS ON ANTI-MALARIAL MEASURES IN THE CROWN COLONIES AND PROTECTORATES, &c.

	Government.		Private.		Total.		Grand Total.
	Europeans.	Other Races.	Europeans.	Other Races.	Europeans.	Other Races.	
Total attendance during year...	169	41,055	12	13,827	181	54,882	55,063
Attendance for malaria ...	11	2,131	6	856	17	2,987	3,004
Attendance for filarial diseases	—	159	—	263	—	422	422
Attendance for dengue ...	—	—	—	—	—	—	—
Attendance for blackwater fever	—	—	—	—	—	—	—

8. Medical Service :—
   (*a*) Number of Government Medical Officers ... 7
   (*b*) Number of Special Health Officers 2
   (*c*) Number of other registered practitioners ... 2
9. Schools :—
   (*a*) Number of Government and State-aided schools 6
   (*b*) Number of scholars registered in the schools 632
   (*c*) Percentage of daily attendance ... ... 86·27
10. There are no estates employing indentured labour.
11. Estimated revenue of the Protectorate :—
   (*a*) Total revenue during the year ... £210,452.
12. Estimated expenditure of the Protectorate :—
   (*a*) Total during the year £226,611
   (*b*) Annual medical and sanitary expenditure £23,380
   (*c*) Upkeep of Government hospitals and dispensaries £6,146
   (*d*) Total salaries and allowances of Medical Officers £3,470
   (*e*) Total annual sanitary expenditure* ... £13,511
13. No towns under municipalities.
14. Table of deaths by districts :—

Districts.	No. of deaths.	Total.
Island of Zanzibar :—		
Zanzibar Town	1,128†	
Mkokotoni	889	
Chwaka	328	
Mwera	766	
		3,111
Island of Pemba :—		
Chake Chake	567	
Weti	435	
M'Koani	219	
		1,221
Total for both islands ...		4,332

15. Table of deaths in principal towns (see No. 14).
16. Rainfall during the year :—

January	0·39
February	1·37
March	9·99
April	17·59
May	11·18
June	0·07
July	0·31
Carried forward ...	40·90

* Including the upkeep of leper and poor establishments and of the quarantine station.
† Includes 85 deaths in the Poor House and 21 in the Leper Asylum at Walezo.

	Brought forward ...	40·90
August		0·88
September		2·58
October		4·22
November		3·20
December		1·31
	Total ...	53·09
	Average ...	77·03

17. Additional information to be given, if possible, on the following points :—

(*a*) Is there any legislation in force against the breeding of mosquitoes in premises?
Yes. Under the Public Health Decree. "Any collection of water in any well, pool, channel, barrel, tub, bucket, or any other vessel, and found by the Health Officer to contain mosquito larvæ, shall be liable to be dealt with under this decree."

Number of notices during the year ...	881
Number of convictions	32
Number of warnings	581

(*b*) Number of persons of the age of 15 examined for enlarged spleen 298
Where was this done? At the Government School.
Percentage affected ... ... 23·4

(*c*) Does Kala-azar exist? No.

(*d*) Number of persons examined for filarial diseases 227
Where was this done? Mkunazini Mission Hospital. Percentage affected ... 21·59

(*e*) Large works for surface drainage of towns and reclamations of swamps :—
(i) Kiungani Swamp drain ... ...Rs. 15,000
(ii) Zinani Swamp outlet to the sea ...Rs. 4,068

(*f*) Number of men employed in town for petty anti-mosquito work—
In Zanzibar Town. (See introductory remarks.)
In Pemba the Sanitary Inspector at Chake Chake and two Sub-Inspectors at Weti and M'Koani go round once in a week.

(*g*) Amount of quinine sold or distributed gratis during the year.

Sold in packets of 5 grains each	17 ozs. 5 drs.
Distributed gratis	50 ozs. 4 drs.

(*h*) Is quinine regularly distributed in the schools? Yes.

(*i*) Not applicable. There is no indentured labour.

(*j*) Housing of poor :—Wherever possible insanitary native huts in Zanzibar are being demolished. There is a poor house at Walezo.

(*k*) Increase or decrease in the diseases noted :—(*Vide* introductory remarks).

(*l*) Any other remarks on the subject :—(*Vide* introductory remarks).

No. 13.

MAURITIUS.

THE ACTING GOVERNOR to THE SECRETARY OF STATE.

(Received 16th September, 1914.)

SIR, Government House, Port Louis, 27th July, 1914.

IN compliance with the instructions contained in your Circular despatch of the 20th December, 1910,* I have the honour to transmit herewith two copies of the return of malarial fever and other tropical diseases during the year ended 31st December, 1913.

2. In paragraph 17 (*a*) of the return for 1912,† it was stated that legislation to prohibit the breeding of mosquitoes in premises was in course of preparation, and the matter is specifically dealt with in Article 4 of Ordinance No. 31, of 1913.

I have, &c.,

J. MIDDLETON.

Enclosure in No. 13.

RETURN OF ANTI-MALARIAL MEASURES AND OF MOSQUITO-BORNE DISEASES, 1913.

1.	Name of Colony: Mauritius.	
2.	Total area: 720 square miles.	
3.	Estimated population on 31st December, 1913:—	
	(*a*) Total population	373,185
	(*b*) General „	108,814
	(*c*) Indian „	258,837
	(*d*) Chinese „	5,534
4.	Births during the year	15,153
5.	Deaths during the year	13,201
	(*a*) Ascribed to fever (malaria included) ...	4,001
	(*b*) „ „ blackwater fever	nil
	(*c*) „ „ yellow fever	nil
6.	Government hospitals:—	
	(*a*) Number	12
	(*b*) Admissions during the year	16,685
	(*c*) Malarial fever:	
	Admissions	2,546
	Deaths	47
	(*d*) Blackwater fever	nil
	(*e*) Yellow fever	nil
	(*f*) Filarial diseases:	
	Admissions	27
	Deaths	nil
	(*g*) Dengue	nil
7.	Government dispensaries:—	
	(*a*) Number	28
	(*b*) Total attendances	48,356
	(*c*) Attendances for malaria	14,688
	(*d*) „ „ filarial diseases ...	32
	(*e*) „ „ dengue	nil
8.	Medical service:—	
	(*a*) Number of Government Medical Officers	23
	(*b*) Number of special Health Officers ...	5
	(*c*) Number of other registered practitioners	39

* Appendix I., page 4. † See page 12 of [Cd. 7261], March, 1914.

9. Schools:—
   (*a*) Number of Government and State-aided schools 149
   (*b*) Number of scholars registered in these schools 20,325
   (*c*) Percentage of daily attendances:—
      (i) Government schools ... ... 61·72
      (ii) Aided schools ... ... 65·76
10. Estates employing indentured labour:—
   (*a*) Number 112
   (*b*) Number of indentured labourers employed 33,270
   (*c*) Number of hospitals and dispensaries... 108
   (*d*) Total deaths among such labourers ... 2,343
   (*e*) Deaths ascribed to malaria 217
   (*f*) Total admissions and attendances at hospitals and dispensaries: the manner in which the estate hospital records are kept does not allow of this information being obtained, and the law, as it stands, does not compel the Medical Officer to supply it.
11. Estimated revenue of the Colony during the year 1913-14, Rs.10,939,500.
12. Estimated expenditure of the Colony during the year 1913-14:
   (*a*) Total during the year, Rs.10,589,500.
   (*b*) Annual medical and sanitary expenditure, Rs. 1,089,100.
   (*c*) Upkeep of Government hospitals and dispensaries, Rs.287,030. (exclusive of repairs, additions, &c., to buildings, Rs.41,200).
   (*d*) Total salaries and allowances of Medical Officers, Rs.116,630.
   (*e*) Total annual sanitary expenditure, Rs.363,603.
13. Towns under Municipalities and Town Councils:—
   (*a*) Number: 4 (Port Louis, Curepipe, Quatre Bornes, and Beau Bassin-Rose Hill).
   (*b*) Total population: 80,909 (Census of 31st March, 1911).
   (*c*) Total revenues: Rs.658,997.
   (*d*) Total medical and sanitary expenditure: Rs. 114,565.
14. Table of deaths in the Colony by districts: *Vide* Annexure A.
15. Deaths in the principal towns during the year:—
   Port Louis 1,810
   Curepipe 342
   Quatre Bornes 175
   Beau Bassin-Rose Hill 386
16. Rainfall during the year: *Vide* Annexure B.
17. Additional information:—
   (*a*) Is there any legislation in force against the breeding of mosquitoes in premises?
   Under the Public Health Ordinance, No. 32 of 1894-95, Article 29 (*f*), any accumulation of water injurious to health is punishable as a nuisance. Further legislation has been introduced to prohibit the breeding of mosquitoes and the matter is specifically dealt with in Article 4 of Ordinance No. 31 of 1913, which came into force on 13th December, 1913.
   (*b*) Number of children examined for enlarged spleen: 13,605.
   Where was this done?—In the primary schools.
   Percentage affected: 19·82.
   Does kala-azar exist?—No.
   (*c*) Number of persons examined for filarial diseases?—None.
   (*d*) Anti-malarial works of a permanent character are being undertaken over the whole of the island costing Rs.1,000,000 approximately. A sum of Rs.150,000 is annually provided for this purpose.
   (*e*) 186 men are employed in towns and villages for petty anti-mosquito works at a cost of Rs.3,050 per month. A sum of Rs.50,000 is spent annually on minor anti-malarial works and quinine distribution (Rs.10,000).

(*f*) 488 lbs. 2 ozs. of quinine have been distributed gratis during the year by specially appointed distributors. The drug is also distributed regularly, as far as possible, in the schools. The sale of quinine at cost price is now effected at all the Government dispensaries.

(*g*) Quinine is distributed regularly in the schools. See (*f*).

(*h*) Measures taken against these diseases on estates employing indentured labour?

An Ordinance, No. 15 of 1913, was passed last year providing for major anti-malarial works at the joint expense of Government and of the private parties benefited.

(*i*) Any steps regarding the housing of the poor?—None.

(*j*) Any exceptional increase or decrease of these diseases recently noticed?—Although the figures for malaria show a decrease it is still too early to judge of the results obtained from the campaign against malaria.

(*k*) A general anti-malarial campaign has been started and works of a permanent character carried out, particularly in the districts of Pamplemousses, Flacq and Black River. Rivers are being canalized and cleaned, marshes reclaimed, and objectionable collections of stagnant water removed. Works of a minor character continue to be carried on, such as filling in of hollows and water holes, cleaning of canals, trenches, upkeep of permanent works, &c. Quinine is distributed free by special distributors, and the drug is sold at the Government dispensaries at cost price. It is still too early to see what effect these measures have on the public health as regards malaria, and it is only when the campaign will have been well on its way that any improvement is expected to be felt.

ANNEXURE A.

NUMBER OF DEATHS IN THE ISLAND OF MAURITIUS DURING THE YEAR 1913, AND DURING EACH MONTH OF THE YEAR.

Districts.	January	February	March	April	May	June	July	August	September	October	November	December	Total
Port Louis	197	160	233	209	232	220	176	170	78	214	173	157	2,314
Pamplemousses	198	168	178	135	103	110	125	134	91	98	82	74	1,496
Riviere du Rempart	155	160	128	84	64	87	98	72	66	61	54	67	1,096
Flacq	311	235	209	158	192	171	164	128	142	122	114	105	2,051
Grand Port	209	227	167	147	128	138	161	148	107	107	96	105	1,740
Savanne	97	93	90	85	79	94	112	85	82	82	70	89	1,052
Plaines Wilhems	262	198	190	137	151	148	161	148	133	126	126	115	1,895
Moka	151	99	104	73	81	68	75	69	68	69	76	64	992
Black River	86	42	53	76	42	51	43	43	35	29	23	42	565
Grand Total ...													13,201

ANNEXURE B.

RAINFALL IN MAURITIUS DURING THE YEAR 1913.
In inches.

Where observed	District.	January	February	March	April	May	June	July	August	September	October	November	December	Grand Total
Observatory	Pamplemousses	15·83	5·69	2·89	4·66	2·27	10·84	0·85	2·17	1·42	1·03	0·83	5·37	53·85
The Manse	Plaines Wilhems	8·68	6·53	3·56	3·64	1·06	6·69	0·64	2·18	0·80	1·85	0·78	3·53	38·89
Curepipe ...	do.	12·59	11·39	14·80	7·17	4·16	10·52	5·20	7·75	2·68	2·17	2·13	4·72	85·28
Alma ...	Moka	25·51	19·31	14·53	12·00	8·72	15·67	4·27	10·50	4·26	1·16	2·10	10·89	128·92

APPENDIX I.

REPORTS ON ANTI-MALARIAL MEASURES IN THE CROWN COLONIES AND PROTECTORATES, &C.

No. 14.

NORTHERN TERRITORY OF AUSTRALIA.

RETURN OF MALARIAL FEVER, BLACKWATER FEVER, YELLOW FEVER, FILARIASIS, AND DENGUE DURING THE YEAR FROM THE 1ST JANUARY TO THE 31ST DECEMBER, 1912.

(Received in Colonial Office, 2nd October, 1914.)

1. Name of Colony: Northern Territory of Australia.
2. Total area: 523,620 square miles.
3. Estimated population:—
   - (*a*) Total 3,459, and about 20,000 aboriginals.
   - (*b*) Europeans, 1,931.
   - (*c*) Chinese 1,246.
   - (*d*) Other races, 282.
   - (*e*) Aboriginals about 20,000.
4. Births during the year:—
   Total births, 37; Europeans 17, other 20, = 37.*
5. Deaths during the year:—
   - (*a*) Total deaths, 64; (European 29, Chinese 27, other races 8).
   - (*b*) Deaths ascribed to fever: Nil.
   - (*c*) Deaths ascribed to blackwater fever: Nil.
   - (*d*) Deaths ascribed to yellow fever: Nil.
6. Government hospitals:—
   - (*a*) Number of such hospitals, 2.
   - (*b*) Totals during year: Admissions 228, deaths 19.
   - (*c*) Malarial fever: Admissions 12, deaths nil.
   - (*d*) Blackwater fever: Nil.
   - (*e*) Yellow fever: Nil.
   - (*f*) Filarial diseases: Nil.
   - (*g*) Dengue: Nil.
7. Government dispensaries: Nil.
8. Medical Service:—
   - (*a*) Number of Government Medical Officers: 2.
   - (*b*) Number of special Health Officers: 1. (Included in (*a*); appointed Medical Officer of Health for Territory, May, 1912).
   - (*c*) Number of other registered practitioners: Nil.
9. Schools:—
   - (*a*) Number of Government and State-aided schools: 3.
   - (*b*) Number of scholars registered in these schools: 133.
   - (*c*) Percentage of daily attendances: 72·5.
10. Estates employing indentured labour: Nil.
11. Actual revenue of Colony:—
    Total during year 1911-12: £47,152.
12. Actual expenditure of Colony:—
    - (*a*) Total during year 1911-12: £122,685. In addition, Commonwealth paid interest on loans and sinking fund, £168,531.
    - (*b*) Annual medical and sanitary expenditure, £3,021.
    - (*c*) Upkeep of Government hospitals and dispensaries, £1,039. (Excluding nursing staff).
    - (*d*) Total salaries and allowances of Medical Officers, £1,450.
    - (*e*) Total annual sanitary expenditure, £100.
13. Towns under Municipalities or Town Councils:—
    - (*a*) Number of such: 1.
    - (*b*) Total population: 1,100.
    - (*c*) Total revenues: About £1,000.
    - (*d*) Total medical and sanitary expenditure: About £200.

* *Birthrate.*—Low birthrate is due to very small population of females of childbearing age. Population of Territory is mainly male.

14. Table of deaths by districts: No deaths from malaria.

15. Table of deaths in the principal towns:—Town: Darwin. District where situated: Coast. Population of town: 1,100. No deaths from malaria.

16. Rainfall during the year:—

Where observed.	District.	Rainfall.												
		January.	February.	March.	April.	May.	June	July.	August.	September.	October.	November	December.	Total.
Darwin	Coast ...	1899	1489	1449	417	7	7	5	1	98	101	612	968	6503 points.

17. Additional information to be given if possible on the following points:—

(*a*) Is there any legislation in force against the breeding of mosquitoes in premises? Numbers of notices, convictions, and warnings during the year.—Legislation in preparation.

(*b*) Number of children examined for enlarged spleen. Where was this done? Percentage affected. Does kala-azar exist?—Not been observed.

(*c*) Number of persons examined for filarial diseases. Where this was done. Percentage affected.—No systematic examination. No cases observed.

(*d*) Any large works for surface drainage of towns or reclamation of marshes: Nil.

(*e*) Numbers of men employed in towns and villages for petty anti-mosquito works: Nil.

(*f*) Amount of Government quinine sold or distributed gratis during the year: Nil.

(*g*) Is quinine distributed regularly in the schools?—No.

(*h*) Measures taken against these diseases on estates employing indentured labour.—No indentured labour employed except in Pearling trade.

(*i*) Any steps taken regarding the housing of the poor: No.

(*j*) Any exceptional increase or decrease of these diseases recently noticed.——

(*k*) Any other remarks on the subject: No.

NORTHERN TERRITORY OF AUSTRALIA.

RETURN OF MALARIAL FEVER, BLACKWATER FEVER, YELLOW FEVER, FILARIASIS, AND DENGUE DURING THE YEAR FROM THE 1ST JANUARY TO THE 31ST DECEMBER, 1913.

(Received in Colonial Office, 2nd October, 1914.)

1. Name of Colony: Northern Territory of Australia.
2. Total area: 523,620 square miles.
3. Estimated population:—
   (*a*) Total: 3,588 whites and Asiatics (and about 20,000 aboriginals).
   (*b*) Europeans, 2,143.
   (*c*) Chinese, 1,173.
   (*d*) Other races 272.
   (*e*) Aboriginals about 20,000.
4. Births during the year:—
   Total births, excluding aboriginals, 59: Europeans 22, other races, 37, = 59.*

* *Birthrate.*—Low birthrate is due to very small population of females of childbearing age. Population of Territory is mainly male.

5. Deaths during the year:—
   (*a*) Total deaths: 57; European 22, other races 35, = 57.
   (*b*) Deaths ascribed to fever: 1.
   (*c*) Deaths ascribed to blackwater fever: Nil.
   (*d*) Deaths ascribed to yellow fever: Nil.
6. Government hospitals:—
   (*a*) Number of such hospitals, 2.
   (*b*) Totals during year: Admissions 273, deaths 14.
   (*c*) Malarial fever: Admissions 6, deaths nil.
   (*d*) Blackwater fever: Nil.
   (*e*) Yellow fever: Nil.
   (*f*) Filarial diseases: Nil.
   (*g*) Dengue: Nil.
7. Government dispensaries: Nil.
8. Medical Service:—
   (*a*) Number of Government Medical Officers: 3. (Each a gazetted Medical Officer of Health).
   (*b*) Number of special Health Officers: 1. (Included in (*a*) as Chief Health Officer). (Also 1 fully qualified Sanitary Inspector).
   (*c*) Number of other registered practitioners: Nil.
9. Schools:—
   (*a*) Number of Government and State-aided schools: 3.
   (*b*) Number of scholars registered in these schools: 117.
   (*c*) Percentage of daily attendances: 72·7.
10. Estates employing indentured labour:—The only indentured labour is that of about 100 Malays and Philipinos employed in pearling industry. No fever occurs amongst them.
11. Actual revenue of Colony:—
   Total during year 1912-13: £56,317.
12. Actual expenditure of Colony:—
   (*a*) Total during year 1912-13: £233,636. In addition, Commonwealth paid interest on loans and sinking fund, £149,062.
   (*b*) Annual medical and sanitary expenditure: £5,592.
   (*c*) Upkeep of Government hospitals and dispensaries: £1,837 (excluding nursing staff).
   (*d*) Total salaries and allowances of Medical Officers: £1,860.
   (*e*) Total annual sanitary expenditure: £622.
13. Towns under Municipalities or Town Councils:—
   (*a*) Number of such: 1.
   (*b*) Total population: 1,150; (Europeans 600, coloured 550).
   (*c*) Total revenues: About £1,000.
   (*d*) Total medical and sanitary expenditure: £750. Sanitary and scavenging service.
14. Table of deaths by districts: Only one death in the Northern Territory in 1913 was ascribed to malaria, and as a medical man did not see the patient the diagnosis is doubtful.
15. Table of deaths in the principal towns:—Town: Darwin. District where situated: Coast. Population of town: 1,150. No deaths from malaria during the year.
16. Rainfall during the year:—

Where observed.	District.	Rainfall.												
		January.	February.	March.	April.	May.	June.	July.	August.	September.	October.	November.	December.	Total
Darwin	Coastal ...	1588	755	1862	25	8	—	—	—	58	57	78	431	4847 points.

Rainfall diminishes as one passes inland until at 1,000 miles inland the fall is only about 6 inches per annum. Fall occurs always between September and April.

17. Additional information to be given if possible on the following points:—

(*a*) Is there any legislation in force against the breeding of mosquitoes in premises? Numbers of notices, convictions, and warnings during the year.—Regulations for effective drainage of premises, mosquito-proofing of water collections, cleansing of occupied and unoccupied allotments of tins, bottles, and other receptacles capable of holding water. Number of written notices served and complied with: 169. Innumerable verbal notices and warnings. No legal action required.

(*b*) Number of children examined for enlarged spleen. Where was this done? Percentage affected. Does kala-azar exist?—No systematic examination made. Enlarged spleen uncommon in hospital and private practice. No kala-azar observed.

(*c*) Number of persons examined for filarial diseases. Where this was done. Percentage affected.—No systematic examination. No cases of filariasis have occurred as far as is known. No elephantiasis has been seen.

(*d*) Any large works for surface drainage of towns or reclamation of marshes. Approximate cost.—Gradual reclamation of mangrove swamp is being carried out by filling in with town refuse.

(*e*) Numbers of men employed in towns and villages for petty anti-mosquito works. Approximate cost.—In Darwin one man is employed, with occasional black labour. Approximate cost £75 per annum.

(*f*) Amount of Government quinine sold or distributed gratis during the year. Agencies employed.—520 ozs. quinine distributed gratis. Medicine chests are sent out at Government expense and are placed in charge of responsible persons at bush stations and aboriginal depôts, etc. A book of instructions accompanies the chests, and the system is supervised.

(*g*) Is quinine distributed regularly in the schools?—No, unnecessary. No malaria has been observed amongst the school children.

(*h*) Measures taken against these diseases on estates employing indentured labour.—No indentured labour except on pearling luggers.

(*i*) Any steps taken regarding the housing of the poor?—At Darwin, provision is being made by the Government to house destitute Chinese and coloured people (Asiatics, Malays, Philipinos, South Sea Islanders, &c.) under good sanitary conditions outside the actual town. Aboriginals are provided for in a separate village.

(*j*) Any exceptional increase or decrease of these diseases recently noticed?—No. The diseases are not prevalent.

(*k*) Any other remarks on the subject.——

No. 15.

TRINIDAD.

RETURN OF MALARIAL FEVER, BLACKWATER FEVER, YELLOW FEVER, FILARIASIS, AND DENGUE DURING THE YEAR FROM 1ST JANUARY TO 31ST DECEMBER, 1913.

(Received 29th October, 1914.)

1. Name of Colony: Trinidad and Tobago.
2. Total area: 1,850 square miles.
3. Estimated population:—
   (*a*) Total 346,981

	(*b*) Europeans	not ascertained
	Other races	not ascertained
4.	Births during the year:—	
	Total births	11,576
5.	Deaths during the year:—	
	(*a*) Total deaths	8,245
	(*b*) Deaths ascribed to fever	916
	(*c*) Deaths ascribed to blackwater fever	nil
	(*d*) Deaths ascribed to yellow fever	2
6.	Government hospitals:—	
	(*a*) Number of such hospitals	9
	(*b*) Totals, during year:—	
	Admissions	12,686
	Deaths	1,583
	(*c*) Malarial fever:—	
	Admissions	1,091
	Deaths	56
	(*d*) Blackwater fever:—	
	Admissions	3
	Deaths	1
	(*e*) Yellow fever	nil
	(*f*) Filarial diseases:—	
	Admissions	40
	Deaths	nil
	(*g*) Dengue	nil
7.	Government dispensaries:—	
	(*a*) Number of such dispensaries	53
	(*b*) Total attendances during year	51,985
	(*c*) Attendances for malaria	8,448
	(*d*) Attendances for filarial diseases	96
	(*e*) Attendances for dengue	nil
8.	Medical service:—	
	(*a*) Number of Government Medical Officers	40
	(*b*) Number of special health officers	2
	(*c*) Number of other registered practitioners	37
9.	Schools:—	
	(*a*) Number of Government and State-aided schools ...	274
	(*b*) Number of scholars registered in these schools ...	47,700
	(*c*) Average daily attendances	28,034
10.	Estates employing indentured labour:—	
	(*a*) Number of such	121
	(*b*) Number of indentured immigrants employed ...	9,691
	(*c*) Number of hospitals and dispensaries on such estates	64
	(*d*) Total deaths among such labourers	178
	(*e*) Deaths ascribed to malaria	10
	(*f*) Total admissions and attendances at hospitals and dispensaries	21,701
11.	Estimated revenue of the Colony, 1913-14:—	
	Total during year	£933,767
12.	Estimated expenditure of Colony:—	
	(*a*) Total during year	£953,645
	(*b*) Annual medical and sanitary expenditure	£84,900
	(*c*) Upkeep of Government hospitals and dispensaries...	£50,143
	(*d*) Total salaries and allowances of Medical Officers ...	£23,243
	(*e*) Total annual sanitary expenditure	£11,514
13.	Towns under Municipalities or Town Councils:—	
	(*a*) Number of such	3
	(*b*) Total population	72,587
	(*c*) Total revenues	$354,030
	(*d*) Total sanitary expenditure	$31,125

APPENDIX I.

REPORTS ON ANTI-MALARIAL MEASURES IN THE CROWN COLONIES AND PROTECTORATES, &C.

14. Table of deaths by districts :—

District.	Area in Square Miles.	Population, Census 1911.	Quarters, 1913.				Total, 1913.
			March.	June.	September.	December.	
Town of Port of Spain	*	59,796	459	421	441	439	1,760
Ward Union of St. Ann's ...	48,408	11,998	62	58	79	78	277
„ Diego Martin ...	53,789	17,923	81	94	95	100	370
„ Tacarigua ...	115,889	31,561	182	166	244	180	772
„ Blanchisseuse ...	64,886	1,433	4	5	4	4	17
„ Arima... ...	192,274	14,367	68	86	108	92	354
„ Toco	143,981	6,883	36	25	30	35	126
„ Manzanilla ...	195,453	18,289	72	75	87	110	344
„ Chaguanas ...	85,812	17,444	95	72	111	102	380
„ Couva	32,756	13,685	113	69	105	94	381
„ Montserrat ...	137,733	17,152	109	61	109	79	358
Town of San Fernando	*	8,667	117	95	143	158	513
Ward Union of Naparima ...	115,929	29,987	185	137	149	193	664
„ Savana Grande...	280,583	34,157	176	154	234	193	757
„ Cedros	83,936	7,869	38	40	38	35	151
„ Oropuche ...	128,520	13,313	77	76	126	124	405
„ Mayaro	176,175	4,438	26	24	30	30	110
„ Tobago	114,395	20,749	117	90	149	130	486
Waters of the Colony	—	841	8	—	1	11	20
Total	—	333,552	2,025	1,748	2,285	2,187	8,245

15. Table of deaths in the principal towns :—

Town.	Area in Acres.	Population, Census 1911.	Quarters. 1913.				Total, 1913.
			March.	June.	September.	December.	
Port of Spain	1,388	59,796	459	421	441	439	1,760
San Fernando	670	8,667	117	95	143	158	513
Arima	588	4,020	37	45	47	50	179
St. Joseph†	—	—	50	20	27	43	140
Total	—	—	663	581	658	690	2,592

16. Rainfall during the year :—
Mean rainfall for twelve months at 94 stations ... ... 63·54 inches

17 (*a*). Is there any legislation in force against the breeding of mosquitoes in premises?
Yes; Regulations under Section 8 of the Public Health (Special Powers) Ordinance No. 188.
Number of notices served, 1,403.
Number of prosecutions, 180.
Number of convictions, 161.
Number of warnings, no record kept.

(*b*) Number of children examined for enlarged spleen : 17,495.
Where was this done? Throughout the Colony.
Percentage affected : 17·91 per cent.
Does kala-azar exist? No.

(*c*) Number of persons examined for filarial diseases.
Persons are not specially examined for filarial diseases. There were, however, 40 admissions, with no deaths, in nine Government hospitals in different parts of the Colony.

* Given separately. † Not ascertained.

(*d*) Any large works for surface drainage of towns or for reclamation of marshes?
None.

(*e*) Number of men employed in towns and villages for petty anti-mosquito works. Approximate cost.
A gang of six men were employed during the year for petty anti-mosquito work in the town of Port of Spain, at an approximate annual cost of $648.

(*f*) Amount of Government quinine sold or distributed gratis during the year.
Government quinine is not distributed gratis, and it is very difficult to ascertain the amount of quinine sold all over the island.

(*g*) Is quinine distributed regularly in the schools?
Quinine is not distributed in any schools.

(*h*) Measures taken against these diseases on estates employing indentured labour.
Some few estates provide for quinine distribution, but not systematically.

(*i*) Any steps taken regarding the housing of the poor.
A Government house of refuge or poor house is established in Port of Spain, accommodating 462 paupers, for whom medical attendance is afforded by one of the Medical Officers of Port of Spain.

APPENDIX II.

Reports of the Professor of Protozoology at the University of London, and of his Assistant, for the Year ended 30th June, 1914.

No. 1.

REPORT OF THE PROFESSOR OF PROTOZOOLOGY AT THE UNIVERSITY OF LONDON, FOR THE YEAR ENDED 30TH JUNE, 1914.

(Received 3rd November, 1914.)

My work during the year covered by this report has been carried on at the Lister Institute without interruption, other than the usual vacations.

Miss Muriel Robertson returned from Uganda (where she has been at work on problems connected with sleeping sickness and other trypanosomiases during the past three years, see [Cd. 6024], p. 70) in March last, and resumed her former position as my assistant. There are no other changes to report with regard to the *personnel* of this department.

The account of my work during the year may be divided conveniently into (1) research, and (2) teaching work.

1. *Research.*—My chief work this year has been the completion, in collaboration with Dr. J. D. Thomson, of our joint investigations into the development and transmission of *Trypanosoma lewisi* in and by its intermediate host, the rat-flea; investigations upon which we have been engaged intermittently for the last five years. The complete memoir, embodying all our results and fully illustrated, has been sent for publication to the *Quarterly Journal of Microscopical Science*, where, we hope, it will have appeared before this report is published. After an introduction (Part I.), in which we describe our technique and give an account of the anatomy and histology of the flea and other subsidiary questions, the main body of our memoir is divided into two parts (II. and III.), the first containing the full account of our observations upon the development of the trypanosome in the flea, the second consisting of experimental results with regard to the transmission by the flea and other kindred problems. Roughly speaking, Part II. of our memoir contains the results of *observation*, Part III. the results of *experiment*; but the distinction is not an absolute one, since the one method of investigation is controlled and checked by the other throughout.

The development of the trypanosome in the flea is described under its two principal phases, corresponding to the regions of the digestive tract in which it takes place, namely, the stomach-phase and the rectal phase. The first of these two phases begins very soon after the trypanosome is taken into the stomach, when the flea sucks the blood of an infected rat.

In the stomach-phase the parasite retains the typical trypanosome-type of structure, and only becomes crithidial in character under very exceptional circumstances. It penetrates into the epithelial cells of the flea's stomach, and reproduces itself by a process of multiple fission within the cells, whence the daughter-trypanosomes produced (usually a dozen or more in number) break out and return to the stomach-cavity. They may then enter into other epithelial cells again and repeat the process of multiplication, or they may pass backwards out of the stomach and initiate the rectal phase. The trypanosomes never multiply when free in the stomach-cavity, but only within the epithelial cells, by multiple fission. We have studied in full detail the effects produced by the trypanosomes upon the epithelium of the stomach.

The product of the intracellular multiplication in the stomach is a long, active form of trypanosome, which we have designated "crithidiomorphic," because, while it lacks the diagnostic feature of the crithidial form (inasmuch as the kinetonucleus is situated well behind the trophonucleus), it nevertheless has crithidial characteristics in form and movement, especially in its stiff, more or less distinctly club-shaped body, very different from the flexible, sinuous body of the trypanosome which occurs in the rat and initiates the development in the flea.

The rectal phase might perhaps be termed with greater propriety the proctodæal phase, because, although the parasites in this phase of the development are found most usually in the rectum (the hindermost part of the proctodæum), they occur frequently in the intestine connecting the stomach and rectum, especially in its anterior region immediately behind the pylorus. Some experiments conducted by Dr. Thomson (XIX. in Part III., see below) have shown that the differences to be observed in the position occupied by the parasites in this second phase can be correlated with the condition of the host. If the flea is kept on the rat, and so has

access to abundant food, the parasites are found in the rectum; if, on the other hand, the flea be starved and allowed to feed only at long intervals, the parasites tend to migrate forwards and attach themselves round the pylorus, the opening of the stomach into the intestine.

The rectal phase is initiated by the long, active "crithidiomorphic" trypanosome-form described above, which migrates from the stomach to the proctodæum. In spite of a great deal of laborious investigation, we have not been able to satisfy ourselves with regard to the exact manner in which the transition from the stomach-phase to the rectal phase is effected. This point still remains open for decision by future investigations. All that can be stated at present with certainty and unanimity is that the relatively large trypanosome-form which comes down from the stomach multiplies by repeated binary fission, a process that results finally in the production of a number of small crithidial forms, very much smaller than their progenitors, the trypanosomes of the stomach phase. This transformation appears (from the rarity of transitional forms in fixed preparations) to take place very rapidly, and apparently also in relatively few of the numerous trypanosomes which come down from the stomach.

However the rectal phase takes origin, it consists, in its fully established form, of small individuals of the typical crithidial structure, that is to say, with the kinetonucleus moved forwards so as to lie beside, or in front of, the trophonucleus. The crithidias are found in the cavity of the rectum or intestine, and never penetrate into the epithelium; they multiply continually by binary fission. Two well-marked types of crithidias can be distinguished. The one, for which we adopt Woodcock's term "haptomonad," is typically pear-shaped, with the free flagellum very short, or wanting altogether; it is attached by the flagellar end of the body to the cuticle lining the proctodæum and multiplies actively by binary fission. The other, which we term the "nectomonad" type, has usually a long and slender body, with a long, free flagellum; it is found swimming freely in the cavity of the proctodæum. All possible transitions are to be found between the two extreme forms, which are to be regarded as functional phases of the parasites. There can be no doubt that a haptomonad can develop into a nectomonad, loose itself from its attachment, and swim away, and that, conversely, a nectomonad can attach itself to the cuticle, develop into a haptomonad, and start to multiply. The function of the haptomonad form is multiplicative, that of the nectomonad migratory, and it is in the nectomonad condition that the parasites change their venue in the manner above described.

From the crithidial forms in the proctodæum arise the small trypanosome-forms which are the final form of the development in the flea, and which are destined to pass into the rat and produce a fresh infection in the vertebrate host. The final form is produced by a transposition of the two nuclei of the crithidia; the kinetonucleus passes back to the extreme hinder end of the body, and in relation to this displacement a shallow undulating membrane is formed, running the whole length of the body of the parasite. We have never observed any multiplication of these final forms.

With the production of the little trypanosome-form, the developmental cycle in the flea is ended. It remains only to state that the stomach-phase of the development is usually of short duration, sometimes completed in twenty-four hours or less, and that it probably does not persist in any case beyond the second feed of the flea (Part III., XVII., see below). On the other hand, when once the crithidial phase is established in the proctodæum, it probably maintains itself there as long as the flea lives; the haptomonads multiply continually, and the surplus population becomes transformed into the final infective trypanosome-forms which pass out of the flea.

In addition to the *developmental* series of forms, constituting the life-cycle described in the foregoing paragraphs (see also [Cd. 6669], pp. 71, 72), there is also a *degenerative* series to be reckoned with, since, as explained in a former report ([Cd. 6669], pp. 69, 70), the trypanosome fails to establish itself in a large percentage of the fleas fed on infected rats, and in any such flea many of the trypanosomes taken into the digestive tract of the flea do not develop but degenerate and

die off. The process of degeneration is described in detail in our memoir, and it is not necessary to deal with it fully here; I may content myself with remarking that the frequent co-existence of developmental and degenerative forms of the trypanosome in the fleas increased greatly the difficulty of piecing together the connected story of the life-cycle of the parasite in the flea.

In setting forth our experimental results, we have first given a short introduction describing our methods, technique, apparatus, etc., and then have stated a series of nineteen propositions, placed as headings, each followed by a detailed account of the experiments on which the proposition is founded. If we consider the proposition thoroughly proved, it is stated in the affirmative; if further evidence is required to demonstrate it absolutely, it is written in the interrogative form. In order, therefore, to give an abstract of our experimental results, it is sufficient to quote our nineteen propositions, as follows:—

I.—*Trypanosoma lewisi* is transmitted from rat to rat by the rat-flea *Ceratophyllus fasciatus*.

II.—The transmission takes place by the cyclical method. Transmission by the direct method has not been proved to occur.

III.—The trypanosomes make their appearance in the blood of the rat five to seven days after infection; the multiplication of the trypanosomes in the blood of the rat comes to an end eleven to thirteen days after infection.

IV.—The cycle of development in the flea requires a minimum of five days for its completion.

V.—Transmission is never effected until the developmental cycle is completed; that is to say, until at least five days have elapsed since the first exposure of the fleas to infection.

VI.—The infection of the rat is brought about by the small trypanosome-form, which is the final form of the development.

VII.—The final infective form of the cycle is developed first in the rectum on the fifth day of the developmental cycle, but may appear later in the stomach.

VIII.—The developmental forms of the trypanosomes in the flea are not infective when inoculated into the rat during a period extending from a short time (half an hour?) after being taken up by the flea until the developmental cycle is complete.

IX.—The flea, when once it has become infective, remains so for a considerable length of time.

X.—The trypanosome does not penetrate into the salivary glands of the flea, but is confined, during its whole development, to the digestive tract.

XI.—The rat can become infected by eating infected fleas; but not until the developmental cycle of the trypanosome in the flea is completed.

XII.—Infection of the rat is effected contaminatively, by way of the rat's mouth, by the rat licking from off its fur or skin the moist fæces of infective fleas containing the final propagative form of the life-cycle.

XIII.—Can the flea infect the rat by inoculating the trypanosomes into it through the proboscis? [The answer to this question is in the negative for all practical purposes.]

XIV.—Hereditary transmission of the trypanosome from flea to flea does not, in our experience, take place.

XV.—The trypanosomes in the blood of the rat can render fleas infective very soon after they make their first appearance in the blood, before their multiplication period is over.

XVI.—The trypanosomes succeed in establishing themselves in the flea, and rendering it infective to the rat, in only a small proportion of the fleas that ingest them.

XVII.—Can the first phase of the development of the trypanosomes, namely, the intracellular multiplication in the stomach of the flea, continue beyond the second feed of the flea (counting as the first feed that by which it became infected)? [Our experiments indicate an answer in the negative.]

XVIII.—Starvation of the flea during the incubation period of the cycle does not inhibit, nor does it necessarily retard, the developmental cycle of the trypanosome in the flea.

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XIX.—Starvation of the flea following immediately on an infective feed favours the establishment of the haptomonad phase in the rectum, while starvation begun after the incubation period in the flea is over favours migration to the post-pyloric end of the intestine, and the establishment of the haptomonad phase there.

The above is a summary, necessarily brief, of our published results. Two small points require brief further mention. When I was in Paris in the beginning of 1913, Dr. E. Chatton, of the Pasteur Institute, very kindly gave me some living fleas (*Ceratophyllus fasciatus*) which contained a pure infection of *Leptomonas pattoni*. This flagellate is regarded by most authorities as a specific parasite of the flea alone, not related to any parasite of the rat or any other vertebrate. It can be asserted, definitely, at least, that this leptomonas is not related in any way to *Trypanosoma lewisi* of the rat. I started a breeding-cage with the leptomonas-fleas given me by Dr. Chatton, and they bred and multiplied enormously, but none of the rats put in to feed them ever showed any infection with trypanosomes, although examination of the swarming fleas showed that about 50 per cent. of them contained teeming infections of the leptomonas in the hind-gut. We were able, therefore, to make preparations of the leptomonas and to compare these parasites with the stages of *T. lewisi* in the flea.

Recently, however, some very remarkable results have been obtained by Drs. Laveran and Franchini at the Pasteur Institute. They experimented also with leptomonas fleas obtained from Dr. Chatton, and found that rats or mice exposed to the attentions of the fleas acquired an infection of *Leishmania* (*Comptes Rendus Acad. Sci., Paris*, CLVIII., p. 450). This throws an altogether new light on the significance of *Leptomonas pattoni* in fleas, and shows that, in order to prove that a flagellate parasite of an insect is a parasite of the insect alone, it is not sufficient to prove merely that it has no connexion with any trypanosome parasitic in vertebrates.

With the assistance of Miss Lodge, who is working in my laboratory, I have been carrying on some experiments in order to ascertain whether rats which have been in contact with leptomonas fleas, and which therefore may be presumed* to have acquired an infection with *Leishmania*, can produce, in their turn, a leptomonas-infection in clean fleas with which they are brought into contact; that is to say, whether the *Leishmania* and the leptomonas are simply two stages of one and the same parasite, which goes through a regular alternation of generations in the rat and in the flea, in a manner similar to the trypanosome *T. lewisi*. These experiments have not so far yielded a positive result, but are being continued.

The second point to be mentioned is that in the course of our investigations Dr. Thomson and I found many cysticercoids in the fleas dissected, lodged in all cases in the body cavity. In a former report ([Cd. 6024] p. 76 and p. 83), I have mentioned that Dr. Nicoll and myself published a note in the *Proceedings of the Zoological Society* describing two species of cysticercoids in rat fleas. We (Dr. Thomson and I) have now found a third form, which resembles the form with hooks formerly described, but has no hooks; it may be a young stage, in which the hooks are not formed, of the hooked form, or it may be a third species. I am handing over the specimens to Dr. R. T. Leiper, of the London School of Tropical Medicine, for study, as I have no claims to be an expert helminthologist.

In addition to the joint investigations upon *T. lewisi*, I have been engaged in other works of smaller compass. I was invited to contribute a short memoir to a volume to be published in honour of Dr. E. Metchnikoff, of the Pasteur Institute, to celebrate the jubilee of his activities as a scientific investigator. I wrote a paper on the significance of the so-called "Infective Granules" of Trypanosomes, and sent it to Professor F. Mesnil, who acknowledged the receipt of it and accepted it for the volume in question. I have not yet, however, received the proofs to correct.

* Since the leishmanial parasites are lodged in the internal organs of the rat, their presence cannot be ascertained without killing the rat. Miss Lodge has made a prolonged search of the blood of rats exposed to leptomonas fleas without finding any leishmanias in the blood.

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Much against my will, I have been drawn into a polemical discussion on the nature of the bodies known as blepharoplasts (No. 1 in the list of publications appended below).

2. *Teaching Work.*—During the months of January, February, and March, 1914, I gave a course of twelve lectures on the "Protozoa Parasitic in Man," at the Lister Institute, on Tuesdays and Fridays at 5 p.m. Each lecture was followed by a demonstration of microscopical preparations illustrating the subject of the lecture. The average attendance at the lectures was about 25.

I also gave (by permission of the University) a course of five lectures at the Horniman Museum, Forest Hill (under the auspices of the London County Council), on "The Protozoa and their Importance to Mankind," on Saturday mornings at 11.30 (25th April, 2nd, 9th, 16th, and 23rd May). The attendance was good and did not fall off.

I attended the meeting of the British Association at Birmingham last summer (1913), and gave there a public lecture on "Some Aspects of the Sleeping Sickness Problem," with lantern slides. There was a very full attendance, and after the lecture I replied to numerous queries put by members of the audience.

Having been requested to give evidence before the Departmental Committee on Sleeping Sickness, I forwarded to the Committee a written statement, embodying my views on certain points, and on 4th November I attended personally before the Committee and gave evidence (see [Cd. 7350], pp. 60-70, and pp. 270, 271).

A number of workers have occupied places in my laboratory during the year, and have received informal help or advice from me or my assistants.

Dr. Thomson, as stated above, has been collaborating with me in the study of *Trypanosoma lewisi.*

Dr. Bosanquet has been working intermittently on various subjects, more especially on fish parasites of the order Myxosporidia.

Major Perry, I.M.S., who was mentioned in my last report ([Cd. 7261], p. 76), left us in November, 1913.

Mr. G. Lapage (see also my last report) continues his collaboration with Dr. Woodcock, and visits the laboratory occasionally; Mr. C. H. Martin and Mr. E. Heron-Allen also visit us from time to time.

Mr. and Mrs. Goodrich (formerly Miss Helen Pixell) worked here during one vacation on various protozoa, more especially on the genus *Aggregata*, parasites of cephalopods, on which Mrs. Goodrich has published a memoir (No. 8, below).

Major Harvey, I.M.S., who came here in April last, has been studying technique and protozoa generally; so also Dr. R. G. White, of the Public Health Department, Cairo; Mr. H. G. Thornton, of New College, Oxford; and Major S. L. Cummins, Professor of Pathology, Royal Army Medical College.

Miss Olive Lodge, Demonstrator of Zoology at the Birkbeck Institute, has joined this laboratory, and works here in the leisure time left her by her official duties. I have mentioned above her experiments on the leptomonas fleas; she is also engaged with Dr. Woodcock in working out the collection of protozoa made by Surgeon E. L. Atkinson on the Scott Antarctic Expedition.

In addition to assisting those who work in my laboratory, I correspond with various people at home or abroad who consult me with regard to protozoological problems; amongst whom I may mention especially Captain F. P. Mackie, I.M.S., on special duty with the kala-azar inquiry, and Dr. Castellani, Colombo.

Appended will be found a list of works published from this Department during the year covered by this report.

In conclusion, and although it does not fall strictly within the time covered by this report, I should like to be permitted to state that, with the permission of the University, I attended the meeting of the British Association held in Australia this summer, as a vice-president of Section D (Zoology). I left England on 3rd July, 1914, but my return was delayed by the outbreak of war; the steamer on which I should have returned was taken for troops, and the route across France via Marseilles was closed. Consequently, I was unable to reach London before 17th October. For this reason the preparation and presentation of this report has been delayed beyond the usual time.

E. A. MINCHIN.

Appendix II.

Reports of the Professor of Protozoology at the University of London, and of his Assistant, for the year ended 30th June, 1914.

List of Publications relating to Investigations carried on wholly or in part at the University Department of Protozoology.

By Professor E. A. Minchin:—

(1) Remarks on the nature of the blepharoplasts or basal granules of flagella. *Archiv für Protistenkunde*, Vol. XXXIV, pp. 212-216.

By Dr. H. M. Woodcock:—

(2) On "*Crithidia*" *fasciculata* in hibernating mosquitoes (*Culex pipiens*) and the question of the connexion of this parasite with a Trypanosome. *Zool. Anzeiger*, Vol. XLIII., pp. 370-382, 41 text-figg.

(3) Further remarks on the flagellate parasites of Culex. Is there a generic type, Crithidia? *Zool. Anzeiger*, Vol. XLIV., pp. 26-33, 1 text-fig.

(4) Protozoa. *Zool. Record*, Vol. XLIX., 62 pp.

By Dr. H. M. Woodcock and Mr. G. Lapage:—

(5) On a Remarkable New Type of Protistan Parasite. *Quarterly Journal of Microscopical Science*, Vol. LIX., pp. 431-457, plates xxix., xxx.

By Mr. T. Goodey:—

(6) A Preliminary Communication on three new Proteomyxan Rhizopods from Soil. *Archiv für Protistenkunde*, Vol. XXXV., pp. 80-102, plates v.-viii.

By Mrs. E. S. Goodrich (Miss Helen Pixell):—

(7) Notes on *Toxoplasma gondii*. Proceedings of the Royal Society, (B), Vol. LXXXVII., pp. 67-76, plate ix.

(8) The Sporogony and the Systematic Position of the *Aggregatidæ*. *Quarterly Journal of Microscopical Science*, Vol. LX., pp. 159-174, plate xiii.

By Messrs. C. H. Martin and K. R. Lewin:—

(9) Some Notes on Soil Protozoa. *Phil. Trans.*, (B), Vol. CCV., pp. 77-94, plates v., vi.

No. 2.

REPORT BY H. M. WOODCOCK, D.Sc. (Lond.), ASSISTANT TO THE UNIVERSITY OF PROTOZOOLOGY, ON WORK DONE DURING THE YEAR ENDING 30th JUNE, 1914.

My work during the year under review may be considered under the two headings of: (A) Research; and (B) Assistance to the Professor and in the Department.

(A). Research.

My work has dealt with the following three subjects:—

(1) *Flagellates occurring in the common British mosquito, Culex pipiens.*—In my last report (*vide* Cd. 7261, March, 1914), I described my observations of certain flagellates in the intestine and rectum of hibernating females of *C. pipiens*; these flagellates I regarded as "*Crithidia*" *fasciculata* Léger, as had been done formerly by Novy, McNeal, and Torrey. Very soon after writing my last report, I was fortunate in finding the cysts of this parasite, which had not been previously observed. The cysts are similar in type to those described in the case of certain other flagellates of insects. I have published an account of my observations (No. 1, below). In a subsequent note (No. 2), I have discussed the question of the distinction between the forms known as *Leptomonas* and *Crithidia*, and the manner in which these two important generic types are to be defined, in view of the confusion still prevalent, even among writers who ought to know better. I point out clearly that, in the "resting," attached phase of either of these parasites, for which I propose the term *haptomonad* phase, it cannot be determined from that phase alone to which type a particular parasite belongs; since, in the case of both, the haptomonad phase is similar as regards appearance and morphology. Only

when the parasites are in the active, monadine condition (the *nectomonad* phase, as Minchin has proposed to term it), can it be decided to which of the above types they belong. In my second note I give the reasons which lead me to consider that the parasites found by myself and the American workers previously are best regarded provisionally as Leptomonad rather than Crithidial forms, and should therefore be termed *Leptomonas fasciculata* (Novy, McNeal and Torrey).

One very interesting and important point, which is nevertheless difficult to decide from the data yet available, is whether these parasites of *Culex* are to be considered as solely parasitic in the mosquito, or as connected with some Hæmoflagellate (probably an Avian Trypanosome). The occurrence of cysts in an insectan flagellate is, on *a priori* grounds, an indication of *contaminative*, as opposed to *inoculative* infection of a fresh host; and therefore it might be concluded that such a parasite is a purely insectan form. I have discussed the question fully in my notes, taking into consideration the case of *Trypanosoma grayi*, of the crocodile and tsetse-fly. It should be borne in mind that it is by no means improbable that, in certain cases, e.g., *T. grayi*, a hæmoflagellate, descended from what was originally a purely insectan parasite, may have *retained the ability to produce cysts* in the invertebrate, to aid in transmission or dispersal. I will add only that if these Leptomonads of *C. pipiens* are indeed purely insectan parasites, it remains a very remarkable fact that none of the early larvæ, nor any of the early summer mosquitoes examined, were infected, in spite of the heavy infection of the hibernating females (*vide* Report, l.c., p. 80). Moreover, the hibernating females examined again last autumn (1913) were, on the other hand, very rarely infected, and I cannot help thinking this condition perhaps stood in relation to the fact that the birds (chaffinches) I examined during the early part of that year were also surprisingly free from any trypanosome-infection—more so than I have previously known them to be. Unfortunately the question must remain undecided for the present.

(2) *The development of the Trypanosome of the Little Owl (Athene noctua) in the mosquito (C. pipiens).* I have hitherto postponed the full study of my preparations and the completion of the account of my observations made at Rovigno on this important subject, because I hoped before now to obtain the corresponding development, and moreover the actual transmission back again to the bird, of *T. fringillinarum*, here in England, in order to round off the whole subject. This last-named part of the research progresses, unfortunately, very slowly, owing to the great difficulties in the way, so that I came to the conclusion it would be useful to publish the observations I had, without waiting longer, more especially as the only other worker who has written anything of late upon the subject namely, Mayer, in his account of the parasites of another owl (*Syrnium aluco*), continues to uphold Schaudinn's view and to maintain that the flagellates occurring in mosquitoes which have fed on an owl are developed from the halteridia and leucocytozoa present in the blood. In my "Notes on Sporozoa," No. IV. (*vide* last Report, Paper No. 2), I showed clearly that, considered from the standpoint of these intracellular parasites, everything is against such a connexion of either with a trypanosome. And the evidence which I have now brought forward, dealing with the question from the standpoint of the actual development of the trypanosomes in the mosquito, is equally negative and does not bear out Mayer's contention in the slightest degree.

I proceed to give a brief resumé of my principal observations and conclusions; the paper will be published in the Quart. Journ. Micr. Sci. in the course of a few weeks.

(*a*) Experimental observations. In mosquitoes fed on an owl which had a good infection of *Halteridium*, in the form of ripe gametocytes, but which contained the trypanosomes in the blood, numerous well-developed ookinetes were found. Several of these were watched for considerable periods, at the time when, according to Schaudinn, their transformation into flagellates takes place, but in no instance was the least sign of such a phenomenon observed. Similarly, in mosquitoes fed on an owl containing only Leucocytozoon, only the large ookinetes of this parasite were found. On the other hand, in no less than 45 per cent. of

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REPORTS OF THE PROFESSOR OF PROTOZOOLOGY AT THE UNIVERSITY OF LONDON, AND OF HIS ASSISTANT, FOR THE YEAR ENDED 30TH JUNE, 1914.

the mosquitoes fed on an owl in which *Trypanosoma noctuæ* was known to be present in the blood, characteristic developmental phases (crithidial and trypaniform flagellates) were found. As I have shown, alone and in collaboration with Minchin, in previous papers, the only form of the trypanosome present in the blood of the birds with which I have worked, whether owls or chaffinches, during the early summer-time, is of a very definite type, stumpy and fusiform and relatively stout; I have never found this form at any other period. Moreover, the parasites were—for avian trypanosomes—not at all infrequent, whereas at other times of the year, *e.g.*, in winter and early spring, they are excessively scarce in the general circulation, and may even not be present at all, so far as can be ascertained. I have never seen the slightest indication of these developmental phases of the trypanosome in any bred-out mosquito fed on a bird which did not contain this stumpy form of the trypanosome in the general circulation at the time—whether the bird was infected with *Halteridium*, or *Leucocytozoon*, or with neither! Therefore, as was clearly pointed out by Minchin and myself in our paper three years ago, a characteristic form of the trypanosome is present in the blood during the early summer, which constitutes a definite transmissive phase (*vide* Report for 1911 [Cd. 6024], p. 78). I wish to emphasize that we were the first to show this important fact, namely, that a trypanosome in the blood of the vertebrate host may have such a definite transmissive form, for infecting the invertebrate, just as a definite transmissive phase is now known to be developed regularly in the invertebrate, for the infection of a fresh vertebrate; because Nöller, in a recent note on this question, has entirely overlooked our work.

(*b*) The course of the development undergone by the trypanosome in the mosquito. In studying the different forms observed, a comparison with the course of the development of *Trypanosome fringillinarum*, of the chaffinch, in cultures, as I described it some years ago, has been most instructive; and for this reason. In the mosquito, digestion goes on fairly rapidly and is completed, in favourable conditions, in 3 to 3½ days. Correspondingly, the development of the parasites is rapid, and the various modifications in form are passed through hurriedly, and the final types soon attained. Hence actual stages in the division of intermediate forms, a knowledge of which, for instance, assists greatly in the correct interpretation of the sequence of the developmental changes, are very hard to catch. On the other hand, in the culture-tube, there is no absorption of the medium and consequently not the same stimulus to the production of the final forms. Hence, until the medium becomes too full of toxic products for the parasites to thrive, the trypanosomes persist, for the most part, in the multiplicative (crithidial) phase and go on dividing actively. Now the different phases of the trypanosome which I have observed in the mosquito agree essentially with those which I had previously found in cultures. Hence, on the one hand, the determination of the mode of origin and the course of development of the various forms in the mosquito has been greatly facilitated; and, on the other hand, I am now able to say with confidence that the cultural development, at any rate so far as avian trypanosomes are concerned, *does* correspond, in the main, with the natural development in the insectan host, and may certainly be regarded as furnishing a general indication of the latter. The differences found are largely due to the different conditions prevailing in the environmental medium, just alluded to. The account given in my paper provides, I believe, the most detailed comparison between the course of the cultural and of the natural development (in the invertebrate host) which has yet been brought forward in the case of a trypanosome.

The development in the mosquito proceeds along two distinct lines, which culminate in the production of two extreme types with different functions. The earliest forms found are trypanomonad (crithidial) individuals, of a typical character. Along one line of development, these forms pass into trypaniform individuals, by a progressive modification of the body-form and a change in the relative position of the nuclear organellæ. Not to enter into descriptive details here, I will merely say that the end-result of the process is an extremely long, attenuated—almost "spirochætiform"—trypanosome, which has a remarkable appearance. In stained preparations it is seen that the trophonucleus is greatly

elongated and ladder-like, *i.e.*, it consists of a number of karyosomes, which have the form of short rods, transversely arranged. I have no doubt that this final type represents the inoculative phase, *i.e.*, the form in which the parasite is transmitted back again to a fresh vertebrate host (owl). Unfortunately, I was not able to prove this by the actual infection of a bird; but from a comparison of what is known with regard to piscine trypanosomes, this conclusion can be regarded as certain. From Minchin's work on piscine forms, as they occur in fish, and from mine on avian forms, as they are found in birds, it is clear that both these groups of trypanosomes are closely related. There is the same pronounced polymorphism in type, due to the very varied form at different periods of growth; and, moreover, the two sets of forms agree very closely in morphology and appearance at the different stages. These two groups together form a division quite distinct, for example, from all mammalian trypanosomes. Again, that part of the life-cycle of piscine trypanosomes which is passed through the invertebrate host (some leech), as described by Miss Robertson, shows just the same types of form as I have found in the case of *T. noctuæ* in *Culex*. The important point is that the propagative (inoculative) phase developed in the leech is of a fundamentally similar type to that above described, the only difference being that it is not quite so remarkably attenuated and thread-like.

The other line of development is initiated from certain of the ordinary crithidial forms in which the nuclear division has been slightly oblique, with the result that in some daughter-individuals the two nuclei are not in the middle of the body, as is usual at first, but tend to be in the posterior half. Such individuals give rise to the characteristic "club-shaped" forms, with both nuclei distinctly in the hinder, swollen part of the body. These then undergo markedly unequal division, and by this means numbers of small, pear-shaped forms are developed, which possess only a short flagellum and practically no membrane. From these in turn, the other extreme type is produced, namely the *haptomonad* forms, which become attached to the wall of the alimentary tract—probably, in this case, chiefly of the stomach—and constitute the reserve stock of the parasite in the mosquito. This is as far as I have been able to carry my observations of the life-cycle, but there can be no doubt that, under favourable conditions, *e.g.*, a fresh meal of blood, these haptomonads are able to give rise to a fresh succession of active crithidial forms, which can, in their turn, produce again trypaniform, inoculative individuals.

Through every period during the course of the development, as I have observed it, the trypanosomes retain the characters of a typical binucleate flagellate; at no time is there the least indication of any direct affinity with the hæmosporidian parasites, any more than there is in the case of the development of piscine trypanosomes, with hæmogregarines! And, on the other hand, I have studied carefully the structure of the ookinetes of *Halteridium* and *Leucocytozoon*, as they occur in my preparations, and can say with certainty that they are *not* binucleate, and do not show any sign of developing into a flagellate form. I had already arrived at this conclusion from my detailed study of the cytology of these parasites in the blood of the bird (*vide* Cd. 6669, p. 75). I think, therefore, as a result of these studies, I may claim not only to have actually disproved the view of Schaudinn, that the trypanosomes of the little owl are ontogenetically connected with the hæmosporidian parasites, a view which has been long supported by German workers, but also to have shown the main outlines of the development of avian trypanosomes, in the birds, in the mosquito (where this is the transmitting host), and in cultures.

(3) *Living observations on the life-history of a new type of Flagellate, Helkesimastix fæcicola, together with remarks on the question of conjugation in the Trypanosomes.* In this interesting and important work, I have had the assistance of Mr. Lapage, M.Sc., of Manchester University. This new flagellate is a "passenger" in an encysted condition, through the alimentary tract of sheep and goats. In moistened dung, the creature is liberated from the permanent cyst, by a dissolution of the cyst-wall. We have cultivated the flagellate on various special media, on which it thrives amazingly. By means of special observation-preparations

we have been able to observe in life the whole course of the life-cycle. We consider that the dissolution of the cyst-wall is due to the secretion of some enzyme or ferment by one or more particular species of aerobic bacillus, which are always present in the dung and in the cultures. In preparations to which air is not admitted there is no development of these bacilli and the flagellates never emerge from their cysts. The principal morphological characteristic of this new flagellate is that it possesses a single flagellum, inserted at the anterior end of the body, but always directed backwards, like a trailing flagellum, and usually closely applied to the body. There is no kinetonucleus, and no attaching membrane has been developed. There is no definite mouth-aperture, and we are very doubtful whether the creature actually ingests bacteria. We consider that the principal mode of nutrition is by osmosis; *i.e.*, *Helkesimastix* is a saprozoic form. The most remarkable and characteristic method of locomotion is a steady gliding movement. This is seen when the flagellate is at the upper surface of the medium; when it is thus gliding along, the flagellum lies on the dorsal side of the body, and trails passively behind, not acting in any way as a pulsellum. We think surface-tension is most probably concerned in this mode of movement.

Life-cycle.—As soon as the flagellate has emerged from its cyst, a short period of vegetative activity and growth ensues, and then multiplication begins. Division is always by equal binary fission. We have been able to observe the entire process. After two or three days of rapid multiplication, when the flagellates simply swarm in the cultures, an epidemic of conjugation sets in. The vast majority of the flagellates normally conjugate. We have been able to watch the complete process. This phenomenon has been actually observed in the case of these lowly flagellates by only one other worker (Dobell), since the able research of Dallinger and Drysdale, many years ago. Two conjugating individuals (gametes) unite by their lateral surfaces to form a biflagellate "zygote." Although cytoplasmic union is thus accomplished, a long period elapses before the zygote assumes a definite body-form and the nuclear fusion takes place. At first, owing to the looseness of the union, the behaviour of the two united gametes is amazing, and we believe, unique in the history of conjugating elements. Owing partly to the fact that the protoplasm of this form is very plastic, and partly to the fact that there is at first no attraction, apparently, between the two nuclei (this being probably because no nuclear maturation has yet taken place), the two gametic halves behave just as they like for some time. One will "slither" in front of, or behind, the other, and the two may even separate for some distance, remaining connected only by an extremely thin cytoplasmic thread. But, once joined, we have never seen the two gametes actually break loose from one another, and do not believe this ever occurs.

Ultimately, the zygote assumes a characteristic form, which we have called the banner-stage, because it is exactly like a procession-banner, with the two flagella as the standards or poles. This gradually changes to an ovoid form, which persists for some time. During this period, the two flagella are gradually becoming shorter, being slowly absorbed by the zygote. During this time, we consider that the nuclear changes leading up to the actual nuclear union, take place; but as we have restricted ourselves to living observations, up to the present, we cannot say with certainty until we have studied permanent preparations. Finally, the zygote comes to rest, becomes rounded-off and loses its flagella. It now encysts, forming first a "shrinkage"-cyst, which after a time passes into the permanent one. This completes the life-cycle. It remains only to add that the zygote never continues to multiply in the active condition, but always encysts. Also, we are convinced that every cyst formed is the product of an act of syngamy. There is no multiplication within the cyst, from which, as stated above, only a single individual emerges.

Biological questions.—We have found that if a subculture is made from a culture in which the flagellates are actively multiplying, before conjugation has set in, multiplication will continue to go on for a further period of two or three days, after which conjugation, followed of course by encystment, then occurs. In the light of the interesting and important work done recently by Cropper and Drew on the biological factors causing the encystment of *Amœbæ*, we have no doubt that

Appendix II.

Reports of the Professor of Protozoology at the University of London, and of his Assistant, for the year ended 30th June, 1914.

the chief stimulus to the onset of syngamy (and subsequent cyst-formation) is to be found in the development in excess of toxic products in the immediate environment. This explains why, on making a fresh sub-culture of a small quantity of the flagellates on to a fresh (non-toxic) medium, multiplication continues actively. This is accompanied, of course, by an even more rapid bacterial development, and thus, in a few days more, the new medium is full to excess of toxic substances.

Now by continuing to subculture the flagellates at intervals of a few days, we have discovered a most interesting fact, which has, we consider, a highly important bearing upon the biology of the trypanosomes and other parasitic flagellates. Not only do the flagellates go on multiplying and multiplying, endlessly, without conjugating, but they are apparently *no longer able to conjugate* when left in a culture the medium of which is becoming full to excess of toxic substances. Up to the time of writing, we have kept such a "non-conjugating" strain going for more than three months, through about twenty subcultures, and in spite of repeated observations, in the course of which thousands of individuals have passed under our eyes, not a single cyst has been seen (*i.e.*, the normal product of conjugation). Instead of the vast majority regularly conjugating and forming cysts as in the normal and usual life-cycle, the flagellates have been propagated, through more than a thousand generations, solely by continuous multiplication. In old cultures the flagellates become altered and abnormal, and eventually all die off. This radical modification of the life-history is entirely due, we consider, to two factors:—(1) An abundant supply of nutriment, and (2) removal of the toxic substances, before these are present in excess in the medium. The essentially important point to note is that this strain has, so far as can be seen, lost the power to undergo syngamy. Left in an old subculture, becoming full to excess of toxic products, instead of conjugating and forming protective and quiescent cysts, the flagellates all die off!

In our paper on this flagellate, which has been communicated to the Royal Society, we show how this experimental fact affords the best explanation of why conjugation in the trypanosomes and other binucleate parasitic flagellates has been entirely lost, which we think is in all probability the case, as, in spite of numerous and careful observations, it has never been seen in any authentic instance. I will not develop the argument here but will merely say that the environment in which these parasites live is equally one in which the two above-mentioned factors operate; and, moreover, certain biological conditions which have been observed in trypanosomes (*e.g.*, involution and abnormal forms), agree closely with the corresponding conditions which we have found in the case of the non-conjugating strain of *Helkesimastix*, in old cultures.

(B). Assistance to the University Professor and in the Department.

As usual, I arranged the demonstrations in connexion with Professor Minchin's annual Course of Lectures, during the early Spring of 1913. The course was a most interesting one, on "The Protozoan Parasites of Man," and was very well attended. I have given considerable assistance to various workers in the laboratory, and have also given advice on many occasions to workers from laboratories abroad, on points in regard to which they desired information.

H. M. WOODCOCK.

10th August, 1914.

APPENDIX III.

Report on the Work of the Quick Laboratory at Cambridge for the year 1914.

REPORT OF PROFESSOR G. H. F. NUTTALL, F.R.S., ON THE WORK OF THE QUICK LABORATORY, CAMBRIDGE.

THE papers published by the workers in the Quick Laboratory during the year 1914 (of which a list is appended) relate to the structure and biology of ticks and their pathogenic action, to pathogenic protozoa, and to serological studies.

The work of the Laboratory has been considerably disturbed by the outbreak of war. Moreover, both Dr. Hindle and myself have been busily engaged in writing books and various papers which will shortly be published. The number of papers issued from the Laboratory is, for these reasons, diminished as compared with the output of previous years. Several changes have also occurred in the staff and a number of its members have joined the Army temporarily.

Mr. Gordon Merriman (Trinity Hall), who held the studentship in Medical Entomology for several years, was killed in action near Karonga, Nyasaland, on 9th September. All who have been associated with him in the Quick Laboratory greatly deplore his loss.

Mr. K. R. Lewin, B.A. (my late assistant), Dr. E. Hindle (my assistant), and Mr. T. Storrar Cave (Helminthologist to the Quick Laboratory) have obtained commissions and are serving in the Army. Dr. Hindle's expedition to Africa was necessarily postponed owing to the war. Mr. E. S. Hay (Secretary) is serving as a trooper in the Loyal Suffolk Hussars, and Mr. B. G. Clarke (senior laboratory assistant) is serving as sergeant in the Royal Army Medical Corps Territorials. Mr. C. H. Harpley (junior laboratory assistant) was, prior to the outbreak of war, granted leave to proceed to Antigua to aid in the work of ankylostomiasis eradication.

Miss A. Porter, D.Sc. (London) resigned the post of Helminthologist upon her appointment to a Beit Memorial Research Fellowship, and was succeeded by Mr. T. Storrar Cave, B.A. (Corpus).

Mr. N. Cunliffe, B.A., resigned the studentship in Medical Entomology for a post in the Museum of Comparative Anatomy at Oxford. I have, with the consent of the Vice-Chancellor, appointed Mr. M. E. MacGregor, B.A. (Trinity), as his successor. Mr. MacGregor has recently held a Carnegie studentship under the Imperial Bureau of Entomology.

My staff is, therefore, temporarily reduced to Mr. C. Warburton, M.A. (Demonstrator in Medical Entomology), Mr. M. E. MacGregor, B.A. (student in Medical Entomology) and a laboratory boy.

Messrs. Warburton and MacGregor are at present actively engaged in research.

In addition to the members of the staff, we have had the following gentlemen carrying on research in the Laboratory during the year 1914:—Dr. Lajos Gózony, assistant in the Bacteriological Institute, Budapest (worked for five months); Dr. P. H. Ross, Government Veterinary Bacteriologist, Nairobi (worked for five months); Dr. J. O. Shircore, Medical Officer of Health, Nyasaland (worked for about four months). Mr. L. P. W. Renouf, B.A. (Trinity), pursued parasitological studies during the first half of the year, and Mr. L. Denton Sayers, B.A. (Downing) is now preparing himself to carry on research work in protozoology. Mr. L. Harrison, B.Sc., from Australia, has recently established himself in the Laboratory to pursue detailed studies upon the mellophaga and other parasites.

Dr. J. Y. Wood, Medical Officer, Kaballa, Sierra Leone, and Mr. F. J. MacCall, M.R.C.V.S., Veterinary Officer, British East Africa, both came, at the instance of the Colonial Office, to spend a week in the study of special subjects.

Miss Porter's work upon *Herpetomonas patellæ*, a parasite of the edible limpet, is of special interest as revealing such a flagellate for the first time in mollusca. She, in conjunction with Dr. Fantham, has made a remarkable observation showing that *Herpetomonas jaculum*, parasitic in *Nepa cinerea*, an aquatic insect, is pathogenic when introduced into mice. She is pursuing investigations upon the prevention of bee diseases and upon gapes in fowls.

Appendix III.

Report on the work of the Quick Laboratory at Cambridge for the year 1914.

Drs. Hindle and Gózony have shown that Abderhalden's reaction may be of use in the study of protozoal diseases, and, together with Dr. P. H. Ross, they have obtained some interesting results by means of serological tests. They found (*a*) that precipitating antisera prepared by me in 1902 and since maintained in the dark at room-temperature in some instances still gave specific reactions, and (*b*) that complement fixation and precipitin reactions were obtainable with anti-fowl serum and the gut contents of *Argas persicus* and *Ornithodorus moubata* as long as twenty-three months after these ticks had fed upon fowls. Positive precipitin reactions, using anti-human serum, were obtained with the gut contents of *Pediculus vestimenti* up to three days after these insects had fed upon man.

Messrs. Hindle and Cunliffe report upon interesting experiments showing the remarkable power of regeneration of lost limbs possessed by *Argas persicus*. Mr. Cunliffe has shown by experiments upon *Rhipicephalus sanguineus* that the size and structure of the nymph and adult of this species is greatly influenced by the degree to which it is allowed to feed upon the host; he also gives the first description of the larva of *Argas brumpti*, a species which, in its maturer stages, has been found to attack man in Africa. Dr. Hindle records a curious malformation observed in *Acanthia lectularia*, and I have illustrated and described some remarkable monstrosities and malformations encountered in ticks. A paper of mine deals with the obscure affection known as "tick paralysis," of which further cases are cited as occurring in man in North America and in sheep in South Africa; moreover, in a short note I record the first observation made in Great Britain of the penetration of *Ixodes* beneath the skin, coupled with an explanation of the mechanism whereby penetration is effected.

It is largely due to the aid received from the Tropical Diseases Research Fund that we are able to carry on our work successfully. I trust, in view of the urgent need of men in the army, that the Advisory Committee will agree to my proposal to allow Dr. Hindle and Mr. Cave to receive their pay from the Fund during their term of military service, especially as the service they are performing is of paramount importance to the Empire.

GEO. H. F. NUTTALL,
Quick Professor of Biology in the University of Cambridge.

12th November, 1914.

List of Publications for the Year 1914.

1. Hindle, E., and Cunliffe, N. (I. 1914). "Regeneration in *Argas persicus*." (With 4 text-figures.) *Parasitology*, VI., 353-371.
2. Cunliffe, N. (I. 1914). "*Rhipicephalus sanguineus*: Variation in size and structure due to nutrition." (With 4 text-figures.) *Parasitology*, VI., 372-378.
3. Cunliffe, N. (I. 1914). "Observations on *Argas brumpti* Neumann, 1907. (With 1 text-figure.) *Parasitology*, VI., 379-381.
4. Nuttall, G. H. F. (V. 1914). "'Tick Paralysis' in Man and Animals. Further published records with comments." *Parasitology*, VII., 95-104.
5. Hindle, E., and Gózony, L. (XI. 1914). "Abderhalden's Reaction and its application to certain protozoal infections." *Parasitology*, VII., 228-239.
6. Nuttall, G. H. F. (XI. 1914). "Tick Abnormalities." (With 11 text-figures.) *Parasitology*, VII., 250-257.
7. Nuttall, G. H. F. (XI. 1914). "Penetration of *Ixodes* beneath the skin." *Parasitology*, VII., 258-259.
8. Hindle, E. (XI. 1914). "Note on a Leg Abnormality in *Acanthia lectularia*." (With 1 text-figure.) *Parasitology*, VII., 260-261.
9. Porter, A. (XI. 1914). "The morphology and biology of *Herpetomonas patellæ*, n. sp., parasitic in the limpet, *Patella vulgata*, together with remarks on the pathogenic significance of certain Flagellates found in Invertebrates." (With 17 text-figures.) *Parasitology*, VII., 322-329.
10. Gózony, L., Hindle, E., and Ross, P. H. (XI. 1914). "Serological Tests. 1. On the persistence of precipitins in sera stored in vitro; 2. On the reactions obtained with (*a*) complement fixation tests, and (*b*) precipitin tests, with the gut-contents of blood-sucking Arthropods." *Journal of Hygiene*, XIV., 354-359.

APPENDIX IV.

Reports from the London School of Tropical Medicine for the year ended 31st October, 1914.

No. 1.

LONDON SCHOOL OF TROPICAL MEDICINE to COLONIAL OFFICE.

(Received 14th May, 1914.)

SIR, Royal Albert Dock, E., 13th May, 1914.

I BEG to submit herewith, for the information of the Advisory Committee of the Tropical Diseases Research Fund, the reports of the three Departments of Entomology, Helminthology, and Protozoology, for the half-year ended 30th April, 1914.

It will be observed that Dr. Leiper addresses his report from China. This is occasioned by the fact that he has been awarded the Wandsworth Scholarship, which, together with the grant of £250 made by your fund, has enabled him to undertake this expedition. He left England on the 20th February, accompanied by Surgeon E. L. Atkinson, R.N., who has been seconded by the Admiralty.

The report from Dr. Wenyon is the last that he will present, as he has resigned his appointment as Protozoologist in the School. Dr. Wenyon's resignation has been accepted with regret, and with an expression of appreciation of the work that he has done for the School. Arrangements are now being made for the appointment of a successor to him.

An assistant, in the person of Dr. F. W. O'Connor, has been provided for the Entomological Department, and the School purposes appointing assistants to the other Departments.

In order to make as complete as possible the arrangements for the examinations in the School, an Invigilator was engaged to supervise the School examinations at the end of the last session, and this method will be adopted on all future occasions. The School is indebted to Mr. G. K. Paley, of the Civil Service Commission, for assistance in this matter.

At the end of the year Mr. Austen Chamberlain closed his fund. The total amount received, with interest, during the time the appeal was in progress, is £73,475, which has been allotted as shown in my last communication.*

I enclose herewith a statement of the School accounts† for the year ending 31st December last. It will be seen that the form is materially altered so as to bring the accounts into line with the method adopted by the Board of Education. The accounts submitted show no income from Mr. Chamberlain's Fund, for the reason above stated.

I am, &c.,
P. MICHELLI,
Secretary.

Enclosure 1 in No. 1.

REPORT OF THE ENTOMOLOGIST FOR THE HALF-YEAR ENDING 30TH APRIL, 1914.

THE activities of the Entomological Department during this period have been directed almost entirely towards maintaining and perfecting the arrangements for teaching, this limitation of outlook being inevitable so long as the official courses of instruction are so frequent and the classes so large as they now are. Such a limitation, however, is not entirely a matter for regret, since one of the most useful services to tropical medicine and hygiene that the entomologist stationed at home can render is educational.

In the teaching the chief novel feature is that more attention is being directed to the study of living insects in the new insect house.

Four courses of lectures and demonstrations in medical entomology, and two dealing with snakes and their venoms have been conducted.

* See page 91 of [Cd. 7261.] † Not reprinted.

Appendix IV.

Reports from the London School of Tropical Medicine for the year ended 31st October, 1914.

In the insect house the life history of the bed bug, of certain ticks and mites, and of *Anopheles bifurcatus*, and several aquatic insects found in association with its larva, have been under observation. Among the mites particular attention was paid to the viviparous parasitic species, *Pediculoides ventricosus*.

The *Pediculoides* was brought to our notice through the authorities of the Port, in consequence of an outbreak of an exceedingly irritant form of skin eruption among labourers engaged in unloading cotton seed. Samples of the seed were brought to the School, and were found to be infested with caterpillars of the moth *Gelechia gossypiella*, Durrant, the "boll-worm" caterpillar, so destructive to growing cotton in Egypt. The caterpillars in turn were found to be grossly infected with the mites *Pediculoides ventricosus*, and it was these that had so freely attacked the labourers who had handled the seed. The caterpillars were bred out for identification in the insect house, and the whole life history of their interesting parasite was observed and recorded, and plenty of material in all stages was preserved. It was noticed that caterpillars attacked by several mites at once were always killed, but that while the caterpillars were concealed in the seed the mites could not get at them. The "medical" aspects of the case were carefully studied by my assistant, Dr. F. W. O'Connor, who has prepared a report on this unusual—though not novel—matter, which, at the time, had a most disconcerting effect, not only upon the victims of the attack, but also upon their immediate employers and upon the consignees of the cotton seed.

The Entomological Department has kept in touch with numerous interested correspondents in many parts of the world, by whose kind attentions the museum and the reserve and study collections have been much enriched. The following donors deserve particular notice:—

The Imperial Bureau of Entomology: a large collection of well-preserved and authentically-named blood-sucking flies.

Professor R. T. Hewlett: a multitude of *Anopheles maculipennis* and *bifurcatus*.

The Hon. Charles Rothschild: specimens of *Pygiopeylla*, a flea which has been shown by experiment in Java to be capable of harbouring the plague bacillus.

Assistant-Surgeon C. R. Avari: beautiful specimens of various snake venoms, and photographs of living venomous snakes, from India.

Dr. P. H. Bahr: a very fine collection of mosquitoes and snakes from Ceylon.

Major A. B. Fry, I.M.S.: a select series of *Culicidæ* from Bengal.

Captain C. A. Gill, I.M.S.: an inexhaustible box of divers species of *Anopheles* from Northern India.

Captain G. G. Jolly, I.M.S.: some venomous snakes from Baluchistan, including *Pseudocerastes persicus*.

Dr. P. J. Kelly: venomous snakes from South China.

Major C. Lane, I.M.S.: bot worms and other parasitic muscoid larvæ from India.

Dr. A. R. Neligan: several species of ticks—some living—from Persia.

Dr. R. Roper: *Anopheles* mosquitoes from North Borneo, including great store of *A. umbrosus*, which he has discovered to be one of the local malaria carriers.

Dr. G. C. H. Davies: a venomous fish (*Pelor didactylum*) from the Solomon Islands, with notes of a case of injury inflicted by it.

Dr. D. Burrows, Dr. Graham Cobb, Dr. W. B. Johnson, and Dr. C. E. S. Watson: each and severally common mosquitoes and other blood-sucking flies of Nigeria.

Dr. W. E. Glover: numerous insects and venomous snakes from Nigeria.

Dr. J. C. L. Johnstone: scorpions from Nigeria.

Dr. J. Pollard: specimens of the larva of a tiger beetle from Nigeria. These larvæ, according to Dr. Pollard's own observation, inflict a bite which is almost as serious as the sting of a scorpion.

Dr. Minnett: flies from British Guiana.

Dr. R. U. Moffatt: numerous mosquitoes from the Amazon country, also specimens of a Staphylinid beetle, *Pœderus amazonicus*, Sharp, that exudes an actively vesicant secretion

APPENDIX IV.

REPORTS FROM THE LONDON SCHOOL OF TROPICAL MEDICINE FOR THE YEAR ENDED 31ST OCTOBER, 1914.

Dr. J. M. O'Brien: a large Belostomatid bug from South America.

Dr. H. G. F. Spurrell: another large collection of noxious insects, and some venomous snakes from Columbia.

A. ALCOCK,
Lieut.-Col. I.M.S. (retired list).

London School of Tropical Medicine,
27th April, 1914.

Enclosure 2 in No. 1.

REPORT OF THE HELMINTHOLOGIST FOR HALF-YEAR ENDING 30th APRIL, 1914.

SIR, Soochow, China, 10th April, 1914.

I HAVE the honour to submit my report as Helminthologist to the London School of Tropical Medicine for the half-year ending 1st May, 1914.

The various papers referred to as at press, or in preparation, in my last report have now been published. Four additional contributions have been published during the period under review.

(*a*) *Seven Helminthological Notes*:—In the Journal of the London School of Tropical Medicine.

(*b*) *Parasites of Domesticated Animals which Infect Man*:—In the Veterinary Record and Veterinary News.

(*c*) *The Helminthes Collected by the National Antarctic Expedition*, 1910-1912 (Jointly with Surgeon Atkinson):—In the Proceedings of the Zoological Society of London.

(*d*) *Materials for a Bibliography of the Trematode Infections of Man*:—(Jointly with Miss V. A. Inglis), published separately.

Instruction.

The usual courses of medical and veterinary helminthology were given, but it has been decided to discontinue the latter course. In future, lectures on helminthology will also be given in the course on tropical sanitation and hygiene.

The helminthological laboratory has been utilized for research by two workers during the three months from October to December.

Captain Shortt, I.M.S., devoted attention to certain new nematodes, partly collected by himself in India, and partly derived from the Zoological Gardens in London. I regret that owing to my absence abroad I have had to resign the work of reporting upon the worms collected at the Zoological Gardens. Surgeon Atkinson, R.N., parasitologist to the Scott Antarctic expedition, has worked constantly in the laboratory upon the large collection of worms made by him in the south, and, with me, has written for the scientific results of the expedition a detailed report upon the helminthes. A preliminary note establishing a large number of new species and several new genera has already been published by us in the proceedings of the Zoological Society of London.

With funds provided partly by the Tropical Diseases Research Committee of the Colonial Office and partly by the London School of Tropical Medicine I was afforded the opportunity of undertaking further research work in the field, and early in February proceeded to China for the purpose of studying the mode of spread of trematode infections of man, especially bilharziasis.

In view of the importance of Asiatic schistosomiasis to the Navy, it was thought that the Admiralty might assist in these investigations, and they were pleased to second Surgeon Atkinson, R.N., for the work.

The party reached Shanghai on 30th March, 1914, with the intention of working in the Yangtsze Valley in the first instance. The local authorities of Shanghai have shown much practical interest in the proposed researches, especially Mr. Pearce, the Chairman of the Municipal Council, Mr. Leveson, the Secretary, and Dr. Stanley, the Medical Officer of Health. Mr. Cleor, the General Manager of the Shanghai-Nanking Railway, and Dr. Ziervogel, the Chief Medical Officer, have given us many facilities.

Appendix IV.

Reports from the London School of Tropical Medicine for the year ended 31st October, 1914.

During the fortnight that has now elapsed since our arrival, we have obtained a houseboat and equipped her as a floating laboratory, so that we can proceed through the agricultural regions by water. Dr. Stanley has placed a room at our disposal in the Municipal Health Department, so that for the present we intend to utilize Shanghai as our base, returning there periodically and when necessary with material for more careful investigation and for supplies. Later, it will probably be advisable to go higher up the Yangtsze River to compare the fauna, but our immediate plan is to ascertain a heavily infected village in what we have already determined to be an endemic area extending to within fifteen miles of Shanghai City.

I have, &c.,
Robert T. Leiper.

Enclosure 3 in No. 1.

Report of the Protozoologist for the Half-Year Ending 30th April, 1914.

During the period covered by this report the usual classes in general and advanced protozoology have been conducted.

Research work has been chiefly concerned with investigations on leishmaniasis. It has already been frequently pointed out that the kala-azar of India differs from that of the Mediterranean districts in that in India (Madras and Calcutta) the disease seems to be limited to human beings, whereas in the Mediterranean centres dogs also are liable to be infected. Search in the Indian centres for naturally infected dogs has always been negative, so that some have been led to conclude that this constitutes a specific difference between the two parasites. The Mediterranean disease is inoculable experimentally from children to dogs, and one naturally wondered whether this was true also of the Indian form. Quite recently Donovan and Patton have succeeded in infecting Indian dogs by injecting large doses of virus obtained from human cases. I have been able to test the result of the inoculation of English dogs with the virus of Indian kala-azar, my material having been obtained from an Indian case which died in the Albert Dock Hospital.

The spleen of the case, which was very heavily infected, was broken up in about an equal volume of saline solution, and the resulting emulsion injected into the dogs intraperitoneally, this having been shown to be the most successful method with the Mediterranean virus.

(A.) Four healthy dogs were thus inoculated with five c.cm. of this emulsion, which, as already stated, contained enormous numbers of parasites.

Dog 1. Inoculated 22nd September, 1913. This dog remained well till 10th October. It became worse and was killed on 12th October. Fair numbers of leishmania were found in the liver, spleen, and bone marrow. Apart from the leishmania there was no apparent cause of illness.

Dog 2. Inoculated 22nd September, 1913. This dog remained in good health. A liver puncture performed on 20th October showed one typical leishmania in a large cell. On 20th January, 1914, a bone marrow examination was made, when fairly numerous leishmania were found. This was again done on 16th April, 1914, but no parasites could be discovered. During the whole of this time the dog has remained in perfect health, and has grown even more quickly than a control of the same litter kept with it in the same run.

Dog 3. Inoculated 22nd September, 1913. This dog had previously (26th March, 1913), been inoculated intravenously with 4 c.cm. of cultures of varying ages of *Leishmania donovani* (Bombay strain obtained from Dr. Row). No infection resulted. Six months later it was inoculated (22nd September) from the case of kala-azar. On 19th November a liver puncture was negative. On 16th December the dog did not appear well—liver puncture again negative. On 16th January, 1914, bone marrow examination revealed numerous leishmania. The dog was developing a mangy condition of the head, a feature very common in the natural canine kala-azar of the Mediterranean districts. 5th April, another bone marrow examination again revealed numerous leishmania. The dog is still under observation.

Appendix IV.

Reports from the London School of Tropical Medicine for the year ended 31st October, 1914.

It is interesting to note that the previous inoculation of cultures did not either infect the dog nor did it protect against subsequent inoculation of virus.

Dog 4. Inoculated 22nd September, 1913. This dog had also previously received an intravenous injection of 4 c.cm. of culture, as in the case of dog 3, on 26th March, 1913. No infection resulted. The inoculation of the virus on 22nd September also has produced no detectable infection, though repeated examinations of the marrow have been made. Dogs 3 and 4 belonged to the same litter and were of approximately the same size.

(B.) *Dog* 5. This dog between 1st March and 23rd June, 1912, had a mild attack of piroplasmosis, resulting from an infection by ticks collected in Aleppo in September, 1911. The ticks were fed on the dog on 1st March, 1912.

On 26th July, 1912, the dog was inoculated in each ear from sores on the ear of another dog which had been infected from a case of South American dermal leishmaniasis (*Leishmania tropica*).

During August and September, 1912, the dog developed sores on the ears at the points of inoculation. During the course of the next few months the sores which had contained large numbers of leishmania completely disappeared. On 22nd September, 1913, the dog was inoculated with 20 c.c. of the spleen emulsion from the case of kala-azar by way of testing whether the previous infection with *Leishmania tropica* of oriental sore would protect against *Leishmania donovani* of kala-azar. This dog did not become infected. It was killed on 16th January, 1914, and a careful examination of the organs by smears and culture methods gave only negative results.

From these experiments it results :—

1. That English dogs may be infected with the virus (*Leishmania donovani*) of Indian kala-azar.

2. The previous failure of injection of cultures to infect does not protect against a subsequent inoculation of virus.

3. A dog recovered from a previous attack of oriental sore did not become infected with kala-azar virus, though the dose given was four times as great as that which infected other dogs. It must be remembered, however, that one dog (dog 4) did not become infected with *Leishmania donovani*, though it had had no previous infection with *Leishmania tropica* of oriental sore.

4. From these experiments on dogs there appears to be no reason to regard the Indian and Mediterranean diseases as distinct.

One cat was inoculated intraperitoneally with the spleen virus, but no infection resulted.

Five rats were similarly injected. In one of these liver puncture performed three weeks later showed a few leishmania. The others were killed later, but were not infected.

The culture of leishmania from the finger blood of a case of kala-azar.

On a case of kala-azar which was in the Albert Dock Hospital, under the care of Dr. Sandwith, I was able to test the possibility of culturing leishmania from the peripheral blood. Six tubes of N.N.N. medium were inoculated each with two or three drops of blood obtained by pricking the finger of the patient. Eighteen days later there was a culture of flagellates in each of five of the tubes which were not contaminated with bacteria. The culture method may thus be employed as a means of diagnosis in this disease and it is a method which is not so distasteful to the patient as either spleen or liver puncture. A paper on this subject was published in the Journal of Tropical Medicine and Hygiene for 16th February, 1914.

On 19th December, 1913, I read a paper before the Society of Tropical Medicine and Hygiene on the subject of kala-azar in Malta with some remarks on the various Leishmaniasis. This was published in the "Transactions of the Society." The main points of this paper were based on observations I made in Malta during last summer and have already been mentioned in my last half-yearly report.

A good deal of my time has been occupied in the examination of material from the hospital and in reporting on other material which has been received from abroad.

C. M. Wenyon

APPENDIX IV.

REPORTS FROM THE LONDON SCHOOL OF TROPICAL MEDICINE FOR THE YEAR ENDED 31ST OCTOBER, 1914.

No. 2.

LONDON SCHOOL OF TROPICAL MEDICINE to COLONIAL OFFICE.

(Received 31st October, 1914.)

London School of Tropical Medicine (University of London),
Royal Albert Dock, E., 30th October, 1914.

SIR,

THE reports of the Special Departments of the London School of Tropical Medicine are now due and I have the honour to submit herewith Colonel A. Alcock's report in regard to entomology for six months and Dr. C. M. Wenyon's report in regard to protozoology for the three months ended 31st July. There is no report from Dr. R. T. Leiper, the Helminthologist.

Dr. Wenyon has resigned his post as Protozoologist as from the 31st of July and he is now no longer in the service of the School. He is succeeded by J. Gordon Thomson, M.B., Ch.B., formerly of the Liverpool School of Tropical Medicine and of the Royal Society of Medicine. Dr. Thomson took up his duties at the School on the 21st of September, and his report for the ensuing six months will be made in due course.

Dr. Leiper, the Helminthologist, as stated in my last communication, has been in China and Japan in connexion with an inquiry into the mode of spread of trematode infections of man, especially bilharziasis, and the relation of these diseases in man to those in domesticated animals. Dr. Leiper had to curtail his stay on account of the outbreak of war and has only just returned to England. The position of some of his investigations is scarcely sufficiently far advanced for him to make a formal report at the moment in regard to the subject of his mission to the East. His report for the whole of the period during which he was absent will be submitted at the end of the ensuing six months.

Surgeon E. L. Atkinson, R.N., who accompanied Dr. Leiper, left China on the announcement of the outbreak of war, and arrived in England on the 31st August.

Up to the end of the summer session the work in the school was carried on uninterruptedly. During the academic year commencing 1st October the total number of students attending was 168, as follows:—

October—December, 1913	71
January—April, 1914	40
May—July, 1914	57
	168

In consequence of the war the number of students who have entered for the present session, which commenced on the 1st of October, is only 15.

Furthermore, it has been found necessary to abandon the course in Tropical Sanitation and Hygiene as Dr. B. H. Wedd, the Bacteriologist and Demonstrator, has been called up for active service.

It will be observed in Colonel Alcock's report that his Assistant, Dr. F. W. O'Connor, has also been called up for service, and thus the Entomological Department is now without an Assistant.

I am, &c.,
P. MICHELLI,
Secretary.

Enclosure 1 in No. 2.

REPORT OF THE ENTOMOLOGIST FOR HALF-YEAR ENDING 31ST OCTOBER, 1914.

London School of Tropical Medicine, Royal Albert Dock, E.

SINCE the beginning of August the Department has suffered a check, just as it was beginning to expand in a new direction, by the departure for the war of the Assistant, Dr. F. W. O'Connor, and the Laboratory Assistant, W. McDonald. Their places are being kept open, but it will be very difficult to obtain trained substitutes for temporary service, and without experienced assistants who can give continuous attention to the matter it will be impossible to carry on the vivarium.

Appendix IV.

Reports from the London School of Tropical Medicine for the year ended 31st October, 1914.

During the period in report the usual school courses of instruction in medical entomology and snake toxicology, and a special course of entomology for officers deputed by the Colonial Office, have been conducted. The entomological demonstrations included living insects pertinent to medicine—among them larvæ of *Stegomyia fasciata* which were hatched here from eggs sent from West Africa by Mrs. Connal, who formerly, as Miss Summers, worked in this laboratory.

The life-history of several common insects of pathogenic importance has been followed out in the vivarium in confirmation of recorded observations, and a good deal of material required for class work has thus been secured in all stages of development.

In the summer recess an expedition visited Lough Mask, in the west of Ireland, to observe some of the blood-sucking flies—in particular *Chrysops relicta*—which are so abundant there. The observations were interrupted, by events arising from the outbreak of war, at a most promising stage, but strong presumptive evidence was obtained that *Chrysops relicta* pairs and oviposits in sheltered situations having well-defined natural features, of which propinquity to water is by no means the only one, and sufficient living material was brought away to give hope of settling the question. In any case observations were recorded exact enough to enable the inquiry to be resumed at the proper moment without loss of time.

In the summer session Dr. Richard Roper, an old student of the school, worked out a collection of Anopheles mosquitoes which he had brought back from North Borneo. His results, which are an important contribution, on the entomological side, to the sanitation of an almost unstudied British settlement, have been published in the *Bulletin of Entomological Research*.

The inquiries of numerous correspondents have been attended to. Among interesting items of this correspondence the following deserve mention :—

From the Bombay Presidency Dr. J. F. D'Mello sent a lot of living *Ornithodorus savignyi*, with an account of their habits as pests in market-places and cattle stands. Among them were some small crab-spiders having a remarkable resemblance in form, colour, pose, and movements to the ticks themselves.

From Berar Major J. S. Oxley, I.M.S., sent a number of Cecidomyid larvæ and pupæ which were said to have been removed from the eyes of patients by a quack doctor.

From Assam Dr. F. C. McCombie sent some Mycetophilid flies—a species of Sciara—which are said to bite.

From Assam also Dr. R. Murphy sent an entomological collection that had been passed alive by one of his patients : it included a caterpillar of a flour moth, a small adult mealworm beetle (*Tribolium ferruginium*) and a number of larvæ and pupæ of a moth-midge.

From Travancore Major Clayton Lane, I.M.S., sent some larvæ of a large Carabid beetle taken from the gut of an elephant, and some extraordinary larvæ, probably of a large Anthomyid fly, passed by another elephant.

From North Borneo Dr. E. L. Mansel sent a specimen of *Chrysops fixissima* with an account of the effects of its bite upon a strong healthy European planter. The bite was not painful at the moment, but caused enormous local swelling so that an "arm became like a leg," and an "ear like a cauliflower," and eventually gave rise to "nausea, malaise, and general prostration," lasting for forty-eight hours. The fly is "well known to the natives of the district, who call it *pikat*."

From Northern Nigeria Captain H. D. Foulkes sent a number of *Ornithodorus savignyi* with a long and interesting account of its habits and local occurrence. Captain Foulkes states this tick in Northern Nigeria is found only in sandy districts in the vicinity of Lake Chad, and there chiefly on the sites of old-established markets, and that the natives, who know it as *Girgidi*, "fear its bite as much as they do guinea worm."

The museum of the Department, which is strictly a "practical" one, has continued to increase. Among the many friends who have contributed to it, and to the departmental library which is associated with it, the following have to be mentioned with due acknowledgments :—His Majesty's Secretaries of State for the Colonies and for India, the Imperial Bureau of Entomology, the Tropical Diseases Bureau,

the Indian Research Fund Association, Dr. D. Burrows, Mrs. A. Connal, Dr. Drummond, of Nyasaland, Dr. W. A. Lamborn, Dr. D. T. Mitchell, Dr. J. S. Pearson, Dr. G. Rollason, Dr. R. Roper, Dr. G. H. F. Spurrell, Dr. A. T. Stanton, Dr. R. Y. Stones, Dr. G. V. Sturgess, Dr. P. H. Bahr, Dr. C. W. Daniels, Dr. F. W. O'Connor, and Dr. F. M. Sandwith.

October, 1914. A. ALCOCK.

REPORT OF THE PROTOZOOLOGIST FOR THE THREE MONTHS ENDED 31ST JULY, 1914.

THE last report submitted by me covered the six months ending 30th April, 1914. This report covers only the succeeding three months, owing to my having resigned from the post of Protozoologist at the London School of Tropical Medicine in July During this period I carried out the regular duties of the Protozoologist in conducting the protozoological section of the general course and in giving instruction to two students in the advanced course.

In the way of research work my experiments on leishmania were continued, and I have shown that it is possible to transmit the human parasite in India *Leishmania donovani* to dogs and to carry on the strain a certain number of passages.

The possibility of doing this is of the greatest importance in experimental work on the transmission of kala-azar by means of insects, for until the disease can be reproduced with certainty in animals it will be impossible to test the transmitting power of various insects.

Another line of investigation has been an inquiry into the possibility of conferring immunity on an animal against kala-azar by a previous infection of the much milder and local disease of oriental sore. As far as my results go they are not at variance with the view that oriental sore will confer immunity against kala-azar. These investigations have not yet been completed but they will form the subject of a future publication.

The importance of the claims made by Dr. Harald Seidelin that he had succeeded in inoculating the virus of yellow fever into guinea-pigs, and that in these animals he could detect in the red corpuscles the piroplasma-like bodies claimed by him to be the cause of the disease, led Dr. G. C. Low and me to examine the blood of healthy guinea-pigs for similar bodies. As a result of these investigations we found that bodies did occur in the red blood corpuscles of these animals and that it was extremely difficult to distinguish such from those claimed by Dr. Seidelin to be parasites of yellow fever. These observations, again, were not completed when I left the London School of Tropical Medicine, but they have been continued elsewhere. It is hoped to publish a paper on the results very shortly.

On the subject of trypanosomiasis an investigation was made of several cases of human disease under treatment in the Albert Dock Hospital. In three of these it was found by inoculation into rats that the trypanosomes were of the Rhodesian type and were *Trypanosoma rhodesiense*. In two other cases from Nigeria it was found possible to produce a mild infection in one rat from one of these. The trypanosomes behaved as *Trypanosoma gambiense* and were probably of this nature. These cases illustrate very well the difference in virulence of the two human African trypanosomes. The rats inoculated from the Nigerian cases either did not become infected or acquired a mild infection from which they recovered. Those inoculated with the Rhodesian forms invariably had an intense infection which terminated fatally.

October, 1914. C. M. WENYON.

No. 3.

LONDON SCHOOL OF TROPICAL MEDICINE to COLONIAL OFFICE.

(Received 15th January, 1915.)

Helminthological Department,
London School of Tropical Medicine, E.,
1st January, 1915.

SIR,

IN the last half-yearly report presented by me, in April, 1914,* brief reference was made to my arrival in Shanghai and the commencement, under exceedingly favourable auspices, of investigations upon trematode infections of man.

* Enclosure 2 in No. 1.

APPENDIX IV.

REPORTS FROM THE LONDON SCHOOL OF TROPICAL MEDICINE FOR THE YEAR ENDED 31ST OCTOBER, 1914.

This long-projected expedition had been rendered feasible by a special grant from the Tropical Diseases Research Fund of the Colonial Office, which was supplemented by certain funds at the disposal of the Committee of the London School of Tropical Medicine. The Admiralty also assisted, in view of the importance of the subject to the Navy in the Far East, by seconding Surgeon E. L. Atkinson, R.N., to accompany me.

It was anticipated that the full programme of the expedition would occupy about a year, but the outbreak of war at the beginning of August necessitated its curtailment. Surgeon Atkinson left at once via Canada to rejoin the Fleet. Failing to obtain official instructions, and in view of local conditions, I also decided to return, but, as our experiments were at a most interesting and critical stage, I remained for a further period of three weeks in order to ensure that at least the primary object of our work should be fully secured. I then proceeded home via Suez, breaking my journey at Colombo and Port Said to canvass the possibilities of resuming work in Rhodesia, Egypt, or Cyprus. The difficulties, financial and other, proved everywhere insurmountable to a civilian at that time. After an absence of eight months, I reached London towards the end of October.

Outline of Programme of the Wandsworth Expedition.

Two ideas underlie the general plan of campaign projected and actually followed. (1) A laboratory base was to be established in a large European centre within a few days' access by rail or water of the great endemic areas of the trematode infections of man in Asia. (2) The occurrence of the various infections of man in domesticated animals, especially dogs, rendered the work independent of hospitals and native patients.

Shanghai was chosen and proved ideal as a centre, being within easy reach by rail and river boat of endemic areas of schistosomiasis around Kashing, on the Yangtse, as far as Hankow: and, by ocean steamer, of the infected areas of Japan. Paragonomiasis in North Formosa and in Korea could also be reached by steamer in forty-eight hours. Clonorchis and yokogawa proved to be endemic in and around Shanghai itself. Fasciolopsis was found sporadic within two hours by train, while the endemic centre of Shaohsing could be reached in less than two days. Shanghai possesses, moreover, a highly efficient Public Health Department and well-equipped Municipal Laboratories, in which, through the kindness of Dr. Stanley, the Principal Medical Officer of Health, every facility and assistance was enjoyed. Moreover the daily operation of the stringent regulations of the municipality provided large numbers of dogs at short notice for our work. It became then only necessary to secure dogs heavily and naturally infected with the various trematode diseases, and to bring into the central laboratory, for experimental work, the various molluscs and other possible intermediaries inhabiting the different endemic areas. These latter were obtained from various districts within 500 miles of Shanghai, mostly by working from a house-boat upon the canals which intersect this region.

The other investigations were intended to be subsidiary to the elucidation of the exact life history of the *Schistosoma japonicum*, but, owing to our failure to obtain from any source a suitable case of schistosomiasis until the end of June, our work on the other infections was more frequently interrupted than we had allowed for in our time-table. The partial results obtained from these, however, may be briefly summarized here:—

Summary of Results.

(*a*) The following helminths, which occur as parasites of man, were found in dogs collected by the police from the Shanghai municipal area:—*Clonorchis sinensis*, *Yokogawa yokogawai*, and *Dibothriocephalus latus*. A species of Echinosome, a new Metorchis, *Dirofilaria immitis*, and the common *Ankylostoma caninum* were collected also.

(*b*) We were unable to establish the complete life history of Clonorchis, but it is noteworthy that no species of trout (which has been shown to be the carrier in Japan) occurs round Shanghai. Houghton has claimed to have found a free-moving

cercaria on the mucous membrane of the gut of a certain fish from the river Yangtse. We have found a similar body to this, but are convinced that it has nothing to do with the life cycle of Clonorchis. A study of the morphology of these canine Clonorchis throws some light upon the question of duality of species.

(*c*) *Yokogawa yokogawai* occurred in a large number of the dogs in Shanghai. This parasite has not heretofore been noted as occurring in China. We found in a kind of perch (not yet named) encysted cercariæ, which further work will probably prove to be the larval form of this parasite. The eggs resemble closely those of Clonorchis, and it may be that records of the discovery of Clonorchis eggs in fæces in human cases in Shanghai may be to some degree inaccurate.

(*d*) *Dibothriocephalus latus* was found in one dog, and the eggs were isolated and set aside to hatch for experimental work. The text-books state that even in warm weather a month is required for the proper formation of the embryo. These eggs hatched quite unexpectedly within a fortnight, when we were not thus early prepared to follow their further course. It is a remarkable thing that, although the infection of man and dogs with this form has been repeatedly carried out in feeding experiments with infected fish, no one has yet succeeded in ascertaining whether the fish are directly infected or secondarily through another intermediate host.

(*e*) The Shanghai dogs were also heavily infected with a species of Echinostome belonging to the genus Echinochasma. We succeeded in recognizing the larvæ of this form in a freshwater fish, not yet named, common in the markets of Shanghai, and in experimentally infecting a dog by feeding. This form may prove of further interest, for the egg resembles very closely that of *Fasciolopsis buski*, and it would be not at all surprising to find it as a human parasite of man in China.

(*f*) A new Metorchis, obtained from the bile ducts of a dog, is of interest as possibly throwing light upon the reputed *Metorchis truncatus* reported from man in Siberia. This form resembles, when stained, *Opisthorchis sibericum* much more closely than does *Metorchis truncatus*. It is small, the skin is covered with spines, the testes are tandem and deeply lobed.

(*g*) *Dirofilaria immitis* in Shanghai, as in other parts of China, is very common in dogs, but, as its life history has already been traced, it did not seem advisable to devote time to this form.

(*h*) *Ankylostoma caninum*, the common hook-worm of the dog, occurs in practically every dog examined. We found no other species. This is notable, in view of the statement in Jeffrey's and Maxwell's "Diseases of China," that *Ankylostoma duodenale* of man occurs also in dogs in Shanghai. The ankylostomes reported there as occurring in snakes are a species of *Kalicephalus*, while those from chickens may be *Heterakis vesicularis*, also found by us.

(*i*) In the public abattoirs we devoted some attention to the parasites of pigs. *Trichinella spiralis* would appear to be very rare in Shanghai if it occurs.* We did not come across or learn of a single case. The pigs were remarkably free from parasites. The pigs in the south of China are often infested with a species of Fasciolopsis. We received specimens in cold storage from Hong Kong and were able to compare the anatomy with that of typical Fasciolopsis from Shaohsing. All specimens show the same morphology. Differences which have given rise to various specific designations are easily produced by various manipulations. It is especially notable that all specimens, both from pig and man, have spines on the skin in the living state.

The larval stage of Fasciolopsis is said to encyst in freshwater shrimps. We found these cysts, but attempts to infect pigs were unsuccessful.

(*j*) The occurrence of a very good case of ankylostomiasis at Hangchow enabled us to test the practicability of employing chemical manures to destroy ankylostomes in fæces without impairing the organic manurial value. All the commonly used chemical manures were tried, and with one we obtained highly suggestive results. The method must be repeated in a larger series of laboratory

* It occurs in a considerable percentage of the pigs in Amoy.—P.M.

experiments, but if these prove equally effective our work may point to a simplification of the nightsoil problem in tropical communities, converting a loss into profit.

(*k*) At Hankow Dr. Atkinson noticed in a species of *Lymnæus* an encysted form, which I diagnosed as an encysted cestode near to *Echinocotyle*, and probably a parasite of ducks. We succeeded in infecting a duck by feeding it on these infected snails, and later obtained the adult tapeworms, which confirmed our preliminary diagnosis. Usually these tapeworms encyst in crustacea.

Results of Schistosome Experiments.

None of the dogs examined in Shanghai were infected with *Schistosoma japonicum*, and our inability to obtain suitably infected dogs greatly embarrassed and delayed our work, in spite of the efforts of many friends. A number of sportsmen from as far up the Yangtse River as Hankow kindly sent dogs to us for examination. Several of these showed signs of old infections but were useless for experimental work. All the cases seen in man were of similar type. It was necessary to obtain an animal passing practically nothing but blood and mucus full of eggs, in order that the eggs might be quickly isolated by dilution with water before they hatched.

In the latter half of June, Surgeon Atkinson and I visited Hankow, 500 miles up the Yangtse. A large number of dogs were examined there, but only on the last day of our visit did we succeed in obtaining one which proved ideal for our purpose, and with this, on loan, we then returned to Shanghai. During the whole period of waiting we had made extensive collections and dissections of all the molluscs in the areas visited, so as to become acquainted with the various larval trematodes with which these are naturally infected. Attempts were made to infect mice and rats with the cercarial forms found. The infected dog now gave us a large amount of material with which to carry out a further biological test on the various molluscs. As the special species of mollusc which acts as the proper intermediary for a trematode has a definite chemiotaxis for the newly hatched trematode embryo we endeavoured to establish such a chemiotaxis for the embryo of *Schistosoma japonicum*.

While these experiments were proceeding I took occasion to visit Katayama, an agricultural district in Japan, which has given its name to Schistosome disease on account of the intensity of infection in that area. I collected the various molluscs from the rice fields and took them back to Shanghai. There were various species of Vivipara, and innumerable samples of a small, exceedingly common, conical form, to the naked eye apparently identical with that already implicated by Miyairi, in Kiu Shu, as the intermediary, and said to be a species of *Lymnæus*. As it had, however, an operculum and more than seven spirals, this small form has been submitted to Mr. Robson, the expert on mollusca at the British Museum, who has sent me a detailed description, and informs me that it belongs to a new genus and new species in the family Hydrobiidæ, for which we propose the name *Katayama nosophora*.

Living specimens of this small form were examined in Shanghai and revealed the following points:—

(*a*) They presented a marked attraction for the miracidia of *Schistosoma japonicum*.

(*b*) The liver frequently contained cercariæ which presented a morphological character of such significance as to establish at once a presumption that they belonged to the peculiar genus Schistosoma, viz., the absence of a pharynx. Although searched for, this character was lacking in all the cercariæ hitherto found by us. In other respects the cercaria resembled a small group of known forms provided with a bifid tail, but with a pharynx. The cercaria was provided with very minute spines and, except for the absence of pharynx, presented all the characters usual in a trematode cercaria. The bifid tail enabled it to progress in a very unusual and striking manner. On a solid surface the oral and ventral suckers were used for progression in "louping" fashion, but, when the cercaria desired to swim freely, it proceeded backwards, the two prongs and stem of the tail vibrating so as to draw along the body behind. In fact, the progress was like

that of an aeroplane with the propeller in front, whereas, in other cercaria with the ordinary simple tail the movement is like that of a ship with the propeller behind.

There is no stylet or chitinous armature in the mouth, but there is a large hollow oral sucker and large secreting glands. The ventral sucker is small but exceedingly muscular, the lumen being a triradiate slit.

(*c*) These cercariæ were contained in very long and slender filamentous sacs which sometimes showed a small non-muscular knob at one end: these sacs certainly are sporocysts in which the cercariæ develop directly without intervention of Rediæ. According to Kumagawa the form described by Miyairi is said to have two generations of Rediæ.

(*d*) Cercariæ of this type were removed from the livers of a number of the infected molluscs into water and allowed to become free-swimming. Young mice, bred in the laboratory at Shanghai and reared upon dry rice and water, were then partly immersed. No fluid was allowed to reach the mouth.

At this stage, convinced (1) by the biological test and (2) by the morphological peculiarity of the cercaria that the mice would probably show infection, I then decided to turn homewards.

Owing to exceedingly rough and inclement weather, some of the mice died within the first few days of our departure. They had to be left in charge of an Indian butcher on the ship, as a lady passenger in a neighbouring cabin early objected to my "pied piper" companions. After a lapse of three weeks, I was able by dissection, under rather difficult circumstances on board ship, to obtain Schistosome worms. Within a few days after my return to England the dissection of the last surviving mouse was made in the laboratories of the London School of Tropical Medicine in the presence of Dr. Sandwith and Dr. Hänschell. Living Schistosome, male and female, worms were then demonstrated in numbers in the mesenteric vessels.

These experiments, carried out with the greatest precautions to avoid fallacy, convince me that the Looss hypothesis (which for so long has dominated scientific opinion, and which supposes that infection takes place by direct contamination with newly hatched embryos without the intervention of an invertebrate host) is entirely erroneous, and that prophylactic measures based thereon would be wholely inefficient. The life cycle of the *Schistosoma japonicum* conforms in essential respects with that of other trematodes. It remains now to be demonstrated that *Schistosoma hæmatobium*, the cause of bilharzia disease, follows a similar course.

Since my return, the War Office has asked the School Committee for my services and is affording me an opportunity of studying the mode of spread of bilharzia disease in Egypt, especially with a view to advising measures for the prevention of the spread of this disease among troops engaged in military operations in the Nile delta.

This cursory report of the joint work of Surgeon Atkinson and myself has been prepared hurriedly within a few days of my leaving again for the tropics. Many details of the work have still to be related. I have also to defer to a later date acknowledgment of the various kindnesses and assistance afforded to members of the expedition during their stay in China and Japan.

I have, &c.,

ROBERT THOMSON LEIPER.

APPENDIX V.

Reports from the Liverpool School of Tropical Medicine for the year ended 31st October, 1914.

No. 1.

LIVERPOOL SCHOOL OF TROPICAL MEDICINE to COLONIAL OFFICE.

(Received 1st May, 1914.)

SIR, B10, Exchange Buildings, Liverpool, 30th April, 1914.

I HAVE the honour to enclose, for the information of the Tropical Diseases Advisory Committee, the following reports of the Liverpool School of Tropical Medicine for the six months ending 30th April, on the work done in connexion with the Government grant, *viz.*:—

(1) Report of the Professor of Tropical Medicine. (Professor J. W. W. Stephens.)
(2) Report of the Professor of Medical Entomology. (Professor Robert Newstead.)
(3) Report of the Lecturer in Parasitology. (Dr. H. B. Fantham.)
(4) Report of the Director of the Runcorn Research Laboratories of the School. (Dr. B. Blacklock.)

I also enclose statement showing expenditure of the Government grant for the year ending 31st December, 1913.

I am, &c.,
A. H. MILNE,
Secretary.

Enclosure 1 in No. 1.

SIR, B10, Exchange Buildings, Liverpool, 30th April, 1914.

I BEG to submit the following report on the work done during the period from 1st November, 1913, to the 30th April, 1914.

Students.

The number of medical men who attended the Autumn Term was 19, and the number for the Lent Term, 16; total, 35. This number includes members of the Royal Army Medical Corps, Indian Medical Service, West African Medical Staff, Colonial Medical Service, etc.

Diploma of Tropical Medicine.

The number of candidates for the examination in December was 13, of whom 12 passed. The number of candidates for the April examination was 13, of whom 12 passed.

Museum.

The thanks of the School are due to the following gentlemen for their kindness in sending specimens to the School during the last six months:—

Major J. Davidson, I.M.S., Dehra Dun, India; Dr. C. B. Hunter, Accra; Major W. H. Kenrick, I.M.S., India; Dr. Ricona, Cape Province, South Africa; Major Myles, R.A.M.C., Chester; Dr. W. T. Prout, Liverpool; Dr. Christopherson, Khartoum; Captain W. S. Patton, Madras; Mr. Pillers, Liverpool; Dr. S. Bell, Hong Kong; Dr. D. E. Anderson, Trinidad; Sir Ronald Ross, K.C.B., London; Professor N. Leon, Jasi; Professor E. E. Glynn, Liverpool; Dr. J. Hope Reford, Uganda; Dr. R. W. R. James, Brisbane; Dr. J. Borle, Pretoria; Dr. J. S. Pearson, Sierra Leone; Dr. Keating, Cairo; Dr. M. K. Bhupal, Madras.

Publications.

The following is a summary of the papers contributed during the year by the staff of the School. They are referred to in detail in the various reports appended:

Stephens, J. W. W. Studies in Blackwater Fever. Annals Trop. Med. & Parasitol. Vol. VII. No. 4. December, 1913.
" A New Malaria Parasite of Man. Annals Trop. Med. & Parasitol. Vol. VIII. No. 1. April, 1914.
Newstead, R. Notes on Scale Insects (Coccidæ). Part II. Bull. Ent. Res. Vol. IV., pp. 301-311. February, 1914.

APPENDIX V.

REPORTS FROM THE LIVERPOOL SCHOOL OF TROPICAL MEDICINE FOR THE YEAR ENDED 31ST OCTOBER, 1914.

Yorke, W., & Barratt, J. O. W. The Production of General Symptoms in Hæmoglobinæmia. British Medical Journal. 31st January, 1914.

„ & Blacklock, B. The Differentiation of the more important Mammalian Trypanosomes. Annals Trop. Med. & Parasitol. Vol. VIII. No. 1. April, 1914.

„ & Blacklock, B. Observations on a so-called Cure for Trypanosomiasis. Annals Trop. Med. & Parasitol. Vol. VIII. No. 1. April, 1914.

„ & Blacklock, B. Antimony Trioxide in the Treatment of Experimental Trypanosomiasis. Annals Trop. Med. & Parasitol. Vol. VIII. No. 1. April, 1914.

Blacklock, B., & Yorke, W. The Probable Identity of *Trypanosoma congolense* (Broden) and *T. nanum* (Laveran). Annals Trop. Med & Parasitol. Vol. VII. No. 4. December, 1913.

„ & Yorke, W. *Trypanosoma vivax* in Rabbits. Annals of Trop. Med. & Parasitol. Vol. VII. No. 4. December, 1913.

Fantham, H. B., & Porter, Annie. *Herpetomonas stratiomyiæ*, n. sp. a Flagellate Parasite of the Flies *Stratiomyia chameleon* and *S. potamida*, with Remarks on the Biology of the Hosts. Annals Trop. Med. and Parasitol. Vol. VII. No. 4. December, 1913.

„ & Porter, Annie. The Pathogenicity of *Nosema apis* to Insects other than Hive Bees. Annals Trop. Med. & Parasitol. Vol. VII. No. 4.

„ & Thomson, J. G. The Culture of *Babesia* (Piroplasma) *canis* in vitro. Annals Trop. Med. and Parasitol. Vol. VII. No. 4.

„ & Thomson, J. G. The Successful Cultivation of *Babesia* (Piroplasma) *canis* in Vitro, following the Method of Bass. Transactions of the Society of Tropical Medicine and Hygiene. Vol. VII. No. 3, with 1 plate. January, 1914.

Thomson, J. G., & Thomson, David. The Growth and Sporulation of the Benign and Malignant Tertian Malarial Parasites in the Culture Tube and in the Human Host. Annals Trop. Med. & Parasitol. Vol. VII. No. 4. December, 1913.

Carter, H. F. On Certain Mosquitoes of the Genera *Banksinella*, Theob. and *Taeniorhynchus Arribalzaga*, Annals Trop. Med. & Parasitol. Vol. VII., No. 4. December, 1913.

Seidelin, Harald. On "Vomiting Sickness" in Jamaica. Annals Trop. Med. & Parasitol. Vol. VII. No. 3. November, 1913.

I have, &c.,

The Secretary
Incorporated Liverpool School
of Tropical Medicine.

J. W. W. STEPHENS,
Professor of Tropical Medicine.

Enclosure 2 in No. 1.

B10, Exchange Buildings, Liverpool, 30th April, 1914.

Department of Medical and General Economic Entomology.

SIR,

I HAVE the honour to submit herewith a report for the half-year ending 30th April, 1914.

(1) The usual courses of instruction were given to the students attending this School for the Diploma in Tropical Medicine. The number of students attending the courses were:—

For the Autumn Term	19
For the Lent Term	16

(2) For the Special Course in Medical and Economic Entomology for Colonial Officers and others, there were present:—

For the Autumn Term	2
For the Lent Term	1

(3) A course of lectures and demonstrations has also been given to the undergraduates and post-graduates in the Veterinary Department of the University.

(4) One advanced student has devoted considerable time to the study of blood-sucking insects, especially of the families Culicidæ and Muscidæ.

Appendix V.

Reports from the Liverpool School of Tropical Medicine for the year ended 31st October, 1914.

Reports and Publications.

1. Notes on Scale Insects (Coccidæ), Part II. Bull. Ent Res. Vol. IV., pp. 301-311. February, 1914.

By Mr. H. F. Carter.

2. On certain Mosquitoes of the Genera *Banksinella, Theob.* and *Tæniorhynchus Arribalzaga*, Annals Trop. Med. & Parasitol. Vol. VII. No. 4, pp. 581-589. 1913.

Identifications of Blood-sucking Insects, Agricultural Pests, etc.

A considerable amount of time has been devoted to the identification of the insects and other arthropoda concerned in the dissemination of disease in man and in the domestic animals, and also numerous insect pests affecting agricultural crops in various parts of the world, including Asia Minor, Africa (over a wide geographical range), West Indies, Central and South America.

The principal institutions from which collections were received are as follows: Imperial Bureau of Entomology (Colonial Office), Musée Royal d'Histoire Naturelle, Belgique; Konigl. Zoologisches Museum, Berlin; Department of Agriculture, Cairo, Egypt; Department of Agriculture, Pretoria.

A tabulated statement of material received and identified is given below:—

	Species.	*Varieties.*	*Specimens.*
Mosquitoes (Culicidæ)	58	2	966
Sandflies (Phlebotomus, Simulium)	2	1	96
Horseflies (Tabanidæ)	33	1	224
Muscidæ (other than tsetses) ...	4	—	205
Tsetses (Glossina)	17	3	1,654
Scale insects (Coccidæ)	13	1	150
Aleurodidæ	1	—	—
General economic	14	—	—
Ixodoidea (ticks)	8	—	184
Total	150	8	3,479

Microscopical preparations only counted.

The total number of specimens examined cannot be given with any degree of accuracy, owing to their minute size.

I have, &c.,
Robert Newstead,
Professor of Entomology.

The Secretary.
Incorporated Liverpool School of Tropical Medicine.

Enclosure 3 in No. 1.

Sir, B10, Exchange Buildings, Liverpool, 30th April, 1914.

I beg to submit the following report on my work during the period from 1st November, 1913, to 30th April, 1914.

The report may be considered under the following headings:—

Teaching.

On my return from the Sudan at the end of September, I resumed teaching in Liverpool. Since then I have had the entire responsibility of two full courses in protozoology and helminthology to post-graduate students, the courses extending from October, 1913, to December, 1913, and from January, 1914, to April, 1914. Both lectures and practical work were included for students working for the Diploma in Tropical Medicine, and for the Diploma in Veterinary Hygiene.

I have also spent some time in aiding some of my former students in their research work by examining specimens they have submitted, and giving them summaries and references to literature on the subjects in question.

Appendix V.

Reports from the Liverpool School of Tropical Medicine for the year ended 31st October, 1914.

Research Work.

I have continued my researches on pathogenic spirochætes and amœbæ of man, and have also investigated the blood and intestinal parasites of various mammals, birds, and insects.

I have also continued my work on coccidiosis of poultry, both from the point of view of the life-cycle of the parasites concerned and of preventive and curative treatment. The researches are under the auspices of the Board of Agriculture.

Further details will be found in the publications listed below.

Editorial and Literary Work.

As Editorial Secretary I have been responsible for the publication of three numbers of the Annals of Tropical Medicine and Parasitology. Two of these numbers appeared in 1913, the third forming the first part of the eighth volume —in April, 1914. I have also reviewed much current literature as Sectional Editor for Protozoology of the Tropical Diseases Bulletin.

A book serving as a good introductory study of the parasitic Protozoa by Dr. Porter and myself was published by Messrs. Methuen & Co., at the end of March, 1914.

Publications:—

1. The Pathogenicity of *Nosema apis* to Insects other than Hive Bees. (With Dr. Porter). Annals Trop. Med. & Parasitol., VII., pp. 569—579.

2. *Herpetomonas stratiomyiæ*, n. sp., a Flagellate Parasite of the Flies *Stratiomyia chameleon* and *S. potamida*, with Remarks on the Biology of the Hosts. (With Dr. Porter). Annals Trop. Med. & Parasitol., VII., pp. 609—620. With one plate.

3. The Culture of *Babesia* (*Piroplasma*) *canis* in vitro. (With Dr. J. G. Thomson). Annals Trop. Med. & Parasitol., VII., pp. 621—632. With one plate.

4. The Successful Cultivation of *Babesia* (*Piroplasma*) *canis* in vitro, following the method of Bass.—Trans. Soc. Trop. Med. & Hyg., VII., pp. 119—125. With one plate.

5. Some Minute Animal Parasites, or Unseen Foes in the Animal World. xi. + 319 pp. With frontispiece and 56 text-figs. Crown 8vo. Methuen & Co., March, 1914.

I have, &c.,
H. B. Fantham,
Lecturer in Parasitology.

The Secretary,
Incorporated Liverpool School
of Tropical Medicine.

Enclosure 4 in No. 1.

Runcorn Research Laboratories,
30th April, 1914.

Sir,

I have the honour to present the following report on the work done at the Runcorn Research Laboratory for the period 1st November, 1913, to 30th April, 1914.

The grant has been used in the upkeep of the laboratory, purchase of apparatus and animals and the maintenance of the latter. The animals are required for the purpose of keeping up a large number of strains of pathogenic protozoa for teaching and research purposes.

In February of this year Dr. Yorke was appointed Professor of Parasitology in the University of Liverpool, and the position of Director here becoming vacant, the Committee of the School appointed me to fill the post.

Professor Yorke in his last report referred to the experimental work which we had been carrying on in testing the value of stibium trioxide in the treatment of trypanosomiasis. Our paper dealing with this work has now been published.

Appendix V.

Reports from the Liverpool School of Tropical Medicine for the year ended 31st October, 1914.

The British South Africa Company having requested Professor Yorke to examine the claims of a Mr. Sieg in regard to a serum which he stated was of value in the cure of trypanosomiasis, we made a series of experiments which proved conclusively that the samples of the serum supplied to us were of no value in the treatment of this disease, even in small laboratory animals.

Professor Yorke has continued his work in conjunction with Dr. J. O. W. Barratt on the subject of the production of general symptoms in hæmoglobinæmia, These experiments were devised with the object of explaining the occurrence of various obscure symptoms in blackwater fever and other allied conditions, and form a continuation of Barratt and Yorke's previous researches on blackwater fever. The results of these experiments are embodied in a paper published in the *British Medical Journal.*

For some time I have been engaged upon experiments in connection with *T. cruzi*, the South American trypanosome of man. This parasite is transmitted in South America by a reduvid bug. The object of the experiments which I have carried out was to ascertain whether the common bed-bug *Cimex lectularius* might act as a carrier of this disease. The result of the experiments showed that while the parasite *T. cruzi* could exist for a long period in the bug and remain infective on inoculation into animals, yet the feeding of infected bugs on healthy animals did not, except in one single case, produce infection. It would appear, therefore, that it is extremely improbable that the disease caused by *T. cruzi* could be established and spread through the agency of bed-bugs.

We have made a further study of the morphology and pathogenicity of a short form trypanosome from a horse naturally infected in the Gambia. Morphologically this parasite was identical with *T. congolense* on the one hand and *T. nanum* on the other. The point of interest is that whereas in the early inoculations it strongly resembled *T. nanum* in its pathogenicity, it later became virulent and closely resembled *T. congolense.* As a result of our work we are of opinion that *T. nanum* and *T. congolense* (*T. pecorum*) are one and the same parasite.

The following papers from the laboratory have been published since November, 1913:—

1. Yorke, Warrington, & Blacklock, B. Antimony Trioxide in the Treatment of Experimental Trypanosomiasis. Annals Trop. Med. & Parasitol. 1914. Vol. VIII. No. 1, p. 55.
2. Yorke, Warrington, & Blacklock, B. Observations on a so-called Cure for Trypanosomiasis. Annals Trop. Med. & Parasitol. 1914. Vol. VIII. No. 1, p. 51.
3. Barratt, J. O. W., & Yorke, Warrington. The Production of General Symptoms in Hæmoglobinæmia. British Medical Journal, 31st January, 1914.
4. Blacklock, B. On the Multiplication and Infectivity of *T. cruzi* in *Cimex lectularius.* British Medical Journal, 25th April, 1914.
5. Blacklock, B., & Yorke, Warrington. The Probable Identity of *T. congolense* (Broden) and (*T. nanum* (Laveran). Annals Trop. Med. & Parasitol. Vol. VII. No. 4. December, 1913.

I have, &c.,
B. Blacklock,
Director of Runcorn Research Laboratories.

APPENDIX V.

REPORTS FROM THE LIVERPOOL SCHOOL OF TROPICAL MEDICINE FOR THE YEAR ENDED 31ST OCTOBER, 1914.

Enclosure 5 in No. 1.

LIVERPOOL SCHOOL OF TROPICAL MEDICINE.

An Account showing the Disposal of the Government Grant for the Year ending 31st December, 1913.

To grant to special research work on trypanosomiasis, towards purchase of animals and upkeep of same, attendants' wages, instruments, chemicals, etc.	£250	0	0	By grant from the Tropical Diseases Research Fund ...	£1,200	0	0
„ Proportion of salaries of research workers on trypanosomiasis at the Runcorn Laboratories	250	0	0				
„ Research work on parasitology and helminthology ...	250	0	0				
„ Research work on entomology	250	0	0				
„ Research work on malaria	200	0	0				
	£1,200	0	0		£1,200	0	0

Examined and compared with the books and vouchers and found correct.

CHALMERS, WADE AND COMPANY,
Auditors to the Liverpool School of Tropical Medicine.

Liverpool, 29th April, 1914.

APPENDIX V.

REPORTS FROM THE LIVERPOOL SCHOOL OF TROPICAL MEDICINE FOR THE YEAR ENDED 31ST OCTOBER, 1914.

No. 2.

LIVERPOOL SCHOOL OF TROPICAL MEDICINE to COLONIAL OFFICE.

(Received 2nd November, 1914.)

SIR, B10, Exchange Buildings, Liverpool, 31st October, 1914.

I HAVE the honour to enclose, for the information of the Tropical Diseases Advisory Committee, the following reports of the Liverpool School of Tropical Medicine for the six months ending 31st October, showing the manner in which the Government grant to the School has been expended, viz:—

(1) Report of the Professor of Tropical Medicine of the School (Professor J. W. W. Stephens).
(2) Report of the Professor of Medical Entomology (Professor Robert Newstead).
(3) Report of the Professor of Parasitology (Professor Warrington Yorke).
(4) Report of the Director of the Runcorn Research Laboratories of the School (Dr. B. Blacklock).
(5) Report of the Lecturer in Parasitology (Dr. H. B. Fantham).

I am, &c.,
A. H. MILNE,
Secretary.

Enclosure 1 in No. 2.

SIR, 31st October, 1914.

I BEG to submit the following report on the work done during the period from 1st May to 31st October, 1914.

Students.—The number of students who attended the Advanced Course in June was two. The number of admissions for the Autumn Course is ten.

Museum.—The thanks of the school are due to the following gentlemen for their kindness in sending specimens to the School during the last six months:—

Dr. G. J. Pirie, Lokoja, West Africa; Dr. H. Wolferstan Thomas, Manaos, North Brazil; Mr. N. Pillers, Liverpool; Dr. C. Mackay, British Honduras; Dr. A. J. Chalmers, Khartoum; Dr. W. J. Bruce, Gold Coast, West Africa; Dr. J. W. Scott Macfie, Lagos, West Africa; Professor Emrys Roberts, Cardiff; Dr. H. Reford, East Africa; Dr. R. E. McConnell, Uganda, British East Africa; Major R. H. Kenrick, I.M.S., Pachmari, India; Dr. Corson, Gold Coast, West Africa; Dr. J. Hay, Royal Infirmary, Liverpool.

Blackwater Fever.—The first paper written by myself consists mainly of a statistical study of the relationship between malaria and blackwater. It contains, in addition, a summary survey of the geographical distribution of the disease. I have been able to make many additions to the list of localities usually mentioned in text books.

The second paper consists of statistical matter only. While some of the matter in the first paper has been omitted, it contains several additions which appeared to me to render it of more value than in its original form. I may briefly summarize here some of the results arrived at:—

(1) In 100 cases of blackwater examined on the day before the onset parasites will be found in 73 cases, in 100 cases examined on the day of onset in 47·5, and in 100 cases examined on the day after in 23 (based on an analysis of 350 cases recorded in the literature).

(2) The parasite rate in blackwater fever (irrespective of the day of the disease) is 42·9 per cent. (based on 1,003 cases).

(3) The parasite rate in malaria (routine hospital examinations) is 56·8 per cent. (based on 57,362 cases).

(4) Pigmented leucocytes afford evidence of malaria infection where parasites are absent, e.g., second day of blackwater, 7 cases examined, parasites positive 0, pigmented leucocytes positive 6; fourth to sixth day, 10 cases examined, parasites positive 1, pigmented leucocytes positive 4 (based on 10 cases only).

(5) Post-mortem examinations in blackwater. Evidence of malaria in 83·9 per cent., negative 16·1 per cent. (based on 31 cases).

(6) In Ancon Hospital, Panama, of 40,928 cases diagnosed as malaria, 102 developed blackwater in hospital. Of 42,000 cases diagnosed as typhoid, pneumonia, etc., four developed blackwater in hospital.

(7) It has been frequently stated that the malignant tertian parasite especially predisposes to blackwater, but this can only be established if each parasite is given an equal chance, so to speak, of affecting this predisposition. An analysis of the Panama (Ancon) data showed that if x cases of malignant tertian give rise to 100, then x cases of simple tertian will give rise only to 88 of blackwater. But, on the other hand, this conclusion was contradicted by the data from Madeira River, Brazil, an analysis of which showed that if x cases of malignant tertian give rise to 100, then x cases of simple tertian will give rise to 185 of blackwater. This discrepancy requires elucidation.

(8) Effect of length of residence in determining susceptibility to blackwater.—This is difficult to determine accurately, as very rarely is it possible to ascertain what the *number of residents* is who have lived one, two, three, etc., years in a colony, and until this is known the number of cases occurring among first year, second year, etc., residents tells one very little. It is obvious, for instance, if no persons have resided longer than five years, no cases will occur among those of six years' residence, as there are no such persons.

I was able to compile two sets of data bearing on this point, from which it appeared:—

(*a*) Among a population of 100, 4·32 cases will occur among first six months residents; 36 among first year residents, 52 among second year residents. The data for subsequent years were not available.

(*b*) 21·3 per cent. of cases occur in first year, 33·0 in second year, 24·9 in the third year, 9·7 in the fourth year (based on 1,050 cases). These figures are, however, based on the assumption that the population of first year, second year, etc., residents is approximately equal. This is probably so for the first two or three years, but is almost certainly not so for later periods.

(9) Seasonal incidence of blackwater.—The figures, though open to criticism, appear to show that there is a seasonal incidence for blackwater fever. But here, again, unless we are comparing equal populations in the various months, the figures are not strictly accurate.

(10) Relationship to malaria.—A laborious examination of the figures regarding malaria and blackwater in Panama, appears to show that not only is there a correlation between the seasonal and secular variations, but also that a coincidence exists between the *magnitude of the oscillations* of the two diseases.

(11) The paper concludes with a chart of the incidence of malaria and blackwater, for the years 1908-1913, among the three populations on the Isthmus, viz.: Americans, Europeans, and Negroes. This chart plainly shows that, as it is chiefly the Europeans who suffer from malaria, so also blackwater fever is almost entirely confined to them.

The third paper, which is now in the press, deals with a schedule for recording cases of blackwater fever. During an examination of the literature, I have experienced great difficulty in getting at the facts regarding particular points which I desired to investigate. From want of any systematic method in recording cases, it was often necessary to read one or more pages before it could be discovered whether a particular fact was recorded or not; and then it was often impossible to say whether absence of any record was equivalent to absence of a particular symptom. This lack of system often made me despair of ever getting at the truth. I have ventured, therefore, to draw up a schedule of symptoms, which I think may be of much value, in two ways, in recording cases. (1) It will save the recorder much unnecessary writing. (2) It will give a systematic statement, *positive* or *negative*, as to the salient symptoms, and at the same time will allow ample space for any additional matter that anyone may wish to add. A few hundred of these schedules carefully filled up would settle definitely the symptomatology and would clear up many other points.

APPENDIX V.

REPORTS FROM THE LIVERPOOL SCHOOL OF TROPICAL MEDICINE FOR THE YEAR ENDED 31ST OCTOBER, 1914.

Publications.—The following is a summary of the papers contributed during the year by the staff of the school. They are referred to in detail in the various reports appended:—

Stephens, J. W. W. Studies in Blackwater Fever, I. Statistical. Annals Tropical Medicine and Parasitology, Vol. VII., No. 2, December, 1913.

" Blackwater Fever. XVIIth International Congress of Medicine, London, 1914.

" Studies in Blackwater Fever, II. A Schedule for Recording Cases of Blackwater Fever. (In the press.) Annals of Tropical Medicine and Parasitology.

" & Roberts.—Banana débris simulating small tape worm segments. (In the press.)

Newstead, R.—Notes on Phlebotomus with Descriptions of New Species. Bulletin of Entomological Research, Vol. V., Part 2, pp. 179-192.

Yorke, W., & Blacklock, B.—The Differentiation of the More Important Mammalian Trypanosomes. Annals of Tropical Medicine and Parasitology, Vol. VIII., No. 1, April, 1914.

" & Blacklock, B.—The Identity of *T. rhodesiense* with the trypanosome of the same appearance found in game. British Medical Journal, 6th June, 1914.

" & Barratt, J. O. W.—The Relation of Bile Pigments to Hæmoglobin. (In the press.) Annals of Tropical Medicine and Parasitology, Vol. VIII., No. 3, pp. 497-524.

Fantham, H. B.—The Granule Phase of Spirochætes. Annals of Tropical Medicine and Parasitology, Vol. VIII., No. 3, pp. 575-587.

I have, &c.,
J. W. W. STEPHENS,
Professor of Tropical Medicine.

The Secretary,
Incorporated Liverpool School of Tropical Medicine,
B10, Exchange Buildings, Liverpool.

Enclosure 2 in No. 2.

31st October, 1914.

Department of Medical and General Economic Entomology.

SIR,

I HAVE the honour to submit herewith a report for the half-year ending 31st October, 1914.

Students.—(1) The usual courses of instruction were given to the students attending this school for the Diploma in Tropical Medicine. The numbers attending the courses were:—

For the Summer Term (short course)	2
For the Autumn Term (full course)	10

(2) For the special course in Medical and Economic Entomology for Colonial officers and others, there were present:—

Summer Term (June)	4

(3) A course of lectures and demonstrations has also been given to the undergraduates and post-graduates in the Veterinary Department of the University.

Publications.—Notes on Phlebotomus with Descriptions of New Species. Bulletin of Entomological Research, Vol. V., Part 2, pp. 179-192.

Identification of Blood-sucking Insects, Agricultural Pests, etc.—A considerable amount of time has been devoted to the identification of the insects and other arthropoda concerned in the dissemination of disease in man and

the domestic animals, and also numerous insect pests affecting agricultural crops in various parts of the world, including Asia Minor, Africa, over a wide geographical range, West Indies, Central and South America. The principal institutions from which collections were received are as follows: —Imperial Bureau of Entomology (Colonial Office); Musée du Congo Belge, Tervueren, Belgium; Institut Pasteur de Paris; Institut Pasteur d'Algier.

A tabulated statement of material received and identified is given below:—

	Species.	*Varieties.*	*Specimens.*
Mosquitoes (*Culicidæ*)	41	1	837
Sandflies (*Phlebotomus*, *Culicoides*) ...	6	1	100*
Horseflies (*Tabanidæ*)	45	—	267
Muscidæ (other than tsetses)	5	—	38
Tsetse flies (*Glossina*)	15	3	861
Forest flies (*Hippoboscidæ*)	4	—	13
Scale insects (*Coccidæ*)	20	—	200*
Aleurodidæ	1	—	—†
General economic	28	—	—
Ticks (*Ixodoidea*)	15	1	465
Total	180	6	2,781

Before concluding the report of this Department, we desire to tender our sincere thanks to the Imperial Bureau of Entomology, *per* the Director, Mr. Guy A. K. Marshall, for the valuable gift of an extensive collection of blood-sucking insects and ticks, numbering in all 162 species, 8 varieties, and 2,087 specimens.

I have, &c.,
ROBT. NEWSTEAD,
Professor of Entomology.

The Secretary,
Incorporated Liverpool School of Tropical Medicine,
B10, Exchange Buildings, Liverpool.

Enclosure 3 in No. 2.

SIR, 31st October, 1914.

I HAVE to submit the following report on the work done by me during the period from 1st May to 31st October, 1914.

Teaching.—During the month of June I delivered a course of lectures on protozoology, and since the middle of September I have been occupied in teaching the students for the Diploma of Tropical Medicine and those for the Diploma of Veterinary Medicine.

Research.—In the course of the last six months I have published three papers. The scope of two of these papers is described in the report of the Director of the Runcorn Research Laboratory. The third paper is a record of experiments done by Dr. J. O. W. Barratt and myself, with a view of elucidating the connexion between the bile pigments and hæmoglobin. This subject is one of considerable difficulty, and the experiments involved somewhat complicated operative technique. The general scheme of the experiments was as follows:—

A cannula was inserted into the gall bladder of a rabbit, and the ductus communis choledochus was subsequently ligatured. In this manner all the bile secreted by the animal could be collected and examined at regular intervals. In the later experiments the examinations were made at hourly intervals, day and night. The volume of bile passed was estimated, as was also the relative concentration of pigment. No attempt was made to determine the absolute quantity of pigment passed, but the relative concentration was ascertained by comparing the specimens passed one with

* Microscopical preparations only counted.

† The total number of specimens examined cannot be given with any degree of accuracy, owing to their minute size.

APPENDIX V.

REPORTS FROM THE LIVERPOOL SCHOOL OF TROPICAL MEDICINE FOR THE YEAR ENDED 31ST OCTOBER, 1914.

another, by means of a Zeiss comparison spectroscope. The first specimens passed were taken as unity and the concentration of pigment in subsequent specimens expressed as multiples or fractions of the first. Rabbit's bile gives no definite absorption bands but causes a very definite absorption at each end of the spectrum. In comparing different samples of bile, the solutions were diluted until the amount of absorption at each end of the spectrum was equal. A solution of hæmoglobin, prepared by laking the red blood cells of a normal rabbit in distilled water, and after adding sufficient sodium chloride to make the solution isotonic, centrifuging off the red cell stromata, was injected into the marginal vein of the ear of a rabbit, which had been previously operated on in the manner already described. The result of such an injection was the immediate increase both in the volume of bile secreted and also in the concentration of pigment. The increase in concentration and volume was maintained for a period of six to twelve hours.

This work showed clearly that intravenous injections of hæmoglobin are attended by an increased volume of the bile excreted and also by an increased concentration of bile pigment. We were unable, however, to determine whether this increase resulted from an actual conversion of the hæmoglobin introduced into bile pigment, or whether it was merely the result of a stimulation of the liver cells by the hæmoglobin solution. There appears to be no doubt that the increase in volume of the bile excreted depends, at least in part, upon the salt solution in which the hæmoglobin was dissolved, as intravenous introduction of physiological salt solution was followed by a considerable increase in the volume of bile passed; in this case, however, there was no increase in concentration of pigment. It is important to note that these experiments were not attended by the appearance of jaundice. It follows, therefore, that the introduction of large quantities of hæmoglobin into the blood plasma is not necessarily attended by an icteric condition, provided that the outflow of bile be not impeded. This point is of interest in view of the fact that icterus is an almost constant occurrence in blackwater fever.

The following is a list of papers published:—

Yorke, W., & Blacklock, B.—The Differentiation of the more important Mammalian Trypanosomes. Annals of Tropical Medicine and Parasitology, Vol. VIII., No. 1, April, 1914.

" & Blacklock, B.—The Identity of *T. rhodesiense* with the trypanosome of the same apearance found in game. British Medical Journal, 6th June, 1914.

" & Barratt, J. O. W.—The Relation of Bile Pigments to Hæmoglobin. (In the press.) Annals of Tropical Medicine and Parasitology, Vol. VIII., No. 3, pp. 497-524.

I have, &c.,
WARRINGTON YORKE,
Professor of Parasitology.

Enclosure 4 in No. 2.

SIR, Runcorn Research Laboratories, 31st October, 1914.

I HAVE the honour to submit the following report of work done at the Runcorn Research Laboratory for the period 1st May to 31st October, 1914.

The grant to the laboratory has been used for upkeep of the laboratory, and purchase and maintenance of the animals required for the purpose of keeping the various strains of pathogenic protozoa.

Several new strains of trypanosomes have been added during the past year, chiefly to serve as comparison strains for the purpose of making a classification of the pathogenic trypanosomes. A classification has been published by Professor Yorke and myself.

I have continued my work in connexion with attempts to transmit *Trypanosoma cruzi*, the human trypanosome from South America, by means of *Cimex*

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lectularius. In conjunction with Professor Yorke, I have carried out experiments with a view to elucidating some of the problems in connexion with the production of various symptoms in blackwater fever.

The publication of the results of these experiments will be held over at present, owing to the fact that Professor Yorke and I are setting out immediately on the expedition of the school to Sierra Leone.

The important question whether *T. rhodesiense*, the human trypanosome, and the trypanosome of the same appearance found in game in Africa are identical has of late received considerable attention, and has given rise to some controversy. The German authorities, Kleine, Eckard, and others, hold the view that they are not identical, whereas several British authorities, namely, Kinghorn and Yorke and, more recently, Sir David Bruce, consider them identical in all respects. A paper in which we deal fully with the contentions of Professor Kleine has been published.

The following papers have been published from the laboratory:—

1. Yorke, W., & Blacklock, B.—The Identity of *T. rhodesiense* with the trypanosome of the same appearance found in game. British Medical Journal, 6th June, 1914.
2. ,, & Blacklock, B.—The Differentiation of the more important Mammalian Trypanosomes. Annals of Tropical Medicine and Parasitology, Vol. VIII., No. 1, April, 1914.
3. ,, & Barratt, J. O. W.—The Relation of Bile Pigments to Hæmoglobin. (In the press.) Annals of Tropical Medicine and Parasitology, Vol. III., No. 3, pp. 497-524.

I have, &c.,
B. BLACKLOCK,
Director.

Enclosure 5 in No. 2.

SIR, 31st October, 1914.

I HAVE the honour to report as follows on my work from 1st May to 31st October, 1914.

Teaching.—During June, 1914, I lectured and demonstrated to the students on helminthology, and during the present term have lectured and demonstrated to the Diploma of Tropical Medicine students on certain protozoa.

Research.—I have continued investigations on bronchial spirochætosis, and have extended the scope of the work by comparing and contrasting the organisms with some of those found in the human mouth. The work is still in progress.

I am publishing, very shortly, with Dr. Porter, results of the experimental inoculation and the feeding of insect flagellates to vertebrates, wherein an experimental leishmaniasis, or, strictly, a herpetomoniasis, is produced in the latter.

Researches on microsporidia in bees and allied insects have been continued, as well as observations on avian coccidiosis. A paper on a nosema in humble bees is in the press.

I have still much material collected in Khartoum to examine.

Literary Work.—I have written the section on the protozoa for a book on "The Animal Parasites of Man," now in course of publication by Messrs. Bale & Danielsson.

I have continued the reviewing of current literature on the protozoa as Sectional Editor for Protozoology of the Tropical Diseases Bureau Bulletin, London.

Publications.—The Granule Phase of Spirochætes. Annals of Tropical Medicine and Parasitology, Vol. VIII., pp. 575-587.

I have, &c.,
H. B. FANTHAM,
Lecturer in Parasitology.

The Secretary,
Incorporated Liverpool School of Tropical Medicine,
B10, Exchange Buildings, Liverpool.

APPENDIX VI.

Report from the Wellcome Tropical Research Laboratories, Khartoum.

(Received 24th December, 1914.)

THIS report covers the work performed by the Bacteriological Section, and that part of the work of the Entomological Section which is concerned with subjects of interest in Tropical Medicine, of the Wellcome Tropical Research Laboratories, after the change in the Directors in 1913, when Dr. Andrew Balfour, C.M.G., resigned and was succeeded by Dr. Albert J. Chalmers.

The work of the Chemical Section is not mentioned in the present report as it was not concerned, in the period under consideration, with subjects of interest in connexion with the investigation of tropical diseases.

Dr. Fantham, lecturer in the Liverpool School of Tropical Medicine, worked in these laboratories for some time during 1913. He especially studied pathogenic protozoa, but his work, which includes a paper on the morphology of the organisms of bronchial spirochætosis, has not so far appeared in print.

The Laboratory has to gratefully acknowledge generous donations from various sources, and especially one of £E.500 from Mr. Henry S. Wellcome.

THE BACTERIOLOGICAL SECTION.

1. Dr. Chalmers and Captain O'Farrell, R.A.M.C., drew attention to the existence of bronchial spirochætosis in Khartoum, detailing experiments with monkeys, and recording two cases of, apparently, laboratory infection, giving at the same time a general account of the symptomatology as observed by them.

They also gave the differential diagnosis and a method of treatment by an injection of sodium cacodylate, sodium cinnamate, and sodium glycerophosphate, which has since been used in Khartoum, and appears to be useful.

2. Dr. Chalmers and Captain O'Farrell, R.A.M.C., gave a general account of the little recognized disease, "*Pyosis tropica*," together with a specific history of a case in the Sudan which was cured by vaccine therapy.

3. The Trichonocardiases, which are common in Khartoum, were investigated by the same observers, who named the coccus associated with *Trichonocardiasis rubra Micrococcus castellanii*, Chalmers and O'Farrell, 1913. They also gave a general account of the disease with its method of infection and the symptomatology.

4. An epidemic of the same complaint in the Welsh regiment stationed in Khartoum was investigated by Dr. Chalmers and Captain Stirling, R.A.M.C.

The outbreak was traced to a washerman and an improved method of treatment was described.

5. A contribution to the History of Tropical Medicine was made by Dr. Chalmers and Captain Archibald, R.A.M.C., in a paper dealing with two early 18th century treatises which they had in their possession. The principal points of interest were the evidence in favour of the endemicity of yellow fever on the West Coast of Africa at that time, and the account of epidemic gangrenous rectitis which is given in almost similar terms to that published to-day. Apparently dengue fever was observed by these old writers.

6. A curious eruption, appearing after vaccination in a number of Nuba and Nuer recruits, was dealt with in considerable detail by Dr. Chalmers and Captain Byam, R.A.M.C., who were of the opinion that it corresponded with the rash described by the late Dr. Crocker under the heading "vaccine lichen," and never so far reported by any other observer.

7. An extraordinary and apparently new human disease caused by spreading warts was described by Dr. Chalmers and Dr. Christopherson, the Director of the Khartoum and Omdurman Civil Hospitals. These warts, even when situate on the tongue, were associated with a cryptococcus, which was apparently new, and to which they gave the name *Cryptococcus myrmeciæ*, Chalmers and Christopherson, 1914, while the disease they named *Murmekiasmosis amphilaphes*, therein following Galen's nomenclature. They described the pathology, morbid anatomy, symptomatology, diagnosis, and treatment of the disease as well as its prophylaxis.

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Since then they have seen what they consider to be an early stage of the same complaint in another individual, and believe that, being taken in time, the disease will cease to spread.

8. Ringworm of the scalp, as seen in boys in Khartoum and Omdurman, has been inquired into by Dr. Chalmers and Mr. Marshall, Senior Bacteriological Laboratory Assistant.

They found it to be due to a new species of Trichophyton, which they named *Trichophyton currii*, Chalmers and Marshall, 1914.

They gave an account of the history of *Tinea capitis tropicalis* up to the date of publication, together with a differential diagnosis of the Khartoum form from those previously described in the tropics and in the temperate zone. They recommend tobacco-soap to be used in the treatment of the complaint.

9. The morphology of *T. currii* appeared to Chalmers and Marshall to throw so much light upon the classification of the genus *Trichophyton*, Malmsten, 1845, that they contributed a paper upon the subject giving reasons why the genus should be placed in Baranetzky's family *Gymnoascacæ* of De Bary's *Ascomycetes*, in which finding they support the earlier observations of Matruchot and Dassonville, who for quite different reasons arrived at the same conclusion in 1901.

They are continuing the study of *Tinea capitis tropicalis* as seen in the Sudan, and have already isolated, but have not yet reported, *Trichophyton discoides*, Sabouraud, 1909, in an Egyptian soldier.

10. The causal agent in the sleeping sickness of the Lado has been considered by Dr. Chalmers and Captain O'Farrell, R.A.M.C., who, from comparative morphological considerations, comparative immunity experiments, and comparative human blood serum experiments, are of the opinion that it is the same trypanosome as that found in Uganda and in the Congo.

They point out that, Dutton's original strain of *T. gambiense* having been lost, it is very difficult to be certain as to the nature of the trypanosome which is covered by that name, and are of the opinion that, pending further investigation into the strain causing sleeping sickness in the Gambia, it would be better to use the term *T. castellanii*, Kruse, 1903, for the trypanosome of the Lado. During the immunity experiments they met with granules comparable to those described in kala azar by Archibald.

The same workers are employed at an investigation of the causal organism of the sleeping sickness of the Western Bahr-el-Ghazal.

11. The question of the correctness of using the term Babesia or Piroplasma has been looked into by Dr. Chalmers and Captain Archibald, R.A.M.C., who find that the name *Babesia* being previously used by Trevisan for some micrococci, the correct term for the protozoal organisms is *Piroplasma*.

12. The confused subject of the classification and easy recognition of the species of fungi causing tropical diseases, and included in Fuckel's *Fungi Imperfecti*, has been revised by Dr. Chalmers and Captain Archibald, R.A.M.C., who have found it advantageous to make one new family in order to facilitate practical work.

This paper will appear in the new publication entitled "Year Book of Tropical Medicine and Hygiene," which should be published in 1915.

The references to the papers outlined above are as follows:—

1. Bronchial Spirochætosis (1913). Journal of Tropical Medicine and Hygiene, 1st November.
2. Pyosis Tropica (1913). Journal of Tropical Medicine and Hygiene, 15th December.
3. The Trichonocardiases (1913). Annals of Tropical Medicine and Parasitology, Vol. VII., No. 4, December, page 525.
4. Epidemic Trichonocardiasis (1913). *Ibid*, page 541.
5. Two Early 18th Century Treatises on Tropical Medicine (1914). Transactions of the Royal Society of Medicine, History of Medicine Section, February.
6. Vaccine Lichen in Natives (1914). Journal of Tropical Medicine and Hygiene, 15th May.
7. Murmekiasmosis Amphilaphes (1914). Journal of Tropical Medicine and Hygiene, 1st May.

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8. Tinea Capitis Tropicalis (1914). *Ibid,* 1st September.
9. Sleeping Sickness in the Lado (1914). *Ibid,* 15th September.
10. The Systemic Position of the Genus Trichophyton, Malmsten, 1845 (1914). *Ibid,* 1st October.
11. Babesia or Piroplasma (1914). *Ibid,* 1st November.

Nearly all these papers contain photographs and photomicrographs illustrating the subject matter.

The following is a brief account of the work performed by Captain Archibald, R.A.M.C., Pathologist to these laboratories, in addition to the papers indicated above.

13. *Aspergillosis in the Sudan Ostrich.* Journal of Comparative Pathology and Therapeutics, June, 1913. This paper records for the first time in the Sudan the presence of this disease in the lung of an ostrich from Western Kordofan.

From the information obtained the bird was the last of a brood that had died from this disease, thus illustrating the pathogenic properties shown by certain fungi which exist in nature as mere saprophytes. The paper describes the morbid anatomy and histology of the disease as shown in the specimen sent to these laboratories.

14. *An Interesting Case of Kala Azar.* Journal of the Royal Army Medical Corps, May, 1913. This paper gives an account of a peculiar case of kala azar, in which the writer failed to obtain the parasites of leishmania in the spleen and liver, even after repeated punctures of these organs. Clinically, the case resembled kala azar, and intraperitoneal inoculation of an emulsion of the spleen and liver produced the disease and the parasites of leishmania in a monkey.

The case was of interest owing to the presence of peculiar "coccal bodies" found in the liver and spleen smears. The writer was unable to determine the exact nature of these "coccal bodies," but is of the opinion that they are related in some way to leishmania.

It is of interest to note that since this paper has been published other observers in the West Coast of Africa have found these coccal bodies in cases of splenomegaly of uncertain origin. They have also been recorded in a case of Mediterranean kala azar, and Row has also observed them in leishmania infections met with in India.

The paper concludes by calling attention to the presence of a large lymphocytosis present in the peripheral blood of kala azar cases, and also to the development of an eosinophilia in cases that are recovering from this disease. This latter feature was present in the recovered case described in the paper.

15. *A Case of Acute Ankylostomiasis treated by a Vaccine.* Journal of Tropical Medicine and Hygiene, July, 1913.—This paper describes a case of acute ankylostomiasis, in which the patient showed grave anæmia, splenomegaly, and pyrexia. The usual helminth remedies were tried but without success. The fæces were plated out, and a vaccine prepared from the predominant organism isolated. Injections of the vaccine produced most beneficial results. The temperature soon fell to normal, the spleen and liver returned to their usual size, and the patient made a complete and rapid recovery, although ankylostome ova were still present in his stools. The paper calls attention to the fact that some cases of acute ankylostomiasis are in reality intestinal toxæmias, resultant on the absorptions of toxins from the intestinal flora, and that the ankylostoma *per se* is not always the sole agent accountable for the symptoms. In such cases the writer suggests a vaccine treatment combined with the usual helminth remedies.

16. *Intestinal Schistosomiasis in the Sudan.* British Medical Journal, 7th February, 1914.—In this paper the writer calls attention to a specific fever in the Sudan, acute or chronic in type, which is dependent on an infection with *Schistosoma mansoni.* The fever frequently resembles enteric and is often mistaken for that disease.

It is usually accompanied by splenic enlargement, a varying degree of anæmia and a polymorphonuclear leucocytosis. In the more chronic cases the liver becomes enlarged. Intestinal symptoms may or may not be present. The diagnosis is made by a careful examination of the fæces, which may have to be repeated several times before the ova of *Schistosoma mansoni* are found.

An eosinophilia in the peripheral blood is frequently absent, a negative sign, which may be rather misleading.

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The writer records two cases that were benefited by injections of autogenous coli vaccines, and considers that the signs and symptoms in many of these cases are dependent on an intestinal toxæmia caused by coli-like organisms. This view receives some support from the fact that in the serum tests of these cases a group reaction with *B. typhosus* is often obtained.

17. *Emetine Treatment of Dysentery in Young Children.*—This paper describes two cases of entamœbic dysentery in very young children.

The causal agent was *E. tetragena.* In the one case the entamœbæ possessed resistant properties to the action of the drug emetine, a point which has been observed in other cases of amœbic dysentery in the Sudan.

The main points in this paper are as follows:—

(*a*) In severe cases of entamœbic dysentery it is advisable to commence with an initial dose of $\frac{1}{6}$ grain emetine for a child of 2, and repeat this dose every twelve hours till a total of $\frac{1}{2}$ grain has been given.

(*b*) The total amount of emetine administered should be controlled by the evidence obtained by microscopical examination of the stools, a procedure which should also be carried out at intervals during convalescence.

(*c*) In order to avert relapses, the continued treatment by emetine after the patient's apparent recovery would be advisable.

(*d*) In entamœbic dysentery of the Sudan emetine may require to be given in larger doses than are usually employed in other countries.

18. *A Preliminary Report on some further Investigations on Kala Azar in the Sudan.* (Awaiting publication in the Royal Army Medical Corps Journal.)—This paper is too long to be quoted from, but the main points, briefly summarized, are as follows:—

(*a*) Kala azar infections were produced by intraperitoneal inoculations in the following animals:—grey monkey, pup, jerboa, and gerbil—while guinea-pigs, rabbits, cats, kittens, pigeons, and a cheetah failed to show infection.

(*b*) Experiments carried out with cultures of *Leishmania donovani* tend to show that the flagellates are possessed of no mean vitality, and when exposed to unfavourable conditions short of immediate death revert to a cystic stage.

(*c*) Human blood serum has an almost immediate destructive effect on cultures of *Leishmania donovani.*

(*d*) Specific agglutinins are not present in the serum of patients suffering from kala azar.

(*e*) Kala azar may occur as a concomitant infection with filariasis.

(*f*) Intraperitoneal inoculations with cultures produced infection in the grey monkey and the jerboa, but failed to produce infection in white mice, a pup, a wild cat, a guinea-pig, and a domestic cat.

(*g*) A susceptible animal fed with the fæces of a case of kala azar failed to contract infection.

(*h*) Infection was established on two different occasions by feeding grey monkeys with infected material containing kala azar parasites.

(*i*) Cultures introduced into the vagina of a healthy female monkey failed to produce the disease.

(*j*) Vaccinations with cultures failed to produce infection in a grey monkey.

(*k*) Epidemiological and experimental evidence does not support the theory that kala azar in the Sudan is transmitted by a biting insect. A more probable source of infection appears to be some intermediate host, whose habitat is in water.

(*l*) No natural host has been found among the numerous animals examined in the Sudan.

Captain O'Farrell, R.A.M.C., Protozoologist to these laboratories, submits the following report of work in addition to that detailed above:—

19. *Preliminary Note on a New Flagellate, Crithidia hyalommæ, Sp. Nov., found in the tick Hyalomma ægyptium* (*Linnæus,* 1758). Journal of Tropical Medicine and Hygiene, 15th August, 1913.—The article briefly described and named

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a species of crithidia new to science. The discovery illustrated another case of hyper-parasitism, a subject which has received considerable attention during recent years.

The host of the crithidia was the common cattle tick (*Hyalomma ægyptium* (Linnæus, 1785)) of the Anglo-Egyptian Sudan, which is also a fairly widespread cattle parasite in tropical Africa.

An interesting point about this parasite, which has been named *Crithidia hyalommæ*, is that it is believed to be the highest form of protozoal parasite which has as yet been discovered in the class Arachnoidea.

20. *Hereditary Infection, with Special Reference to its Occurrence in Hyalomma ægyptium infected with Crithidia hyalommæ.* Annals of Tropical Medicine and Parasitology, Vol. VII., No. 4, December, 1913.—This publication, with illustrations, was concerned with further researches on the life history of *Crithidia hyalommæ*.

A description was given in the text, and illustrations were inserted showing the different changes the parasite underwent during a process of hereditary transmission, beginning with the infection of the immature tick ovum, and continued in the mature egg after its separation from the parent.

Although hereditary infection has been described before in flagellate protozoa, its occurrence has been doubted by some, but this paper provides a new example, and supports the work of those other authors who have demonstrated such an infection.

MR. MARSHALL'S WORK.

21. Mr. Marshall, Senior Bacteriological Laboratory Assistant, has experimented with the application to pathological amœbæ of the Oxford method of staining fungal spores.

He finds that the resultant preparation resembles those produced by the iron-hæmatoxylin method, the advantage of the Oxford stain being that it is simpler and more easily applied.

His investigations have been published in "The Laboratory Journal," for September, 1914, under the heading "A Simple Method of Staining the Amœbæ Parasitic in Man."

ENTOMOLOGICAL SECTION.

During the last eighteen months the following papers of medical interest have been published by this section of the laboratories, which is in the charge of Mr. Harold H. King, F.E.S., F.L.S.:—

22. H. H. King. *Observations on the Breeding Places of Sand Flies (Phlebotomus spp.) in the Anglo-Egyptian Sudan.* Journal of Tropical Medicine and Hygiene, 1st January, 1914.—Attention is drawn to the fact that in other countries the immature forms of *Phlebotomus* spp. have with but one exception been found living in association with either stones, bricks, tiles, or cement. Reference is made to the finding, by the writer, of a single larva in soil in a cotton field at Tokar, and the rearing from the larval stage of a number of adult *P. papatasii* in soil, in jars in the laboratory, is recorded. The writer considers that the immature forms of this species are not as susceptible to extremes of moisture and drought as had hitherto been supposed, and believes that, while in all probability many sand flies in the Anglo-Egyptian Sudan, as in other countries, breed in crevices in walls and similar situations, an equally favourite, if not the more normal, breeding place, is the soil.

23. A. J. Chalmers and H. H. King. *The Distribution of Glossina longipennis (Corti,* 1895). Journal of Tropical Medicine and Hygiene, 15th October, 1913.

The writers record the capture of specimens of *G. longipennis* in two localities near the south-eastern boundary of the Anglo-Egyptian Sudan and give the entire distribution, as at present known, of this species, illustrated with a map.

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24. H. H. King. *Further Notes on the Bionomics of Tabanus ditæniatus, Macquart, and Tabanus tæniola, Palisot de Beauvois.* (Awaiting publication in the Bulletin of Entomological Research.)—The writer refers to a previous paper in which he recorded the rearing of the mature larva from the egg of *T. tæniola* and the adult from the immature larva of *T. ditæniatus*, and described the various immature forms obtained of these two species. In the present paper the puparium of *T. tæniola* and the egg mass of *T. ditæniatus* are described and figured. Mention is made of a hymenopterous parasite, probably a *Telenomus* sp. having been bred from egg masses of the latter species.

ALBERT J. CHALMERS,
Director, Wellcome Tropical
Research Laboratories.

Khartoum,
2nd December, 1914.

APPENDIX VII.

Observations on the Life-History of Dermatobia Hominis (Linnæus Jun., 1781), by Dr. Louis W. Sambon.

In the course of a recent journey to South America and to the West Indies, for the purpose of investigating pellagra, I had the opportunity of examining several cases of cutaneous myiasis, both in man and animals, and of acquiring some interesting information concerning the bionomics of *Dermatobia hominis*, a warble-fly, the larva of which is a common parasite of man in certain regions of Inter-tropical America.

My observations were made in Cartagena (Colombia), in British Guiana, and in the island of Trinidad. Necessarily they were quite casual, but they aroused my interest so greatly that I feel anxious to urge a more thorough investigation of the natural history of Dermatobia and other Œstrids.

The life-histories of many animal parasites, as instanced by those, now well known, of the malaria germs (*Plasmodium malariæ, P. vivax, P. falciparum*), of the sheep liver fluke (*Fasciola hepatica*), of the passerine intestinal fluke (*Distoma macrostomum*), of *Agchylostoma duodenale* and of *Filaria bancrofti*, are so marvellous that recent manuals of parasitology and tropical medicine contain far greater wonders than our old books of legends and fairy tales. And I have no doubt that the natural history of *Dermatobia hominis*, when fully disclosed, will prove a far more extraordinary tale than any we have listened to so far at the knee of Modern Science.

History of Œstrids.

The injurious Œstrid larvæ must have been known to man from the earliest days of cattle-raising. They are mentioned on Babylonian tablets and Egyptian papyri, in Greek, Roman, and mediæval literature, but their true nature does not seem to have been clearly understood until the beginning of the eighteenth century, when a great Italian physician, Antonio Vallisneri, published his observations on the ox warble-fly (*Hypoderma bovis*), the sheep head-maggot (*Œstrus ovis*), and the horse bot-flies (*Gastrophilus intestinalis* and *G. hæmorrhoidalis*).

Aristotle mentions the occurrence of living worms (larvæ of species of Cephenomyia) in the pharyngeal cavities of deer, and appropriately compares these "worms" to the maggots that live in decaying meats. Eumelus of Thebes, Theomnestes, veterinarian to Theodoric the Great, the superstitious Pelagonius, Apsyrtus, a famous veterinarian of the first half of the fourth century after Christ, and Hierocles, the lawyer, mention the larvæ of *Gastrophilus hæmorrhoidalis* by the name of τερηδονες, and give directions for the removal of the same from the rectum, where they may be found in large numbers at the time of incipient pupation. They judiciously advise the destruction of the voided larvæ by means of hot ashes poured over them.

The very old popular belief, that bees and wasps are produced from the decomposing carcases of oxen and horses, probably arose from a confused knowledge of the metamorphoses of bot-flies, drone-flies, warble-flies, and flesh-flies. Some of the bot-flies do certainly present a striking superficial resemblance to various kinds of bees, and the term "bee" was at one time also applied to bot-flies and other dipterous insects. Thus "gad-bee" was a name frequently used to indicate the "gad-fly."

Homer, Virgil, Oppian, and other Greek and Roman poets have graphically described the wild terror of oxen tormented by the "Œstrus," and entomologists have often quoted these vivid word-pictures, applying them to the ox warble-fly. But the "Œstrus" of the ancients was a Tabanid, not an Œstrid. Aristotle tells us quite clearly that the insect he calls οιστρος is provided with strong piercing mouth parts, that it is a blood-sucker, and that it develops from a free-living larva inhabiting marshy places. Ælian also describes the "Œstrus" as one of the largest flies, provided with powerful piercing trophi and producing a harassing buzzing noise. Whilst in the Roman Compagna in 1900, I had many opportunities of watching the behaviour of cattle and horses tormented by the stabs and terrified by the loud perturbing buzz of gad-flies (Tabanus) and breeze-flies (Hæmatopota), and I have seen them, as described by the ancient authors, suddenly gallop off in a frenzy. The

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horses, in order to protect themselves from the attacks of these cruel, maddening flies, used to form into close rings with their heads all meeting at the centre. Sometimes thirty, forty, or more horses might be seen thus clustered in the middle of a field, and there they would stand, throughout the hottest part of the day, constantly stamping their feet, tossing their manes, and lashing with their tails.

Not infrequently, in the course of time, the meaning of certain names has changed; therefore it is necessary to be careful and discriminating in the interpretation of old texts. Thus, in reading of "insects," "worms," or "serpents" in the writings of bygone centuries, we should put aside the present-day restricted and scientific meaning of these terms and adopt the older, wider, and more popular conceptions. The older and wider meaning of the term "worm" still lingers in the popular names of certain animals such as the "glow-worm," which is an insect, and the "blind-worm," which is a lizard. On the other hand, certain true worms such as the *Filariidæ*, were called "serpents," and the present-day scientific name *Dracunculus* given to one genus is but a survival of the old appellation.

Blundeville, who wrote on farriery during the reign of Queen Elizabeth, describes the horse bot-fly larvæ as "worms short and thick, like one end of a man's little finger" and calls them "truncheons," whilst he gives the name of "bots" to a "second sort of worms which have great heads and small long tails, like a needle" (probably the long-tailed Oxyuris=*Oxyuris mastigodes*). In mediæval England, a cow with its hide perforated by warbles or wormuls (corruption of worm-holes) was said to be elf-shot: the holes being made by the arrows of little malignant fairies, who were accused also of producing galls in plants. The remedy consisted in charms, and in Scot's "Discovery of Witchcraft," printed in 1651, we find a "Charm for the bots in a horse."

> "You must both say and do thus upon the diseased horse three days together, before the sun rising: *In nomine pa+tris & fi+lii & Spiritus+sancti, Exorcize te vermen per Deum pa+trem & fi+lium & Spiritum+sanctum*: that is, In the name of God the father, the sonne, and the Holy Ghost, I conjure thee, O worm, by God the Father, the sonne, and the Holy Ghost; that thou neither eate nor drink the flesh, blood, or bones of this horse; and that thou hereby maiest be made as patient as Job, and as good as S. John Baptist when he baptized Christ in Jordan, *In nomine pa+tris & fi+lii*, et *Spiritus+sancti*. And then say three *Pater nosters*, and three *Aves*, in the right eare of the horse, to the glory of the Holy Trinity. *Do+minus fili+us spirit+us Mari+a*."

Miss Ormerod (1886) tells us how, even at the present day, in Ireland charms are still used against the warbles:—

> "The 'charmer' is generally an old woman. When she enters the stable of the sick cow, she calls for some butter or lard. After it has been placed before her, she prays for a time to some spirit. After the spirit of destruction is exorcised she takes the butter and gently covers the breathing aperture of the maggot and crosses it. The result of all this is that the maggots die, and fall, or are easily picked out, without causing the least pain."

But in all times, by the side of ignorance and superstition, we find the true spirit of observation and research. Thus, in his "Theater of Insects," Thomas Mouffet, an English physician of the sixteenth century, mentions an observation which proves that the oviposition of the horse bot-fly (*Gastrophilus intestinalis*) had been noticed in his day. He says:—

> "This Kinde of Fly called a *Whame* and a *Burrel-fly* is almost like the Bee in shape and colour, only it is bigger in body. It doth not cleave to the flesh, nor suck bloud as others do, but only stings with its tail, flying a long way after horses and stinging them in their travel. Horses are naturally afraid of this Fly, whom upon the least touch, they endeavour by what means possible with their tails, feet and mouths, to drive away. Some are of a mind that these flies do not indeed use a sting, or prick, but with their tails they fasten their dung (?ova) to the horses' hair, from whence a while after come a number of very irksome Nits."

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Bionomics of best known Œstrids.

Hitherto our conception of the life-history of *Dermatobia hominis* has been based on scanty information and erroneous analogies. In order to reach the correct interpretation it is not only necessary to study all the available data, both old and recent, concerning this fly, but, in addition, we should have before us the most recent information concerning the bionomics of other better known Œstrids.

Pasturing horses are attacked, often simultaneously, by several species of Gastrophilus (*G. intestinalis*, *G. hæmorrhoidalis*, *G. nasalis*, *G. pecorum*), all of which go through a very similar life-history. The ovipositing bot-flies may be seen hovering and buzzing round their victims (horses, asses, mules) from about June to September, during the hottest hours of the day. The fly oviposits whilst on the wing, darting suddenly towards the skin with the body bent downwards and the ovipositor fully extended. The eggs are glued, one by one, to the hairs of those parts of the quadruped's body which are more easily and frequently licked. *Gastrophilus intestinalis*, as a rule, selects the forelegs and shoulders. *G. hæmorrhoidalis* and *G. nasalis* choose the hairs of the lips and nostrils. After some days the eggs are ready to hatch and burst open at the slightest touch of the horse's moist tongue. By means of the tongue the young larvæ reach the oral cavity. In the spring months we find them full grown; those of *G. intestinalis* hooked upon the walls of the stomach, so numerous at times that Gaspari compared the affected organ to a bursting pomegranate; those of *G. hæmorrhoidalis* and *G. nasalis* in the duodenum or the rectum, ready to leave their host with the excreta, drop to the ground and pupate. The pupal stage lasts from about thirty to forty days.

The sheep bot-fly (*Œstrus ovis*) is seen from June to September. It is viviparous and is believed to deposit its young larvæ at the entrance of the nasal passages of sheep and goats. The full-grown larvæ are found in the frontal and maxillary sinuses. They begin to give trouble in April, and drop out of the nostrils to pupate in May, June, or July. The pupal stage lasts from forty to fifty or more days.

Oxen, in several parts of the world, are attacked by two species of Hypoderma (*H. bovis* and *H. lineata*) which present a very similar life-history. Oviposition occurs from the middle of June to the middle of August. The fly approaches very swiftly and glues its eggs on the hairs of the fore-legs, flanks, belly or tail, but preferably near the heel, hence the popular name of "heel-fly," given in America to *Hypoderma lineata*, and the reason why, during the summer months, cattle will stand knee-deep in water the greater part of the day, or will rush off in a frenzied state, with outstretched neck and tail erect, to the nearest water at the approach of the dreaded fly. The eggs are laid singly (*Hypoderma bovis*) or from four to six (*Hypoderma lineata*) are fastened side by side to the same hair, all containing a well-developed larva ready to hatch as soon as laid. The fully grown larvæ are found in swellings which develop beneath the skin of the back and sides. These swellings, the so-called "warbles," begin to appear from January or February. They reach their maximum size in April, May, or June, when the larvæ begin to fall out. Few remain so late as July or August. The pupal stage lasts from twenty-six to thirty days.

Réaumur, in 1740, believed that the ox warble-fly (*Hypoderma bovis*) pierced the back and flanks of cattle by means of its ovipositor and thrust an egg within each wound, well beneath the hide, but Modeer, in 1786, and Bracy-Clark, in 1825, showed that the ovipositor is not adapted for boring and could only serve the purpose of fixing the eggs on to the hairs.

To an American veterinarian, Dr. Cooper Curtice, we owe the most striking and important advance ever made in our knowledge of the life-history of the Œstrids. He showed that the ova of *Hypoderma lineata*, like those of the horse bot-flies, are licked off the hair by the nit-covered oxen, that the young larvæ, on being swallowed, penetrate the œsophageal walls, shed their spinous cuticles, and, sooner or later, after wandering through the tissues, reach the skin from within and settle for further development in those parts where the warbles usually appear. These strange and hitherto unsuspected wanderings are proved by the fact that the larvæ are found embedded in the walls of the œsophagus, frequently in great

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numbers, from July to December, and that at the time of their immigration that organ shows marked inflammatory reaction. By the latter part of January or beginning of February all the larvæ have disappeared from the œsophagus, which has resumed its normal appearance. Then the larvæ begin to make their appearance beneath the skin of the back, many reaching their destination already by the end of December or the beginning of January. Meanwhile, during the period of their migration, they may be found in any part of the body.

Already, in 1888, Hinrichsen, a Dutch veterinary surgeon, had found the young larvæ of *Hypoderma bovis* lying between periosteum and dura mater in the spinal canal, but he failed to recognize the significance of his finding.

In 1898, Koorevaar published some very interesting observations and researches on the migrations of the Hypoderma larvæ within the body of cattle. Towards the end of June he found in the wall of the œsophagus minute hyaline larvæ, the smallest of which were scarcely two, the largest three to four millimetres long. During the succeeding months the larvæ were found throughout the whole extent of the œsophagus, from the pharynx to the cardiac orifice. They were embedded between the mucosa and the muscular layer. In July some of the larvæ in the cervical portions of the œsophagus were found to have made their way into the connective tissue surrounding it. By the middle of August some specimens, five millimetres long, were discovered in the subdural fat of the spinal canal. During the autumn months larvæ, varying in length from five to thirteen millimetres, were still found in the œsophagus. The majority, however, had already migrated into the spinal canal. From October to January one could often find as many as forty larvæ within the spinal canal of a single animal. In young cattle as many as fifty-seven larvæ were found distributed throughout the whole length of the vertebral canal, from the neck to the *cauda equina*. Frequently larvæ of the same size were found in the œsophagus and in the subdural fat. By the end of December, Koorevaar noticed a brownish, hæmorrhagic œdema in the subcutis, which indicated the arrival of the larvæ at the point of their final development. However, during the winter months it is by no means rare to find Hypoderma larvæ simultaneously in the œsophagus, the subdural fat, and the subcutis of the same animal.

On one occasion Koorevaar inserted eleven Hypoderma larvæ, from a calf, beneath the skin in the left lumbar region of a small dog. Eight days later fifteen more were introduced beneath the skin of the right side. A period of fourteen days was allowed to elapse, then the dog was killed and dissected. Of the twenty-six larvæ placed beneath the skin of this dog, five were found still in the subcutis, six lying free in the peritoneal cavity between the folds of the intestines, five in the fat round the spleen and kidneys, three on the psoas muscle, three in the wall of the œsophagus, two in the peri-tracheal tissue, and two in the subdural adipose tissue. Notwithstanding these extensive migrations, no traces of their passage could be detected in any part of the host, in spite of careful observations.

Œstrid Larvæ in Man.

In the "*Medicinale Anglicum*," or "The Leech Book of Bald," written in the former half of the tenth century, we find mentioned a "worm" which, judging from the brief description and from the remedies suggested, may probably have been the Hypoderma maggot. It is called the "ana-worm which grows in man," and is referred to as follows:—

> "If the worm eat through to the outside and make a hole, take a drop of honey, drop it in the hole, then have broken glass ready ground, shed it on the hole, then as soon as the worm tastes of this, he will die."
>
> "A salve against the ana-worm thus shall a man work it; take cinquefoil, that is five-leave grass, and rue: boil them in butter, sweeten with honey."

By the name of "bovine disease" the Arabian physicians of the eleventh and twelfth centuries mention a parasitic affection of man which may have been the "creeping disease" of modern authors. Albucasis (Book 2, chapter 92) describes it thus:—

> "This disease is called in some of our towns the bovine sickness from its being common to oxen. It is a small worm, bred between the skin and the

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flesh, which creeps about the whole body either moving upward or downward. It is perceptible during its migrations from part to part until it breaks out, wherever it is possible to pierce the skin, and comes out. It is bred from the putrefaction of certain humours, as is the case both with worms and with the eelworms (Ascarides) and gourd-worms (Cestoda) of the guts, and may give rise to dangerous consequences when, wandering about the body and ascending to the head, it reaches the eye; because it frequently makes an opening in it and escapes, injuring the eye, the which happens very often. In order to cure it and extract it, the attempt should be made during its wanderings, as soon as it is noticed. It is then necessary to bind the parts which are above and below it with a very strong ligature, then cut down to it and extract it. But if it has burrowed into the flesh and cannot be found, then one should cauterise the place until it is burnt. However, as already stated, the danger most to be feared from it is the corruption of the eye. Therefore, if you see it already in the head coming close to the eye, tie the eyebrow beneath it by means of a strong ligature, and making an incision down to it, draw it out. It is also necessary that the patient diligently assist and take care to cleanse his body with solvent medicines which purge the corrupt and bad humours, and let him avoid such foods as may generate putrefaction. This being the pleasure of God Almighty."

This description might also apply to infection by certain Filariidæ, such as *Dracunculus medinensis* and *Loa loa*, but Avenzoar dismisses dracontiasis, because, speaking of the treatment of the "bovine sickness," he says that the patient should be purged "with the same drugs that are administered for the *vena medinensis*." Moreover, the Arabian authors state that the bovine sickness worm "proceeds from the same kind of humour as Lice and Nits," and, like several modern physicians and entomologists, mistaking the posterior extremity with its dark stigmata for the anterior portion of the maggot, say that "its head is black."

In 1854, Dr. J. Matthews Duncan published a case of cutaneous myiasis in the human subject. He stated that he had extracted the larva of *Œstrus* (=*Hypoderma*) *bovis* from the skin of a girl, aged twelve, who had been employed in herding cattle. There was a small tumour, like a boil, with a small opening at the apex. On attentive examination he saw something moving in the interior, and, without difficulty, extracted the maggot; a little fluid containing blood and purulent matter escaping at the same time. On inquiry, Dr. Duncan found that it was the third which the girl had observed on her person. In the present instance the maggot was first perceived over the spine, at the dorsal vertebræ; it then progressed into the neck, disappeared, and was again felt on the right side of the neck, whence it was extracted. According to Dr. R. Walker, who described a case in 1870, this parasitic disease is of frequent occurrence in the Shetland Islands.

In 1879, Professor Berretta published a case of myiasis he had had the opportunity of observing in Catania, Sicily. The patient was a small boy, employed in herding cattle. The parasite was lodged beneath the skin of the nape of the neck. After extraction it was submitted to Professor Aradas, who found it to be the larva of *Hypoderma bovis*.

According to Schöyen (1891) cutaneous myiasis in man has been known to occur in certain districts of Norway for over a century. He says, "Many of these grubs I have seen and examined myself, and all of them were the larvæ of Hypoderma (*sine dubio Hypoderma bovis*). As a rule they had made long excursions beneath the skin, always in an upward direction, before appearing through an opening in a swelling on the upper part of the body (head, neck, shoulders, etc.). All lived in this way for months, and came out during the winter (February), but were always much too young to metamorphose. However, I have no doubt that they belong to *Hypoderma bovis*, because it is especially in persons employed in the herding of cattle during summer that these maggots are seen in the winter months. It is evidently the smell of cattle that attracts the warble-fly."

Dr. Riley (1891) also records the extensive wandering in a child of a grub which was referred to *Hypoderma diana* of deer, but later shown to be *Hypoderma lineata*. The case had occurred, in 1889, in Smethport, McKean County, Pa.,

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United States of America. Another American case was published by Dr. R. T. Miller in 1910. The extracted larva was identified by Dr. Ch. Wardell Stiles as "the larva of *Hypoderma lineata* in the second stage."

The larvæ of several species of bot-flies (*Gastrophilus hæmorrhoidalis, G. nasalis, and G. pecorum*) have been observed in man. In 1877, Schoch published the case of a woman suffering from chronic gastritis, in whose evacuations and vomited matters were found the larvæ of an Œstrid, but the species was not determined. In 1879, Portchinsky mentioned a case reported by Dibovsky from the neighbourhood of Irkoutsk, Siberia. The patient complained of gastric attacks, the cause of which could not be discovered. A lama (priest) recognized the condition, which, to his saying, was common in the locality. The administration of a native remedy brought about the expulsion of maggots, which, examined by Portchinsky, proved to be the larvæ of *Gastrophilus pecorum.*

Far more frequent are the cases of cutaneous myiasis due to the very young larvæ of various species of Gastrophilus (*G. hæmorrhoidalis, G. nasalis*). This form of myiasis has been observed in several parts of Russia, such as Perm, Viatka, Oufa, Saratov. The Russian peasants call it *volosse, or volossatnike,* which means hair, and the name is descriptive of the red hair-like tracing on the skin which marks the progress of the larva beneath it. The disease occurs in persons who are constantly in contact with horses, the newly-hatched larvæ passing, as a rule, from the sweaty coat of the horse to the hands of man, but, according to Sokolov, the female bot-fly may oviposit directly on to the human subject. Its eggs have been found firmly attached to the eyebrows, to the eyelashes, and to the downy hairs on the face of patients suffering from this form of myiasis. Similar cutaneous lesions, due to the migrations of the immature Gastrophilus larvæ, have been observed in the horse by French army veterinary surgeons, especially in the east of France, about Verdun, Châlons, and in the valley of the Meuse.

These observations suggest that the larvæ of Gastrophilus, like those of Hypoderma, may also spend an early quiescent period within certain organs and tissues, and then migrate, in due season, to their respective anatomical habitats, where we usually find them undergoing rapid development towards pupation. And this may be the case not only in warble-flies and bot-flies, but also in other genera of Œstrids, such as *Rhinostrus* and *Œstrus.*

Dermatobia hominis.

Professor R. Blanchard, in a remarkable series of studies on the parasitic Diptera, published between 1893 and 1896, proved that the Œstrid larvæ commonly affecting man in tropical America, and bearing different names in the various countries, belonged to one species, the *Cuterebra noxialis* Goudot, the differences in size and shape being merely the appearances of different developmental stages. He also pointed out that *Cuterebra noxialis* Goudot, 1845, was identical with *Dermatobia cyaniventris* Macquart, 1843.

The specific identity of the various larval forms had already been suspected by Professor P. S. de Magalhães, who, in 1892, wrote: "The simultaneous presence of the three principal forms of Dermatobia larvæ within so limited an area as the geographical zone, including the States of Rio de Janeiro, São Paulo, and Minas Geraes, would not be an argument unfavourable to the hypothesis of the possible specific unity of the three varieties."

Likewise, the identity of *Dermatobia noxialis* and *Dermatobia cyaniventris* had long been suspected by Professor Brauer, who, in his monograph on the Œstridæ, published in 1863, though admitting the two species, considers them hardly distinguishable, the distinction being based solely on certain characters of the hair clothing of the abdomen, which had not been indicated by Macquart in the description of his type specimen. Indeed, Goudot himself says: "This species (*C. noxialis*) is closely allied to the *Cuterebra cyaniventris* of Macquart, differing, however, on account of the abdomen being provided with small black hairs, and having whitish hairs at the base, otherwise the description given by that *savant* corresponds fairly well with the species under consideration."

Macquart's description is as follows:—

"*Cyaneus. Antennis flavis. Pedibus rufis. Long.* 5½ l ♀.. Face yellow. Front

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black, with greyish down and base testaceous. Antennæ yellow; third joint four times as long as the second; arista apparently feathered on the upper side alone. Thorax of a bluish-black, with slight grey down and close black hairs. Abdomen flattened, of a beautiful metallic blue, slightly violet. Legs of a light fawn colour. Squamæ and wings of brownish hue. From Brazil. Vienna Museum."

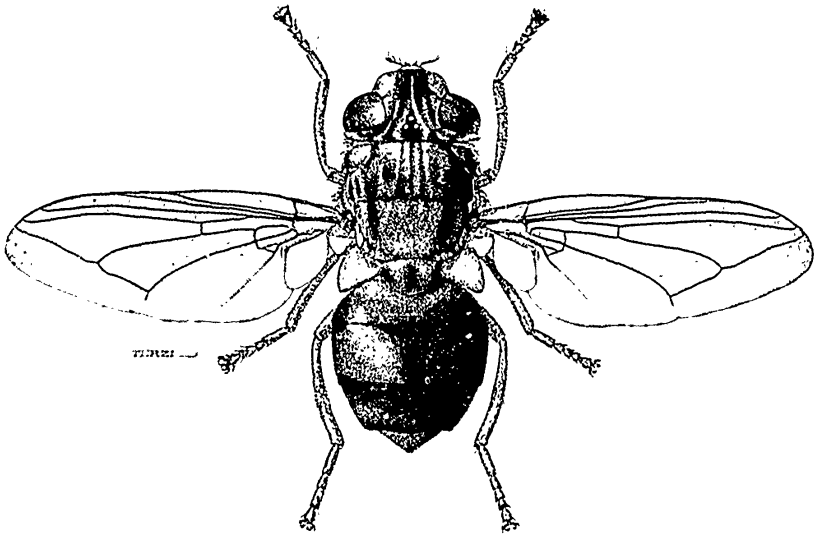

Fig. I.—*Dermatobia hominis* Linn. (×4).

Goudot gives the following description:—

"*C. abdomine cyaneo, basi pilis aloidis.* Length, 1 centimetre 7 millimetres (7 to 8 lines); antennæ yellow, the first joint provided at its extremity with a small tuft of short black hairs, the third joint at least as long as the other two together, arista somewhat brown, with hairs on the upper side only; eyes brown with a blackish band across the middle, front projecting, obtuse, brown, covered by blackish hairs; face and frontal depression fawn, covered by minute hairs forming a kind of down, and giving these parts a whitish silky appearance; thorax brown, shot with bluish hues, variegated with grey and black longitudinal patches, and covered with very short black hairs; scutellum the same as thorax; abdomen of a beautiful blue colour, with a shagreen appearance, and covered with very minute black hairs, first segment and anterior border of second of a dirty white, and covered with hairs of the same colour; legs fawn with fawn bristles; wings brownish. Male specimen. From Colombia."

The first binominal appellation used for this fly is that of *Œstrus hominis*, proposed, in 1781, by Linnæus, junior, who wrote: "I hope to receive from South America this summer the species of Œstrus which torments man in Peru, and of which nothing has been heard of as yet in Europe. The fly deposits on man's skin, one after another, its eggs, or, rather, its living larvæ, of which it carries about fifty on its hinder portion. The worm at once penetrates beneath and grows during half a year. If one tries to get it out by means of external ointments or by other means, it hides more deeply in the muscles, and gives rise to deadly and terrible pains. Abandoned to itself, as is the wise custom, it comes out of its own accord at the time of metamorphosis, and becomes a darkish fly, not much larger than the common house fly: *Œstrus hominis*."

Gmelin retained this name, and in Turton's edition of the "Systema Naturæ," translated from Gmelin, we read:—

"*Œstrus hominis.* Body entirely brown. Inhabits South America. Linné ap. Pall. nord Beytr., page 157. Deposits its eggs under the skin, on the bellies of the natives; the larva, if it be disturbed, penetrates deeper and produces an ulcer, which frequently becomes fatal."

In 1822, Thomas Say gave a short description of a Dermatobia larva received from South America; he showed that this neotropical parasite is not the larva of

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Œstrus bovis, as suggested by Bracy-Clarke, and proposed the retention of Linnæus's specific designation of *hominis*, and the adoption of the generic name *Cutebra* (*sic*) by placing it in Clarke's new genus *Cuterebra*.

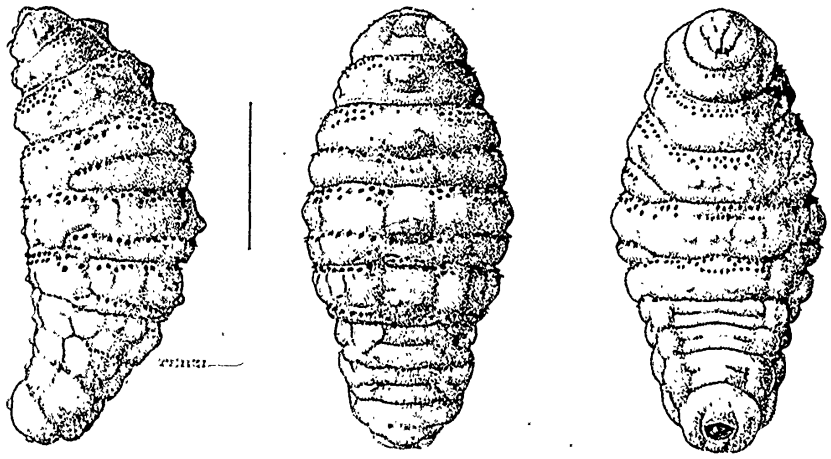

Fig. II.—Larva of *Dermatobia hominis* Linn. (×3)
(Specimen collected in Trinidad.)

In 1837, Hope, in a tabulated list of all known cases of insect larvæ found in the human body, gives the name of *Œstrus guildingii* to an Œstrid larva extracted from beneath the skin of the head of a man in the island of Trinidad, but he does not describe it, and only mentions that the specimen was in the collection of the Royal College of Surgeons, London, from where it has since disappeared.

In 1896, Dr. Serna proposed the name of *Dermatobia mexicana* for the Œstrid larvæ he had found in three patients who had contracted the myiasis in the State of Vera Cruz. According to Professor Blanchard, Serna's drawings of these larvæ do not sanction the establishment of a new species, which, he says, is entirely gratuitous.

Thus Professor Blanchard, having made a careful study of all the available data and many inquiries in various parts of Intertropical America, was led to the conclusion that between the tropical parallels there was probably only one species of Dermatobia attacking man. This conclusion was at variance with the opinion he had expressed in 1890, in his classic "Treatise of Medical Zoology," in which he said: "With the exception of Goudot, no one has ever reared any of these larvæ, therefore it would be impossible to assert that all the cases here ascribed to *Dermatobia noxialis* do really pertain to this species: on the contrary, it is more than likely that several species still unrecognized are capable of attacking man."

To this earlier impression I believe we may have to return. In fact, in the collection of Diptera belonging to the British Museum, by the side of Dermatobia specimens from Sta. Catherina, Brazil, corresponding to the descriptions of Macquart and Goudot, is another female Dermatobia, collected by Bates at Ega, on the Amazon, Brazil. This specimen is larger, its thorax is of a much lighter colour, the abdomen is more finely granulated, and, as pointed out in a manuscript note placed by the side of the specimen, by Mr. E. E. Austen, there is a slight difference in the wing venation, because, while in the other specimens the fourth vein is continued beyond the posterior transverse before turning up at an angle, in the Ega specimen the apical portion is in the same line with the posterior transverse vein.

However, in the absence of the necessary material and information, with Professor Blanchard, I am obliged for the present to consider all cases of Dermatobia

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myiasis throughout Intertropical America as belonging to a single widespread species, the synonymy of which is as follows:—

Nomenclature.

(*a*) *Scientific synonyms.*—

1781: *Œstrus hominis* Linn. jun. (not Gmelin, 1788).
1905: *Œstrus humanus* Humboldt and Boupland.
1822: *Cutebra* (misprint for *Cuterebra*) *hominis* (Linn. jun.) Say.
1837: *Œstrus guildingii* Hope.
1843: *Dermatobia cyaniventris* Macquart.
1845: *Cuterebra noxialis* Goudot.
1860: *Dermatobia noxialis* (Goudot) Brauer.
1896: *Dermatobia mexicana* Serna.
1903: *Dermatobia hominis* (Linn. jun. 1781, not Say 1822) Ward.
1906: *Dermatobia nonialis* (misprint for *noxialis*) Duprey.

(*b*) *Popular names.*—In most places within its distributional area the larva of *Dermatobia hominis* is simply called the "worm." Thus in Brazil, according to Da Silva Araujo, it is known by the Portuguese name of *verme* (worm) and, more frequently, *berne*, a mere corruption of the word *verme*, which is pronounced *berme* by the North Portuguese settlers.

Dr. Bleyer (1900) mentions the name "*bicheiros*" as applied to this maggot in the interior of Brazil, but no doubt erroneously, because the term *bicheiro* is used by the Brazilians to indicate the myiasis of wounds and natural cavities caused by the larva of *Chrysomyia macellaria*, called *bicho de mosca*, that is to say, fly-maggot, the word *bicho* meaning grub or insect.

In British Honduras the Dermatobia larva is called the "Beef-worm." In Colombia and Venezuela it is called either *Gusáno*,* a Spanish word meaning maggot or worm, *Gusano de monte*, which means "forest worm," *Gusano peludo*, the "hirsute worm," or *Gusano macaco*, which, like the French name of *ver macaque* in Cayenne, means the "macaw worm." This last appellation probably arose from the observed fact that *Dermatobia hominis* is a frequent parasite of the Sapajous, or Capuchin monkeys, which are called "macaw-headed" monkeys by the natives of the Amazon River basin.

In Costa Rica we find the name of *Torcel*, possibly from *torcer*, to twist, owing either to the peculiar movements of the parasite or to the twisted appearance given it by its spinulous annulation. A similar appellation has been given to the larva of *Chrysomyia macellaria*, long known in British medical literature by the name of "screw worm."

Dr. Costa (1876) states that it is called *Hura* in Brazil. In the Spanish language the term *Húra* means furuncle, but the Portuguese do not use it. It may be a native name.

Other local native names for this neotropical Œstrid are *Nuche*† (Goudot, 1845) in Colombia and Venezuela, *Colmoyote* (Morales, 1911) in Guatemala, *Cormollote* (Keyt, 1900) in British Honduras, *Mirunta* (Barraillier, 1892) in Pangoa, and *Suglacuru* (De La Condamine, 1745) amongst the Mayas.

The more common and interesting names, however, are those which indicate either the parent or the vector of the parasitic maggot. Thus, in Mexico, the appellations *Moyocuil* and *Gusano moyocuil* indicate that the "worm" is the larva of a fly, because the word *moyocuil* is taken from *moyotl*, a fly, and *ocuili*, a worm, in the Mexican language. In Colombia, Venezuela, and Guatemala the commonest name is *Gusano de Zancudo*, which means "mosquito worm," because the Spanish term *Zancudo*,‡ meaning "long-legged," is used to denote several species of Culex. Indeed, the name *Gusano de mosquito* (Logan, 1892) is also used in Colombia. In Dutch Guiana, the name is "mosquito worm," and in the island of Trinidad "mosquito

* Dr. Brick (quoted by Say, 1822) writes *Husano*, which is only a transliteration of the word *Gusano*.

† This term has been erroneously spelt as *Ouche* (Say 1882), *Muche* (Osborn 1896), *Nuche* (Gonzales Rincones 1912).

‡ *Sancudo*, used by some authors, is a transliteration of the word *Zancudo*.

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worm" is now the usual appellation, though Father Guby, in his time, reported it to be *Ver maringouin*, which has the same meaning, because, although the name *Maringouin* (from the Indian term *Maruin*) applies more especially to marine culicoides, and to other small biting flies of the sub-family Ceratopogoninæ, it is also erroneously used to indicate Simuliidæ and mosquitoes.

GEOGRAPHICAL DISTRIBUTION.

Dermatobia hominis is a neotropical Œstrid ranging throughout Intertropical America. Within this vast area the actual stations are usually located in the wooded tracts of the coastal lowlands and river valleys. Necessary ecological features of the habitat are: a warm temperature, a certain amount of surface water, and forest vegetation.

The presence of large herds of cattle is, of course, an important element in the location, prevalence, and spread of the Œstrid, but it is by no means essential. The Dermatobia attacks man and the domesticated dog in virgin forests far removed from cattle-grazing grounds, where, obviously, local wild animals must serve as hosts for the necessarily parasitic larval stage.

A more important distributional factor is no doubt the insect associate which appears to be frequently employed by the Œstrid for the conveyance of its progeny to a suitable vertebrate host. This nurse, or carrier, is as a rule a woodland breeding mosquito of the genus Janthinosoma. So far, the few specimens with Dermatobia eggs adherent which have been properly determined belong to the species *J. lutzi*, which occurs in damp woods and shady river sides, but probably other species with a similar distribution may also be concerned.

Imported cases of cutaneous myiasis due to *Dermatobia hominis* have been observed from time to time in New Orleans and other United States towns, but so far this Œstrid has not been reported as indigenous from any part of the Union. An inquiry opened on behalf of Professor R. Blanchard, in 1895, by Drs. L. O. Howard and Ch. Wardell Stiles, proved negative.

Ward (1903), in his paper on the "Development of *Dermatobia hominis*," says. "While the habitat approaches closely to the borders of the United States, it does not appear that any evidence has been offered for its presence within our country. Blanchard emphasizes his inability to secure any such, and an extensive correspondence on my part with societies and individuals in Texas and Louisiana has been equally negative."

Dermatobia is absent from the *Mixtlan* or "Cloud land" of the ancient Aztecs, the so-called Mexican plateau made up of irregular uplands bordered by the two converging sierras. Writing to Professor R. Blanchard from Morelia, in 1893, Dr. Eugène Dugès says: "During the twenty-eight years I have lived in Central Mexico, and notwithstanding fourteen years' residence on a large estate, I have never seen any kind of larva beneath the skin of either man or domesticated animal. It is probably limited to the warm lowlands." His brother, Dr. Alfred Dugès, failed to find it in Guanajuato, and states that it is equally unknown in Mexico City. It occurs, however, in the lowlands on either side of the plateau, where extensive savannas alternate with marshy plains and dark forests infested by clouds of mosquitoes. Here, to escape their insect tormentors, the long-horned oxen will plunge into the nearest quagmire, leaving muzzle alone exposed. On this alights an associate of the bovid—a pretty little bird which lives on mosquitoes.

The occurrence of *Dermatobia hominis* in the Mexican lowlands has long been known. Already, in 1653, Father Cobo reported it from the coast district of Alvarado, in the State of Vera Cruz. According to Altamirano it is found on the Atlantic coast plain in the States of Yucatan, Campeche, Chiapas, Vera Cruz, Hidalgo, and Tamaulipas. It is found also in the inland States of San Luis Potosi, Michoagon, and Oaxaca. On the Pacific coast it occurs as far north as Elota and Cosala in the southern portion of the State f Sinaloa. From the Isthmus of Tehuantepec Major Barnard had already reported it in 1852.

As in Mexico, so in Central America, Dermatobia is absent from the mountainous country, but abounds in the low-lying coastlands. Miss Ormerod (1886), Dr. Keyt (1900), and Dr. Gann (1902) report it from the Colony of British Honduras as very common in man, dog, and ox. The well-known naturalist, Dr. Le Conte

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(quoted by Leidy, 1859), met with it during the summer of 1857, in Spanish Honduras, where he and his travelling companions became the unwilling hosts of numerous specimens. Logan (1892) saw it along the banks of the Rio Tinto. Jousseaume and Mégnin in 1884, and Folkes in 1897, reported cases from Guatemala. Dr. Zepeda, while at the London School of Tropical Medicine, in 1913, informed me that it is quite common on the Atlantic coast of Nicaragua, and Dr. Von Frantzius (quoted by Grube, 1860) states that it is very prevalent in Costa Rica. "Such cases," he says, "are so common in Costa Rica that almost every native remembers having seen some. However, the fly is limited to the low, warm, and humid regions, especially in the neighbourhood of large cattle herds. Sometimes they are also found in the primeval forest at a great distance from any cattle."

With regard to Panama, Matas (1888) says: "The importation of cases to New Orleans is not rare since the Panama Canal and other enterprises have increased the traffic between this port and the Central American Republics. I have been informed, in fact, that on one occasion quite a number of returning labourers or immigrants were admitted suffering with these parasitic larvæ."

Coming to South America we find it very prevalent in the river valleys and coastlands of Colombia, where, according to Posada Arango (1871): "there is not one single wooded locality with an average temperature above 18°C., in which cattle are not cruelly tormented by this fly," and, again, elsewhere he says: "It is not in the open pastures, but in the wooded tracts that one meets the fly that produces these worms or larvæ."

Already, in 1569, Friar Pedro Simon reported it from the selvas and savannas along the banks of the Rio Magdalena, and from the low plains to the east of the Andes. More than three centuries later, Logan (1892) again reported it from the Magdalena near Mompos; and from the selvas of the Sinu basin. During nineteen years' experience in tropical forests, Logan estimates that he fostered at least one hundred Dermatobia larvæ in different parts of his body. At one time he had eighteen of the maggots squeezed out of his back. He had been for weeks hunting mahogany, and there were neither cattle nor people anywhere around. Cattle were likewise absent from the locality on the Sinu river. Goudot (1845) says:—

> "It is unknown in the pastures of the cold regions, whilst in the temperate and warm regions of the lowlands it is only found on the borders of the great forests and in the *rastrojos*, that is to say, in those places presenting together both woods and prairies. In such places they swarm exceedingly, especially when prolonged rains have prevented the burning of the prairies; therefore such localities are not considered very suitable for the rearing of cattle. However, when driven thither, one may see these animals spend a great part of the day in sandy and arid areas rather than seek the shade and pasturage of places where the enemy lurks in force. I have seen them at times galloping off frenziedly across the plains, probably on account of the sufferings inflicted by the aggregation of so great a number of cauters. It is especially in the afternoon that I have observed this fact."

Goudot found this Œstrid also in the valley of the Cauca, in rich grazing lands adjoining a salt pit, where horses and mules fattened rapidly, but where horned cattle were never pastured on account of the Dermatobia. In this place dogs were dreadfully riddled on all parts of the body, and men were also affected. Dr. Erasmus Baños tells me that it is very prevalent in the valley of the San Jorge. Forel (quoted by Blanchard, 1896) states that he contracted this form of myiasis in the forests on the northern slopes of the Sierra Nevada of Santa Marta, and Houship (1833) reported a case from Santa Ana in the Mariquita region.

Also, in Venezuela the Dermatobia is very common, especially in the low valleys of the coast and all along the forest-backed grazing belt. Dr. Brick's case (quoted by Say, 1822) was contracted on the Chama, a stream which empties itself in the lagoon of Maracaibo. Dr. Félix R. Páez informs me that it is especially prevalent in the cattle-rearing llanos of Guarico and Barcelona, but he has seen the maggot in patients who had contracted it in the virgin forests of Guayana, south of the Orinoco, where there are no cattle. He says that, according to cattle-breeders, the Dermatobia seems to have spread considerably, in recent years, from west to east.

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Together with Venezuela, it is necessary to consider the islands lying in proximity to its coast, because, though some of them are usually grouped with the Antilles, they are of different geological formation and separated by great oceanic depths Unfortunately, we have no reliable information concerning the presence or absence of Dermatobia on the majority of these islands. Some may at once be discarded either because they are only reefs, or because they do not offer those ecological conditions which are essential to the Œstrid. But others, such as Trinidad and Tobago, appear to be most suitable, and, indeed, the island of Trinidad has long been known as a Dermatobia centre. This island is obviously a mere fragment detached from the Venezuelan region by some comparatively recent disturbance. The geological formations in the island and on the mainland are everywhere the same, and numerous examples show that the Trinidad fauna belongs to continental South America and differs from that of the Antilles proper. Thus, for instance, of the large genus Thamnophilus of the ant-birds (Formicariidæ) at least three species occur in Trinidad, and one is found in Tobago, but no member of the family is found in the other Antilles.

In 1858, Dr. Shaw stated that according to Dr. Weinland, of Cambridge, U.S.A., the *ver macaque* is common in Guadeloupe, but this is a mistake, due, no doubt, to confusion with the myiasis caused by *Chrysomyia macellaria*. *Dermatobia hominis* is unknown in Jamaica, Antigua, Montserrat, Dominica, St. Lucia, St Vincent, Barbados, Grenada, and, I believe, from all the Leeward and Windward Islands, as well as from the Greater Antilles. The cases reported from Martinique, by Guyon in 1835, came from Trinidad.

In 1837, Hope described a larval specimen of Dermatobia from Trinidad, and proposed that it should be called *Œstrus guildingi*. This specimen is no longer at the Royal College of Surgeons, where it had been deposited, but there can be no doubt that it belonged to *Dermatobia hominis*, the only species at present known in the island. In 1895, Mr. E. E. Austen, dipterologist to the British Museum, had the opportunity of examining a specimen from Trinidad and referred it to this species. *Dermatobia hominis* is well-known in this island, where it attacks both man and animals. It is especially prevalent in the eastern and south-eastern districts. Already, in 1902, Dr. A. J. B. Duprey had drawn attention to its frequency in Mayaro, where there are still extensive tracts of primeval forest. I have seen cases in the north-western portion of Trinidad, and Dr. E. N. Darwent told me he had seen many in Chaguanas amongst convicts engaged in clearing forest land. De Verteuil mentions it in his book on "Trinidad" published in 1881.

In the Guianas both surface conditions and climate resemble those of Venezuela, and Dermatobia is equally prevalent. Hill (1830), Ormerod (1886), Daniels and Conjers reported it from British Guiana, Houship (1833) and Wyman (quoted by Shaw, 1858) from Surinam or Dutch Guiana. Houship's patient contracted the parasite on the banks of the Maroni or Marowyne. From Cayenne or French Guiana it has been reported by De La Condamine (1745), Arture (1757), Guyon (1835), Coquerel (1859), Laboulbène and Davaine (1860), Bonnet (1870), and others. The majority of the patients had been affected whilst working in the great lowland forests. Guyon's case, seen in the island of Martinique, had come from near the mouth of the Mana river.

In Brazil, *Dermatobia hominis* is widely spread and very common. According to Costa (1876) it is especially prevalent in the damp lowlands of the provinces of Bahia, Minas-Geraes, and Rio de Janeiro. Bates (1863) reports it from the Upper Amazon, and a specimen in the Madrid Museum was extracted from the thigh of Jimenez de la Espada, a Spanish zoologist, who explored the Amazon and the Rio Napo in 1862-65. Da Silva Araujo (quoted by Blanchard, 1893) reports it from the States of Goyaz and Espirito Santo and from the neighbourhood of Rio de Janeiro. Dr. Bleyer (1900) states that it is frequent in the interior of Brazil Dr Abreu (1854) observed it in the State of Minas Geraes, and especially in the district of the Rio das Velhas, where it occurs frequently both in man and cattle. Dr Magalhães (1896) reports it from Guaratingueta to the north of Sao Paulo, and numerous specimens, such as those of Torre and Sangalli (mentioned by Blanchard, 1893), have been extracted from time to time in Italy from Italian labourers returning from the State of Sao Paulo.

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For Bolivia we have no records, but the British Museum possess a Dermatobia larva from the valley of the Madre de Dios.

With regard to Paraguay, Argentina, Chili, and Ecuador, so far as I know, we have no information whatever. Therefore, the last country to be mentioned is Peru, where the Dermatobia is known to prevail extensively in the humid forest-covered lowland of the Amazon valley. Barraillier (1892) reports it from the basin of the Pangoa, a river which flows into the Ucayali, itself a tributary of the Maranon. Austen (1895) describes a specimen in the British Museum, which was taken from Mr. E. Bartlett's arm in Chamicuros. It is also found to the west of the great chain of the Cordilleras, whence C. Linnæus, junior, had reported it as early as 1781.

Zoological Distribution.

Besides man the vertebrates most frequently observed to be affected by the larvæ of *Dermatobia hominis* are oxen and dogs. Both these animals suffer severely within the fly stations. Goudot states that in certain parts of Colombia, during favourable years, the warbles may be counted by hundreds on the head, back, and flanks of cattle, and it is well known that the "Rio hides" are so greatly damaged by the Dermatobia that they are of little commercial value.

According to Goudot, Posada Arango, and Da Silva Araujo, horses are entirely exempt, but Arture mentions the horse as a host, and Roulin in his "*Récherches sur quelques changements observés dans les animaux domestiques, transportés de l'ancien dans le nouveau continent*," says that in Colombia, from time to time, the horses are collected to rid them of Œstrid larvæ. In Europe, the ox warble (*Hypoderma bovis*) is known to attack the horse, and Vallisneri pointed it out at the beginning of the eighteenth century. Mules are certainly not immune. Coquerel extracted a Dermatobia larva from the back of a mule in French Guiana, and Dr. J. Bleyer (1900) states that the maggot is well known in Guatemala to the "tropeiros" (leaders of mule caravans), who "for the relief of their animals use undiluted creolin, introducing the same by means of small feathers into the swelling containing the larva; after the expulsion of the parasite the cavity is closed with clay or fresh dung. The 'fazendeiros' (land owners) use the same method in the camp districts to free the cattle of the warble-fly larvæ." However, it is possible that there may have been confusion at times between *Dermatobia hominis* and *Chrysomyia macellaria*. Dr. Eduardo Bárcenas tells me that an immunity just as remarkable as that of the horse is observed in the white cattle of the district of Antioquia, in Colombia. These forest cattle have a white coat and black ears, like the British park cattle and the cattle which have run wild in the Falkland and Ladrone Islands. They are believed to have descended from the ancient aurochs, and were probably the first cattle introduced from Spain into South America. Their immunity is no doubt an acquired immunity. Even man may acquire a certain degree of immunity. Logan (1892) tells us "the naked Indians had not one-tenth as many larvæ as whites, who wore shirts."

Of other domesticated animals the hog, the goat, the sheep, and the cat are frequently attacked.

All these domesticated animals were first introduced into tropical America by Europeans at the beginning of the sixteenth century; therefore, notwithstanding the great importance acquired by some of them as hosts and reservoirs of the parasite, we must look to the indigenous wild fauna for the original and normal hosts.

The larva of *Dermatobia hominis* has already been found in various animals belonging to the fauna of the neotropical region. Thus, several authors point out that it is a somewhat common parasite of monkeys—Carriker found it in a large reddish Sapajou or Capuchin monkey (*Cebus sp.*), about one individual in thirty being infected. Bates reported it from the Brown Howler (*Mycetus ursinus*). Roulin found it in the Jaguar (*Felis onca*), Williston mentions the Puma (*Felis concolor*) and the Red brocket (*Cariacus rufus*), and Bonnet states that it occurs in the Agoutis (*Dasyprocta*). It affects also birds. Guyon says that the large larvæ are found in the warty skin that covers the head and neck of the turkey (*Meleagris sp.*). Carriker found it on the Doubtful Toucan (*Ramphastos tocard*) of Colombia, and on ant-birds (Formicariinæ). In Trinidad I was told that the "mosquito worm"

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is also found in the domestic fowl, but an infested chicken shown me at the Arima District Hospital proved to harbour the larvæ of *Mydæa pici* (Macquart), a dipterous parasite of the family *Anthomyiidæ* which occurs very frequently in the nestlings of South American birds. However, with regard to the maggots found by Carriker in the Toucan there can be no doubt, because they were examined by a most distinguished parasitologist, Dr. Henry B. Ward, who found them to be specimens of *Dermatobia hominis*.

Our knowledge of the zoological distribution of *Dermatobia hominis* is very imperfect, and the little we know is by no means recent, for already Arture, in 1757, had stated that its larval stage occurred somewhat frequently in monkeys, and was also found in horses, dogs, cats, birds, and man.

Season.

On account of the well-known seasonal differences between temperate and tropical regions, the life-cycle of the neotropical *Dermatobia hominis* is unlikely to be as markedly periodic as that of the Holarctic Œstrids. However, the necessity of some kind of periodicity is indicated by the fact that conveyance of the hatching larva to the necessary vertebrate host is brought about usually, if not invariably, by a mosquito intermediary, the presence of which is dependent on certain seasonal conditions. Folkes (1897) says that the natives of Guatemala claim the "gusano" to be most frequent during the rainy season, but that from his personal experience he believes it to be most numerous just subsequent to the rainfall, and Goudot (1845), who studied the bionomics of this Œstrid in Colombia, states that it is particularly prevalent after protracted rainy seasons. Dr. Páez tells me that, whilst in the llanos its prevalence is greater during and after the rains, in the selvas it is more or less the same all the year round This is exactly what we should expect in view of its peculiar mode of transmission, and is itself an element in support of the reality of the culicid association. Of course, the rainfall varies greatly in distribution, season, and amount throughout intertropical America, and no doubt the incidence of the disease will be found to vary from place to place in accordance with the respective local meteorological conditions. However, in a general way, we may state that the Dermatobia warbles have been noticed to occur in man and cattle chiefly from March to September, with a greater prevalence in the months of April, June, and July, and this period corresponds more or less with the rainy season of the fly areas in Mexico, Central America, Venezuela, Trinidad, Colombia, the Guianas, and Peru, whence the scanty records come.

Anatomical Distribution.

In cattle the Dermatobia warbles may be found on the head, the sides, the tail, and all along the backbone, but it is principally about the shoulders that they are most numerous. As Goudot points out, they seem to select the parts inaccessible to the animal's tongue, horns or tail. Also in other animals the back and the shoulders appear to be the parts preferred, but they may be found in any part of the body; thus in man they have been seen on the scalp (Posada Arango, Urich) and on the face. Grube extracted one from the tip of the nose. Keyt and Posada Arango have seen them several times in the eye socket, Magalhães in the eyelids, Logan on the upper lip. They occur in the neck region, on the chest, in the armpits, on the abdominal walls, on the buttocks, in the intergluteal furrow. The scrotum is a frequent site, and Dr. Bleyer saw one on the vulva. The extremities are very frequently attacked, especially the arm, the leg, and the thigh. Costa has seen them on the fingers, Da Silva Araujo (1893) saw one on the heel.

According to the majority of authors the warbles appear as a rule on those parts of the body which are usually uncovered. Bonnet suggests that the location of the warbles may be due to the larva's preference for those parts in which the skin is thickest and the cellular tissue more abundant. To explain the presence of larvæ in parts of the body usually clothed, infestation during sleep, bathing or defecation has been suggested. It is quite possible, however, that, as in the case of Hypoderma, some of the Dermatobia larvæ may be ingested, penetrate the walls of the *primæ viæ* and actively migrate to suitable locations. This would explain

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the appearance of warbles in such parts as the inner canthus of the eye (cases described by Gann, 1902, Keyt, 1900, Posada Arango, 1871), and the progression of the maggot beneath the skin noticed by Dr. Brick (quoted by Say, 1822) and by one of the patients I had the opportunity of examining in Trinidad. On the other hand, Da Silva Araujo (Blanchard, 1893) saw a dog with thirty-two Dermatobia warbles, all or the same side of the body, and Dr. Magalhães (Blanchard, 1896) mentions the case of an eight-months' old child, on whose head were eleven Bernes, all on the same side, suggesting development *in situ*.

Infestation.

For a long time entomologists and physicians, guided almost entirely by what was known of other Œstrids, assumed that the female *Dermatobia hominis* deposits its ova or very young larvæ directly upon the skin of man and animals. Some affirmed without hesitation that the fly "stings" during the act of oviposition. Arture (1757) wrote that apparently it places its eggs beneath the skin by means of some boring organ which enables it to pierce through the hide, and added that it attacked its victims only when it found them asleep. The piercing notion is, of course, erroneous, as the Dermatobia has no piercing apparatus, either at the oral or the anal end.

The great majority of reliable and observant patients state that they never saw or felt any fly and that they became aware of the parasite only after it had attained a certain development. Thus an entomologist, Mr. Forel, says: "I have had the pleasure of being punctured by an Œstrid without being aware of it." And another naturalist, Dr. Le Conte, asserts that neither he nor his travelling companions were aware of the time when the Dermatobia eggs were deposited in their bodies. During the whole of his stay in Honduras, Dr. Le Conte never had the opportunity of observing a single specimen of the perfect insect.

Bonnet (1870) says:—

> "The attacks of the insect occur unperceived. The majority of patients come from the great forests in which they work. Not one has ever been able to furnish any information as to the beginning of the affection nor state when he was attacked by a fly."

Guyon (1835), in describing a case, says:—

> "Such was the ignorance of this sailor that, when asked whether he had been pricked by some insect, he answered at once in the negative. On my insisting upon the question, he added, 'with the exception of mosquitoes and sand flies which every evening infested the village.'"

Goudot (1845), who made a special study of the bionomics of *Dermatobia hominis* in Colombia, says:—

> "Notwithstanding the most scrupulous attention, I have never been able to see or hear the insect as it came flying to me to deposit its ova on the uncovered parts of the body. And when I stated above that one sees cattle refrain at times from pasturing, I did not intend to convey the idea that they are molested by this dipterous insect more than by any other; on the contrary it is very probable that they are troubled far more by Culicids, Tabanids, and Muscids."

Toussaint (*vide* Blanchard, 1896), Curator of the Pathological Museum at the S. Andrea Hospital, Mexico City, having made a histological study of the Dermatobia warble, came to the conclusion that the fly must deposit its ova on the skin and hairs, and that, soon after hatching, the larvæ penetrate into the hair-follicles, which become greatly distended owing to the growth of the parasites. This conjecture is erroneous, as the strong fibrous capsules which enclose the larval Œstrids are not formed by distended and hypertrophied hair-follicles.

However, direct oviposition cannot be entirely excluded. Dr. Lutz, whose great competence and accuracy are well known, has assured me that not infrequently *Dermatobia hominis* is seen either hovering round horses and men or perched on cattle. At times he has observed it flying round cattle with ovipositor typically exserted and ready to oviposit.

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Dr. Brick (*vide* Say, 1822) states that in Venezuela some of the Spaniards and Creoles believe that the Dermatobia larva "crawls on the body from the ground, and penetrating the skin increases in size." Thus, according to Roubaud, acts the larva of *Cordylobia anthropophaga* (E. Blanchard), an African Muscid, which, in man and animals, produces furuncular swellings exactly like those of the American Œstrid.

Barraillier (1892) says that, according to the observations of a friend who had resided for some months in Pangoa, this myiasis is brought about through leaving the washing out on the line after sunset. "At that time numerous flies come forth and settle on the clothes put out to dry. On these they oviposit and then fly away, leaving behind the seed of certain worms which, hatched by the heat of the body, at once penetrate through the pores of the skin and then reach the part most suitable to their development."

A belief very widely spread throughout the distributional area of *Dermatobia hominis* is that the fly oviposts upon the leaves and stems of plants. Da Silva Araujo (quoted by Blanchard, 1893) says:—

> "I have frequently heard the peasants state that the fly of the *Berne* likes to oviposit on those plants which are at the edge of a path, and that both man and animals may contract the affection whilst sweeping by the plants, the leaves of which bear the eggs of the Œstrid. The narrowing of paths in the country would explain such a method of infestation."

Major Barnard (1852) says that, according to the natives of the Isthmus of Tehuantepec, "the *Moyoquil* is commonly found on the leaves of a species of wild plantain growing in the country." Dr. Surcouf (1913) also states that, according to information received from Dr. Gonzales Rincones, the fly oviposits on leaves in damp localities.

It is only quite recently that physicians and entomologists have begun to apprehend and to endeavour to ascertain the reality of the extraordinary procedure by means of which *Dermatobia hominis* insures the safe arrival of its progeny to suitable hosts, but the people living within the distributional areas of the fly have known it from time immemorial. They learnt it by the simple, rational, and unerring process of repeated observation and experience, which led the natives of south-east Africa to incriminate the tsetse fly as the transmitting agent of trypanosoma infection (nagana) in horses, the Texas farmers to discover that cattle babesiasis (Texas or red-water fever) is conveyed by ticks, and the inhabitants of malarious regions in many parts of the world to recognize the mosquito as the inoculator of ague.

The Jesuit, Father Bernabé Cobo, in his *Historia del Nuevo Mundo*, written in 1653, says:—

> "In some of the warm lowlands there is a species of mosquito which undoubtedly is the most noxious. It resembles the Zancudo (common mosquito), but its colour is somewhat reddish. In each wound produced by this mosquito soon grows within the flesh a spine-covered worm the size of a haricot bean, or even larger, which must be removed by means of a needle in the same way as the Niguas (*Sarcopsylla penetrans*)."

In 1745 De La Condamine, speaking of the "ver macaque," says:—

> "It is stated to take birth in the wound made by a kind of mosquito or sand-fly, but, so far, the animal which actually lays the egg is unknown."

In 1781, Linnæus, junior, although he does not mention the mosquito and even speaks of the Œstrid as ovipositing directly on man, yet describes the peculiar arrangement of the eggs in a bundle attached to the abdominal segments which is observed not on the fly which deposits the eggs, but on the Culicid carrier, and of which he must have been informed by local observers. He says:—

> "The fly deposits on man's skin one after another its eggs, or rather its living larvæ, *of which it carries about fifty on its hinder portion.* The worm at once penetrates beneath and grows during half a year."

In 1822, Say published a letter received from Dr. Brick, in which it is stated that:—

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"Whilst some Spaniards and Creoles believe the *Ouche* to be produced by a worm which crawls on the body from the ground, others maintain that they are produced from the sting of a winged insect which they call *Zancudo* (word used by the South American Spaniards to denote several species of Culex)."

In 1884, De Verteuil, in his book on Trinidad, speaking of injurious insects, says:—

"The Œstrus deposits its larvæ in the bodies of animals, and even of human beings. It is known here by the name of *Ver-maringouin* or *Mosquito-worm*, the people being under the impression that the larva is that of a large mosquito, but the fact is that no one here has ever seen the mother-insect."

In 1892, a naturalist, Mr. David Logan, who had spent nineteen years in the forest regions of Honduras and Colombia, also reports that the natives of those countries believe that the Dermatobia grubs are produced by a species of yellow mosquito.

These and many other similar statements in the vast literature of travel, together with some of the old and widespread popular names of the parasite, such as *Gusano de Zancudo*, *Gusano de Mosquito*, *ver maringouin*, and *mosquito worm* and the very general assertion that it is contracted at night during sleep prove that, from a remote time, the belief in the necessary association between *Dermatobia hominis* and a special kind of mosquito was widely prevalent throughout the range of this neotropical Œstrid. Yet, until quite recently, we find the popular notion either disbelieved or unheeded by the man of science, just as in the case of the relationship between ticks and cattle hæmoglobinuric fever prior to the epoch-making investigations of Smith and Kilborne.

In 1893, Da Silva Araujo, writing to Professor R. Blanchard, says:—

"It is a widely spread belief in our lands to ascribe the Berne to a mosquito. Already, in Colonial days, Dr. Alexandro Ferreira ascribed the Berne to the Carapaná mosquito, which is very common on the banks of the Amazon. Again, quite recently, I have had the opportunity of ascertaining how very common this error is amongst our peasantry. I inquired about the Berne and its imago stage from a forester inhabiting the State of Espirito Santo. Would you believe it, notwithstanding all my efforts to convince him that the perfect insect presents the features of a fly, he obstinately persisted in assuring me that I was wrong and that the Berne arises from a large mosquito? No wonder, therefore, that mosquitoes have been sent to you as progenitors of the Berne. It is a popular error, very widely spread throughout Brazil."

In 1897, Dr. H. M. Folkes, writing from Panyas, Guatemala, says:—

"The 'gusano sancudo' is a most interesting member of the insect species, not so much on its own account as on that of its work. The usual habitat is on dead trees and decayed vegetable matter in the woods. When found, it presents the body of a mosquito, having a longer head, with wavy greyish lines running down its back, legs longer than those of the ordinary mosquito, the two hind ones being quite stout. When preparing to do business, it settles upon the skin, inserts its bill, draws a little serum towards the surface, and then with a quick movement brings the tail to the point of insertion, puts it into the orifice, using the bill as a guide, and then rears upon its hind legs to insure a certain deposit of eggs. Immediately after the departure of the mosquito, gentle squeezing will produce a drop of serum from the infected point, and thus preclude the resulting worm."

In December, 1911, Dr. Rafael Morales, of Guatemala, published in the newspaper *El Nacional*, an article entitled "An observation on the manner in which the Colmoyote (*Dermatobia noxialis*) is transmitted to man—Transmission of the larvæ of the Colmoyote by means of the mosquito." In this article he states that, whilst studying the Culicidæ of Guatemala, on 2nd August, 1911, from a friend in Quirigua, he received a collection of mosquitoes of about a hundred specimens belonging chiefly to the genus Culex. Together with these, but in a separate box, was

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another specimen of the same genus with the following label: "Mosquito carrier of Colmoyotes (*Dermatobia noxialis, Cuterebra noxialis.*)" On examining this curious specimen he noticed eight elliptical eggs about 2mm. long, of a yellowish-white colour with anterior extremities blackish. They were attached by their posterior extremities to the mosquito's abdomen between its junction with the metathorax and the fourth segment. Two of them still contained a living larva, the others were empty. On the sixth day of observation, on placing the mosquito in the palm of the hand, one of the larvæ escaped from its shell. Dr. Morales' attendant, Macario Cruz, having offered himself for the rearing of the larva, the latter was placed on the anterior surface of his forearm. The larva wandered about over the whole of this region, as if it were searching for a suitable place in which to introduce itself. To favour its penetration the epidermis was slightly abraded and the larva at once began to burrow, pointed end foremost, and soon disappeared. Five days later the patient began to feel some itching and pricking. A swelling had already formed, presenting the appearance of a medium sized comedo with a small opening at the apex, from which, on pressure, oozed out a tiny drop of milk-white matter.

On the 18th, the swelling looked like a true furuncle, the hole at the top had become wider and through it one could distinguish a small appendix (the posterior extremity of the larva). The patient complained of severe itching, and at times, especially during the night, of sharp pains whenever the grub moved within the swelling.

"On the 25th," says Dr. Morales, "we took the patient to the house of Don J. J. Rodriguez, to whom we had already shown the Culex carrier. This eminent naturalist sent for Dr. R. Pacheco Luna, recently back from Paris, who encouraged us to continue our observation.

"In the first days of September we showed both the patient and the mosquito to Dr. Alberto Padilla, Professor of Parasitology at the Medical Faculty. He told us that he had never heard of anything so strange, and that he considered the observation should be continued in the most careful manner.

"On the 9th of September the swelling had assumed somewhat the appearance of a carbuncle, new holes having opened around the primitive one.

"In this condition the patient stated that the pain had increased, owing, he said, to the movements of the larva which became more numerous and more powerful. He now repeatedly asked for the extraction of the parasite.

"On the morning of the 15th the limb was greatly swollen and presented marked lymphangitis. Fearing the development of a phlegmonous cellulitis we proceeded as follows:—With a short scalpel we enlarged the opening through which appeared the caudal extremity, then by means of compression made with the thumbs from the base upwards the larva was extracted. It measured one centimetre in length, was pear-shaped, yellowish-white, and contractile. It had two strong hooks on the upper part of the rostrum and six rows of hooklets on the borders of the segments round the wider part of the body. These hooklets greatly resembled rose thorns, and their concavity was turned posteriorly, thus enabling the larva to advance through the deeper parts of the integuments but not regress. Hence the difficulty of extraction without enlarging the opening or previously killing the larva. (The latter method is the one employed by the natives, who for the purpose apply tobacco.)

"Four hours after extraction the larva was transplanted into the back of a rabbit, and here it continued its development perfectly well.

"On the 1st of October we noticed a change in the position of the larva. Instead of lying perpendicular to the skin it had placed itself parallel to it. The pear-like form could be made out by the touch; also one noticed that the part of the skin corresponding to the cephalic region was red. This enabled us to guess the formation of a new opening.

"In fact, on the morning of the 2nd the opening had been made, but the swelling had disappeared. The larva had escaped. Once nymphosis has begun the larva prepares itself an outlet in order to leave its host.

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"Thus, unfortunately, our observation came to an end. The study of the characters of the larva enable us to affirm categorically that it really belonged to *Dermatobia noxialis.*

"How explain that the Culex was the carrier of the eggs? Undoubtedly the Dermatobia seeks the Culex to deposit its eggs upon it, and the latter undertakes not only to distribute them but also to open for them an entrance through the skin by means of its puncture.

"This method of transmission explains why the peasants do not know the adult fly and also why they do not know how the larva can reach those parts which are usually covered during the daytime.

"According to the present observation the larval period would be of two months' duration (from 8th August to 2nd October). However, a doubt arises as to whether the transplantation into the rabbit might not have had some influence either in retarding or forcing the development. Further experiments will tell us."

Two months earlier, on the 1st of October, 1911, Dr. Nunez Tovar, of Maturin, Venezuela, had wired to Drs. Razetti and Guevara Rojas, of Caracas, the following message:—

> "Sending specimen mosquito I consider animate vehicle which deposits on skin, man, and animals, fly larvæ *Dermatobia cyaniventris.* Transports eggs exteriorly attached to abdomen where they transform themselves into larvæ to pass thence to the skin of man and of animals by intermediary mosquito. Please tell me whether this fact has antecedents in parasitology. Colleague and friend, M. Nunez Tovar."

Dr. Guevara Rojas, having received the specimen, replied on 11th December, 1911, that owing to its great interest he had decided to submit it to Professor Blanchard, and that in due time he would communicate the latter's remarks.

Meanwhile, Dr. Nunez Tovar sent other specimens to Dr. J. M. Romero Sierra, of Caracas, and in the covering letter, dated 24th October, 1911, pointed out that:—

> "The said mosquito has attached to the abdomen a bundle of whitish eggs perfectly visible under a slight magnification. These transform into larvæ which at once adhere to the gnat's body (by preference, about the insertion of the hind pair of legs) and here they remain in the hope that their transporting agent may soon come into contact with the skin of either man or animal, in order that they may penetrate into the subcutaneous cellular tissue, the which medium, as you know, is indispensable in bringing to a successful issue the second part of their developmental cycle."

On 13th May, 1912, in a short note published in the "*Archives de Parasitologie,*" Professor Blanchard stated that he had examined Dr. Nunez Tovar's specimen, but that, owing to bad preservation, he could only say that it was a female Culicid. On the ventral surface of the abdomen were a certain number of eggs agglutinated and arranged after the fashion of Tabanid eggs. The larvæ contained in these eggs certainly belonged to the Brachycerous Diptera, but he doubted whether they could be ascribed to an Œstrid. So little was known of the general characters of the larvæ of Diptera that, in the absence of experimental rearing through the various stages, it would be impossible to state to what family, still less to what genus, they might belong.

On 4th December, 1913, Dr. R. Gonzales Rincones published in the newspaper *El Universal,* of Caracas, an interesting article on the subject, entitled "The Aeroplane of the Macaw-worm." He stated that we owed to Dr. Nunez Tovar the discovery of the extraordinary method of transport by means of which the macaw-worm reaches its mammalian host. "The maggot travels by aeroplane!" and the aeroplane is a mosquito. Having received from Dr. Nunez a whole collection of mosquitoes with Dermatobia eggs attached, Dr. Gonzales Rincones was able to determine that the Culicid carrier is a Janthinosoma, and, further, that it is always a female Janthinosoma. So far, Dr. Nunez Tovar has never captured a single male engaged in this peculiar mode of transport. The eggs are found in clusters and are attached by their more pointed extremities to the ventral surface of the first two abdominal segments of the female gnat. In one cluster he counted as many as

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seventeen eggs. The larvæ escape through a slit which opens at the wider extremity of the egg-shell corresponding to the cephalic region of the larva. At times, the hatching larvæ may be seen protruding the anterior part of the body from the open shell ready to fix themselves on to the first suitable host upon which their mosquito carrier may happen to alight.

Dr. Gonzales Rincones states that Dr. Nunez Tovar experimentally reared the larvæ taken from the abdomen of their Janthinosoma carriers and obtained the characteristic furuncular swellings, from which, after eleven days, he recovered maggots identical with the well-known "macaw maggots," thus proving that the ova carried by the mosquito are really those of *Dermatobia hominis*.

In a note published in 1913, in the "Revue de Médecine et d'Hygiène Tropicales," Dr. Pedro Zepeda states that the natives of the Atlantic coast of Nicaragua speak of a mosquito which, by means of its puncture, inoculates beneath the skin "larvæ of various dimensions and shape." Towards the middle of 1911, while collecting mosquitoes, he found that two of the captured gnats presented small white protuberances scattered over the femora, prothorax, and antennæ. He asserts that two men on whom he had fed these mosquitoes developed the characteristic Dermatobia warbles in the course of a few hours! Indeed, describing his second case, he says the man "was stung on the right hand; two hours later the first symptoms appeared, characterized by itching; forty-eight hours afterwards the tumour was completely developed and there was some pain without febrile reaction; seven days later the larva dropped out." So rapid a period of development is not in accordance with our knowledge of Dermatobia infection, and suggests a possible confusion with the larvæ of some Muscid. An examination of the gnats, which belonged to the subfamily *Culicinæ*, showed that the white protuberances already observed were the larvæ and ova of *Dermatobia cyaniventris*, and Dr. Zepeda says he saw some of these larvæ "detach themselves from the body of the mosquito during the latter's movements while blood-sucking. As soon as they reached the skin, with admirable instinct they made straight for the wounded point. The anæsthetic and irritant action of the mosquito's saliva prevents one feeling the penetration of the larva, which enters the channel head foremost and disappears within the body."

In one of his subsequent experimental cases, Dr. Zepeda found a swelling presenting two openings. The parasite extracted from this tumour four days after inoculation differed so strikingly from those of the previous cases that he sent it to Philadelphia, where it was determined as a larval specimen of *Chrysomyia macellaria*. On account of this finding, Dr. Zepeda was led to believe that the larvæ of *Chrysomyia macellaria* might also be carried by mosquitoes, and further suggests that the larvæ of *Cordylobia anthropophaga* (Em. Blanchard), and Lund's maggot (*Cordylobia rodhaini*, Gedoelst) may be conveyed in a similar manner.

As early as 1905, Mr. F. W. Urich had discovered in the island of Trinidad two Janthinosoma mosquitoes with fly-eggs attached to their abdomens.

Mr. Frederick Knab (1913) says:—

> "These mosquitoes were sent to the Bureau of Entomology in Washington at the time, but no satisfactory explanation was offered, nor was their significance suspected. Unfortunately the specimens cannot now be found."

Having received from Dr. Gonzales Rincones some mosquitoes with Dermatobia eggs adherent, Dr. Jacques Surcouf (1913) was able to study the Œstrid larva in its earliest stage. He says:—

> "The greatly elongate eggs, clustered in a close bundle, are of a very pale yellow colour: close to the micropyle is a small unciform shutter (*volet*) which enables the larva to escape. The latter presents ventrally on the last two segments some short pale spines directed anteriorly; it is by means of these spines that the larva can hold itself protruding from the shell awaiting the favourable moment when it may leave the mosquito carrier and fix itself on to the new host.
>
> "In this first stage of development the larva, consisting of twelve segments, is provided with antennæ, each having two ocelli-form spots at their base. The mouth parts are formed by two chitinous plates, widened and many-branched on the lateral borders, attached to another plate, armed

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with two pairs of hooks of which the exterior ones are bifid, the inner ones simple and articulated with the pharynx. This organ, strongly chitinised and prolonged as far as the fourth segment, is not, in this stage of development, continued by any kind of differentiated digestive apparatus. The external tegument of the young larva is covered by numerous small spines on the first seven segments, the fifth, sixth and seventh segments present at the anterior border a crown of large black spines of rose-thorn shape. On the last segment open the two posterior stigmata, each one composed of two slits, so far there are no anterior stigmata. As soon as the larva has fixed itself it penetrates beneath the skin and there transforms itself. After this ecdysis the posterior spines, which held the larva within the egg-case, disappear, and the posterior stigmatic slits become three in number for each stigma.

"The further development of the Dermatobia larva is known. We wish to point out however, that, between the larvæ already belonging to the collections of the Paris Museum and those recently sent over from Venezuela, there are important differences in the spinulation. This leads us to believe that there may be several closely allied species hitherto confounded. Only complete rearing will elucidate the problem."

Having reviewed practically the whole of the literature concerning the manner in which man and animals become infested with the Dermatobia larvæ, and having taken due notice of the most recent knowledge concerning the bionomics of other Œstrids, we are in a position to form a more or less reasonable opinion on the matter.

In the first place, we should not forget that as a rule Dame Nature employs several ways, not one only, to attain important ends. In the case of *Hypoderma lineata*, for instance, we know that the young Œstrid larvæ are licked up by cattle from off the hairs round their hoofs. We know that they bore their way through the walls of the œsophagus and proceed along connective tissue roads to within the spinal canal, where they remain quiescent for a time, to migrate once again at the right season to a seat of predilection beneath the skin of the back, where they go through rapid development and finally leave the host for pupation. But, while many follow this route, others penetrate the skin at the very place where they were deposited, and then either migrate to other parts or develop *in situ*.

It is quite probable, as Dr. Lutz has pointed out, that *Dermatobia hominis* may, at times, oviposit directly on man or animals, and that the young larva may forthwith proceed to bore through the skin by means of its oral hooks, as is often the case with the larvæ of *Hypoderma bovis* and *Hypoderma lineata*.

With regard to the very general belief that the Dermatobia oviposits on foliage, I see no reason against it. Mr. F. Knab (1913), discussing it solely from the point of view of the rôle of the mosquito, says:—

"There are a number of strong reasons why the explanation of Drs. Surcouf and Gonzales Rincones cannot be accepted. First, the eggs are found attached to a part of the mosquito's body which does not come in contact with the leaf surface when she rests upon it, Janthinosoma rests with the body well elevated upon its long legs. Secondly, the eggs are attached in a definite way by their bases and with the hatching end outward. This would hardly be the case if the eggs were picked up accidentally by the mosquito. Thirdly, were the eggs laid upon the surface of leaves they would be much more likely to become attached to other insects, such as would not bring about their transfer to a suitable host. This last objection is strengthened by the fact that mosquitoes are not ambulatory insects, but, on the contrary, move about as little as possible when not on the wing."

This is quite right, in so far as it is an argument against the surmise put forward by Dr. Surcouf, who says:—

"Therefore, we believe, that the eggs, slightly glued on to the leaves, attach themselves to the Janthinosoma that may happen to walk over them; those which adhere to the abdomen remain attached to it, the thorax is protected by the episterna and elongate coxæ, and the eggs which stick to the legs and wings fall off during the walk or flight of the insect."

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I am surprised that Dr. Surcouf, who has so carefully observed and described the admirable way in which the eggs are clamped on to the mosquito's abdomen, should for a moment entertain the idea of their becoming glued in the loose and ready manner suggested. With regard to the leaves, if the eggs really do occur on foliage, they will, no doubt, be found to be just as firmly attached. Popular opinion is irrevocably fixed upon this point, as I have been able to ascertain myself, and I am quite prepared to believe that this mode of oviposition may very well occur, and that, on hatching, the young larvæ, like those of ticks, may be quite capable of clinging on to any suitable host sweeping through the herbage.

That flies should at times deposit their eggs on clothing is by no means impossible; neither, of course, can we deny the possibility of fallen larvæ reaching their hosts by crawling from the ground.

The most interesting, and to all appearances a very frequent, method of infestation is that brought about by the agency of the mosquito. Although known as early as the beginning of the seventeenth century, it was not until Dr. Rafael Morales published his article, in December, 1911, that any interest was taken in the old popular belief. Dr. Morales received a mosquito, labelled "carrier of Colmoyotes," from a gentleman of Quirigua, whose name should have been recorded. The eggs containing living larvæ were still adherent to the gnat's abdomen, and Dr. Morales, by rearing the larvæ, was able to prove that they were, as suspected, the young of *Dermatobia hominis*. Already, two months previously, Dr. Nunez Tovar had made similar observations, but, unfortunately, they were not published until December, 1913.

Owing to Dr. Roubaud's courtesy, I have been able to examine, at the Institut Pasteur in Paris, the mosquito with Dermatobia eggs adherent, described by Dr. Surcouf. Another specimen, presented by Dr. Gonzales Rincones, was kindly placed at my disposal by Dr. Andrew Balfour, Director of the Wellcome Bureau of Scientific Research. In both these specimens the Dermatobia ova are disposed, clustered and fastened in such a manner as to exclude any method of fixation other than direct oviposition by the fly on to the body of the mosquito. Dr. Morales (1911) had already suggested that the eggs are fastened to the mosquito by the fly herself.

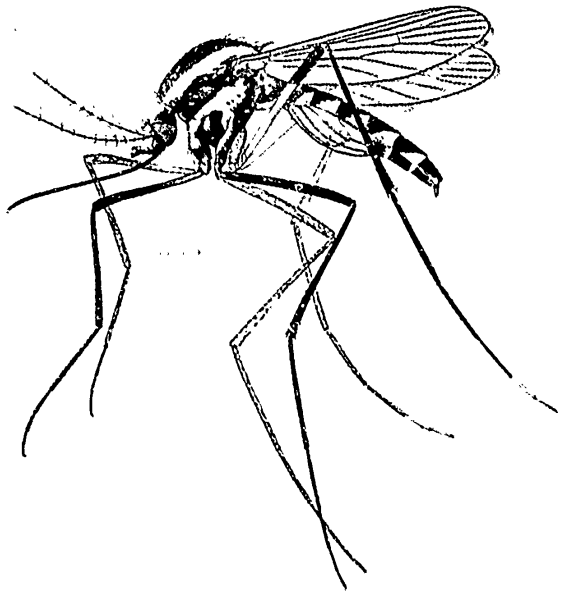

Fig. III. — *Janthinosoma lutzi* Theobald, with eggs of *Dermatobia hominis* attached to abdominal segments.
(Specimen in the collection of the Wellcome Bureau of Scientific Research.)

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Knab also, from the way the ova are cemented to the mosquito and to each other, considers that the "evidence points rather to a definite instinct on the part of the mother *Dermatobia* to seek out the mosquito as the vector for her progeny." Further, he adds: "On the other hand, the claim that the fly captures the mosquito and attaches the eggs to her, needs verification."

Dr. Lutz tells me that Dr. Aragao and he saw Dermatobias holding between their legs other Diptera. On three occasions Dr. Lutz saw on horses flies carrying clusters of white eggs on their backs. One of these was captured and proved to be a specimen of *Anthomyia heydenii*, Wied.; the eggs fastened to it correspond in a general way with those subsequently figured and described by Gonzales Rincones and Surcouf as Dermatobia eggs. Dr. Lutz does not look upon this method of oviposition as the normal one, but in so far as it does take place he thinks that the flies or mosquitoes must be surprised whilst perching on an animal for the purpose of sucking either blood or sweat. *Anthomyia heydenii* is frequently found imbibing sweat on horses.

Dr. Lutz's observations lead us to consider the various possible carriers of the Dermatobia ova. Dr. Gonzales Rincones found that the egg-bearing mosquitoes captured by Dr. Nunez Tovar belonged to the genus Janthinosoma; Dr. Surcouf determined the one sent to him as *Janthinosoma lutzi*. Probably other species such as *Janthinosoma posticata*, for instance, may also be concerned. Father Bernabé Cobo (1653) says the colour of the incriminated mosquito is somewhat reddish. Both *J. lutzi* and *J. posticata* are wood species. Other genera of mosquitoes are also incriminated. Knab (1913) says:—

> "The writer while on the Isthmus of Tehuantepec, in 1905, found this idea (the belief that the Dermatobia larvæ are acquired through the sting of a mosquito) warmly defended by the natives, and certain large mosquitoes (*Psorophora*) were pointed out to him as the 'madre del gusano' (mother of the worm)."

He points out that Psorophora is hardly separable generically from Janthinosoma. Blanchard (1896) states that, in 1893, Da Silva Araujo sent him various flies which were incriminated by the natives as vectors of the Berne. These flies were specimens of *Lucilia ruficornis* Macquart, *Sarcophaga chrysostoma*, Wd., *S. plinthopyga*, Wd., and an *Hystricia*. According to Dr. Neiva, in some parts of Brazil large hairy flies of the type of *Echinomyia* or *Hystricia* are considered to be the parents of the Berne.

Finally, in Trinidad, Mr. Urich told me that he had found Dermatobia eggs attached not only to mosquitoes (Janthinosoma), but also to a Muscid, which he did not determine.

Possibly the female Dermatobia is not always over particular in the choice of the insect to whom she entrusts her progeny. However, she certainly chooses some insect which is likely to reach a suitable host, and, so far as we can judge from the information at hand, certain mosquitoes, especially those of the genus Janthinosoma, seem to be the preferred agents. A fact which undoubtedly proves judicious selection is that the Dermatobia never attaches her ova to a male Janthinosoma, but, invariably, to a newly-emerged, blood-sucking, host-seeking female.

In his article on "The Aeroplane of the Macaw-worm," Dr. Gonzales Rincones draws attention to a colour affinity between the Dermatobia and the Janthinosoma. He says, "the colour of the fly's abdomen is of a brilliant, attractive blue. The abdomen of the mosquito is likewise resplendent owing to the violet, murrey, and sky-blue scales which bedeck it. It is the most beautiful mosquito I know in Venezuela. Are the larvæ deceived or do they merely prefer the abdomen which most resembles that of their mother? It is one of the mysteries of parasitism."

In Trinidad, whilst travelling in Mr. Urich's pleasant and instructive company, I stopped one day in the Majaro "high woods" to examine the water containing flowers of the Balisiers (*Heliconia caribæa*) for insect larvæ. As I touched one of the flower-spikes a fly with gilded face and enamel blue abdomen flew off like a dart. It may have been a Dermatobia. I was struck by the great resemblance in colour between the deep blue abdomen of the fly and the lapis-lazuli seed vessels

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within the crimson and black flower cups, which look like parrot beaks upside down. I looked at once for Dermatobia eggs on all the leaves of the wild plantain but found none. Meanwhile, numerous ants, wasps and mosquitoes of all kinds, including bloodthirsty Psorophoræ and loveliest azure Megarhini, obliged me to retreat, wondering whether there might be any reason for the association of the blue insect and the blue seed I had found so near together.

This interesting association between the Dermatobia and the mosquito seems extraordinary at first sight, but no doubt we can guess how it came about. In the first place, we have numerous instances of insects capturing other insects and placing them with their progeny in a living condition, but totally paralysed, in order that they may serve as food for their young in due season. Thus in the Southern United States the large digger wasp (*Sphecius speciosus*, Say) seeks out the dog-day Cicada (*Tibicen pruinosa*, Say) to oviposit upon it. Having caught its victim, it gives it a sudden sting which reduces it to a comatose condition, from which it never recovers. Then, straddling it with its legs, it drags it along or flies down with it to its nest. The white, elongate egg of the wasp is laid under the middle leg of the Cicada, and when it hatches the larva begins at once to draw nourishment from between the segments of its victim. The ichneumon flies are all parasitic upon other insects, especially upon caterpillars and upon the larvæ of flies and beetles. Collectors of butterflies know full well how often the rearing of some rare specimen has been frustrated by the development of an ichneumon fly larva laid in the specimen before it was captured. Examples of insects being used merely for the purpose of conveyance to suitable feeding grounds are not wanting. Thus, for instance, *Chernes nodosus*, one of the chelifers or book-scorpions, clings to the legs of the house fly solely to be transported from one place to another, just as many small birds, incapable of long-sustained flight, travel on the backs of migrating cranes. The females of the South European bug, *Phyllomorpha laciniata*, place their eggs on to the spinous, saucer-shaped backs of their males, who then carry them about until hatched, a procedure not uncommon amongst several kinds of fishes, the males of which take charge of the eggs and young, carrying them in their mouths (*Arius*, *Osteogeniosus*, *Tilapia*, etc.), or in special receptacles (*Hippocampus*).

The association between Dermatobia and mosquito probably arose from the fact that the Œstrid larvæ deposited on the skin of cattle found it easier to avail themselves of the wound made by the proboscis of a blood-sucking insect than to bore a passage themselves through the thick hide of their host. A similar association probably exists between Hypoderma and the Tabanids. The Hypoderma larvæ either penetrate the skin through the large punctures made by the Tabanids, or the irritation occasioned by the latter cause the animal to lick the part, and thus the young Œstrid larvæ gain access to the mucosæ of the alimentary tract, which are more easy to penetrate than the hide. Thus it may be that the ovipositing Hypoderma chooses not the parts most frequently licked, but those most frequently attacked by blood-sucking flies. The further step taken by the Dermatobia in fixing its eggs on to the body of a mosquito or other insect which is likely to visit a suitable host, either for the purpose of sucking blood or of imbibing the secretions of wounds, is not more wonderful than that taken by our cuckoos or the South American cow-birds in cunningly placing their eggs for fosterage in the nests of other kinds of birds.

Symptoms.

Not infrequently the Dermatobia larva causes very little inconvenience. Dr. Costa (quoted by Blanchard, 1892) mentions a child, only a few months old, who fostered eight of these larvæ in various parts of the body without presenting the least reaction. The accurate naturalist, Dr. L. Conte (quoted by Leidy, 1859), states that the presence of the maggots in his travelling companions, in Honduras, gave rise to comparatively little discomfort. Grube (1860) relates the history of a patient who had complained of nothing save a slight itching at times. The Spanish zoologist, Jimenez de la Espada, suffered himself from this form of myiasis whilst travelling in Amazonia, but felt nothing more than some itching. Another naturalist, M. Forel (quoted by Blanchard, 1896), tells us that, whilst exploring the forests on the northern slope of the Sierra Nevada in Colombia, he

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became the host of some Dermatobia larvæ. These, however, never hindered him in his pursuit of collecting ants and only from time to time caused a somewhat unpleasant lancination. Dr. Bleyer (1900) says that many of his patients had been actually unaware of the presence of the maggots they harboured until informed by their comrades who happened to notice the swellings.

As a rule in the morning or evening the affected person suddenly experiences a sensation of itching, or may be a sharp pain at or near the place where the warble is about to appear. A small rounded swelling forms, and gradually, with the growth of the swelling, the pain increases.

The pain is not continuous, but intermittent; it comes on suddenly, lasts two or three minutes with varying intensity, and subsides as suddenly as it arose. These pain-paroxysms may occur at any time, but they are especially troublesome in the early morning and in the evening.

The pain may be very acute while it lasts, and has been compared to the sensation experienced when thorns and needles are thrust sharply into the flesh, to that produced by the stabs of stinging and phlebotomous insects, and to the shooting and lancinating pains of certain abscesses. Boucard (quoted by Coquerel and Sallé, 1859) says: "During the first month one feels at every instant sharp pains, as if needles were thrust deeply into the flesh. I thought I was being pricked by *choche* thorns." Sometimes the pain becomes very severe and troublesome and the patient finds it necessary to press the swelling with force in order to obtain some relief.

The intensity of the pain depends to a great extent, of course, on the location of the parasite. Grube (1860) reports the case of a Costa Rican in whom the larva chose the region of the nose. The pain was terrible. No less painful, and far more dangerous, is the development of the larva within the orbital cavity. Dr. Brick (quoted by Say, 1822) had a Dermatobia warble in the left leg, over the upper and front part of the tibia, which caused him at times almost intolerable pain. He says: "The severe pain which I experienced for those periods I attribute to the irritation of some of the branches of the nerves distributed to the parts, by the worm in its progress." The larva had travelled on the periosteum along the tibia for at least two inches.

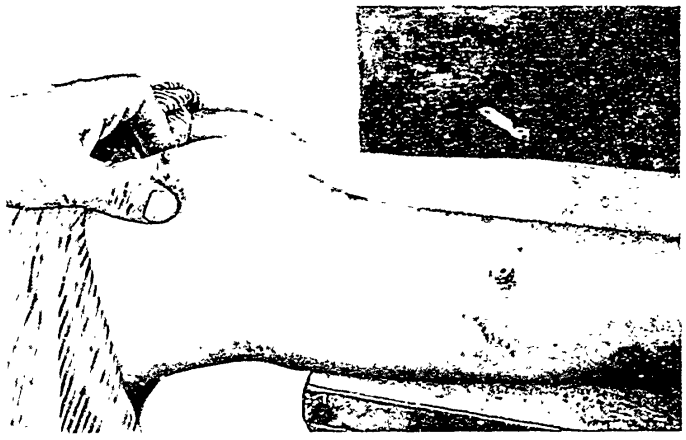

Fig IV. Dermatobia warbles in knee and leg of creole patient, Trinidad. (Author's photograph.)

The warble resembles a boil or furuncular nodule of considerable size, its dimensions increasing with the growth of the enclosed larva and with the amount of serous infiltration surrounding it. When the larva is full grown and ready to pupate, the swelling may measure from two to three centimetres in diameter and project as much as one centimetre above the level of the circumjacent skin. In shape it is rounded or more or less acuminated, its surface is stretched, and it presents, as a rule, a dark-red or bluish-red colour. At the apex, always more or less centrally placed, is a small circular opening similar to that produced by a large needle. This

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orifice, which is hardly visible at first, attains a diameter of from three to six millimetres in those swellings from which the maggots are ready to emerge. The opening may be partly obscured by coagulated and dried matter, which usually incrusts its margins, forming a kind of scab. The swelling feels hard to the touch, and pressure is invariably followed by the escape of a small quantity of cloudy fluid. From time to time, even without pressure, this semi-purulent serosity oozes out of the warble opening. Sometimes the secretion is quite abundant and continual. Jimenez-de la Espada says: "Some very liquid pus flowed abundantly along my leg, oozing out of the opening pierced at the apex of the swelling." The discharge is serous, yellowish, sometimes streaked with blood. Examined under the microscope it shows pus corpuscles, and a few erythrocytes On wiping off the droplet of ichorous fluid oozing out of the orifice, one can clearly perceive, in the last weeks of development of the warble, a moving whitish, vesicular body, marked by two tiny spots of brownish yellow. It is the posterior extremity of the larva with its chitinous stigmatic plates. As a rule, the larva keeps its posterior end close beneath the cutaneous opening in order to take in the air and void out its excrement. At the least contact it will withdraw itself quickly from the mouth of the opening, approaching it again after a certain time has elapsed. By compressing the swelling the posterior end of the wriggling larva may be made to protrude somewhat from the warble's orifice.

In many cases the patient presents only one warble, in others several, either in close proximity or scattered about, and occupying the most distal parts of the body. Often in dogs and oxen hundreds may be seen clustered together about the shoulders and back, the serous discharge issuing from the numerous openings matting the hair in the neighbourhood in an unsightly manner. As a rule, there is one larva only to each warble, but occasionally two or more may be found within the same cavity. Goudot states that, when oxen are greatly riddled by warbles, one may see three to five larvæ escape from a single orifice, and Folkes (1897) mentions finding in one of his patients five Dermatobia larvæ in one warble.

It is possible that the duration of the growth-period of the larva beneath the skin may vary in accordance with local seasonal conditions. Linnæus (1781) puts it down to six months. Boucard (Coquerel and Sallé, 1859) states that as a rule the larva remains about three months between flesh and skin. Mr. E. E. Austen (1910), mentioning a larva in the British Museum collection presented by Sir Francis Laking, and removed in London, in 1897, by Sir Frederick Treves from a patient who had returned from Central South America, states that in this case it is believed that seven months had elapsed between the time when the egg was deposited and that at which the larva was removed.

Towards the end of the larval stage the full-grown maggot prepares to escape from its warble. In order to do this, it wedges the posterior extremity of its body into the warble opening and keeps it there for some time, exerting compression after the manner of a laminaria tent. It then withdraws it for a while and repeats the operation again and again until it has succeeded in dilating the opening sufficiently to enable it to squeeze through. At length it presses itself gradually out, tail end foremost, by means of vermicular contractions aided by the compressibility of its annulated body and by the stout ring-encircling spines which prevent its slipping back again into its former cave. On emerging from the warble it lets itself fall to the ground, and, slowly crawling along the floor by means of its spines and the contractions of its body rings, it endeavours to reach some place of safety in which to undergo pupation.

The exit of the larva from the warble may occur at any time of day, but as a rule it takes place either in the early morning hours or at night. During growth, and especially at the time of exit, the patient can distinctly feel the larva moving within the close cavity of its warble.

Dr. Hill (1830), relating the history of a case in a ship's steward who had contracted the parasite in British Guiana, says:—

> "The patient felt something moving in the centre of a small orifice which had become apparent on the tumour. The motion increased, till to his surprise the head of an animal protruded itself, and this it continued to do

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daily, though the animal was observed to withdraw into its burrow when anyone came near or even pointed at it. The pain at this time was so acute as to cause sickness. The chamber of the insect seemed exactly to fit its body and merely admitted of its motions outwards and inwards. It occasionally discharged a quantity of blood-coloured matter. It was observed to protrude more and more of its body every day, and upon one occasion it came out to the length of more than an inch. At last it dropt out of its own accord upon the floor with a noise resembling that which a pebble would make on falling on the ground. It kept moving and turning about for some time like an earth worm, but ere long shrunk into nearly half its previous size. The insect lived for three days and was then put into spirits, after which it shrunk still more. Calculating from the period at which the itching was first felt, it had lived in the arm for about six weeks."

Soon after the escape of the larva one can squeeze a quantity of thin sanious fluid out of the cavity. In some cases the discharge is thick and muco-purulent. The empty warble presents the aspect of an ordinary furuncle after removal of the central necrosed mass or core—a hollow cavity with surrounding infiltrated tissue. On probing the cavity one finds that it is only slightly larger than the volume of the maggot it had contained, and that its long axis is perpendicular to the surface of the skin. The swelling diminishes rapidly as soon as the grub is out, and the cavity closes up by granulation, leaving behind a hardly perceptible scar.

As a rule, there are no constitutional symptoms, with the exception of sleeplessness at night owing to the recurring pain, but occasionally there may be some malaise, a feeling of general lassitude, loss of appetite, and sometimes a slight febrile reaction.

Various complications, such as erysipelas and tetanus, may arise owing to bacterial agency. The inflammation round the warble may increase considerably and be followed by lymphangitis and swelling of the proximal glands. Occasionally the larva may perish during development and the warble become an abscess. When this happens the orifice is choked up and covered by a thick scab, and the incision of the abscess, or pressure on its base causes the escape of a greenish pultaceous mass of bad odour constituted of pus and the remains of the disorganized larva. Sometimes after the escape of the larva the granulation tissue filling the cavity becomes infiltrated with lime salts and gives rise to hard nodules which persist beneath the skin. Not infrequently, especially in cattle, other kinds of flies (*Sarcophagidæ, Muscidæ*) oviposit into the recently emptied warble and their larvæ give rise to fearful sores.

Treatment.

On seeing a case of Dermatobia for the first time there is an instinctive tendency to endeavour to extract the grub at once, either by using forcible compression or by making an incision.

In an advanced case, when the maggot is ready to pupate and the warble orifice is patulous, compression of the swelling, from the base upwards, by means of the two thumb nails, may bring about the expulsion of the enclosed larva quite readily, indeed it is likely to bolt out as if pushed by a spring. As a rule, however, it is difficult to dislodge the maggot, as it holds on tenaciously by means of its strong oral hooks and numerous body spines. In an earlier stage, when the larva is gourd-shaped and the warble opening very small, it is still more difficult to squeeze it out, and the attempt is likely to cause unnecessary pain. A simple incision is not always sufficient to remove the parasite, but may serve to enlarge the opening prior to digital compression. Matas (1888) says: "Guided by the orifice in the elevation I cut with the point of a bistoury into the very centre of the swelling, but discovered, however, that by simply cutting vertically I had not incised the cavity wherein the larvæ lay concealed, and was obliged to again incise obliquely and to the right in order to expose the parasite burrow. This oblique direction of the larval sinus I found to be constant in each of the three 'stings.' I found that the larvæ were lodged immediately under the derma proper, so that in getting at them, in order to expose them thoroughly, I had to cut completely through the skin, which in the gluteal region is particularly thick. It was also discovered that a simple incision

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was insufficient to remove the larvæ, and that digital expression, and this very forcibly applied, was necessary in order to induce them to relinquish their strong hold."

The natives of intertropical America, familiar with this form of myiasis, do not use the knife. They proceed as follows:—First they kill the maggot within its warble, either simply choking it or poisoning it by means of tobacco and other drugs. As a rule, both choking and drugging are combined. Then after some hours the dead or narcotized larva is squeezed out quite easily. Tobacco is the almost universal remedy. It is used in various ways: the leaf is applied over the swelling, or the juice or smoke or hot ashes are introduced into the warble opening. The use of the leaf is mentioned by Arture (1757) for French Guiana, by Logan (1892) for Spanish Honduras, by Folkes (1897) for Guatemala, and by Keyt (1900) for British Honduras. Logan says: "The common remedy adopted in Honduras was to place a piece of leaf tobacco over the perforation in the skin, and soon after the maggot could be squeezed out." Dr. Keyt says: "Application of tobacco leaf over the swelling and occluding the orifice kills or narcotizes the worm, and its expulsion is easily effected by squeezing."

Bates (1863) relates that an old Indian of Ega, Amazon River, Brazil, showed him "how to stupefy the grub with strong tobacco juice, causing it to relax its grip in the interior and then pull it out of the narrow orifice of the tumour by main force."

In Colombia tobacco juice is introduced into the opening and sticking-plaster glued over it. About twenty-four hours later a slight pressure suffices to expel the dead larva.

Among the natives of Brazil chewed tobacco, or the dry tobacco leaf crushed and mashed in water or spirits of wine, is used. Matas says the natives of Honduras apply hot tobacco ashes to the parts and follow this up by digital expression. According to Folkes some blow tobacco smoke into the hole, thus killing the larva.

Guyon (1835) wrote that, in Trinidad, a mixture of tobacco and pimento (*Pimenta officinalis*) is used to kill the larva, and, according to Arture, in Cayenne leaves of the *choux caraïb* or tania (*Colocasia esculenta*) are sometimes applied over the warble. In Brazil, a plaster of almecega, the resin of *Bursera balsamifera*, one of the *Terebinthinæ*, is applied, or the viscous, milky sap of the Lecherillo, a *Tabernæmontana* of the dog-bane family (*Apocynaceæ*), smeared on lint, paper or leaves, is placed over the swelling. The maggot, in order to get at the air, presses the posterior end of its body against the plaster and its stigmata become glued in the thickened caoutchouc-containing latex. Hence frequently on removing the plaster the larva comes away with it.

Mercurial plaster and ordinary sticking plaster are also frequently used by physicians. According to Duprey (1906). the Trinidad natives use a plaster made of brown paper coated with soft tallow. Folkes says some of the ingenious Gringoes of Guatemala hit on the idea of placing a postage stamp over the hole.

According to Herbert Smith (1892) the Brazilians often tie a piece of fresh pork-fat tightly round the warble; the maggot is thus deprived of air, and, in the effort to obtain it, emerges from the skin, burrowing into the pork. Smith recommends putting a drop of strong carbolic acid in the opening and leaving it until next day, when the maggot can be easily squeezed out. Boucard (quoted by Coquerel and Sallé, 1859) stated that he found turpentine to be excellent; it killed the larvæ immediately. In many parts pure creolin is used. Cotton compresses, soaked in a solution of carbolic acid 4 per cent. or sublimate 1 per cent., give the same results. According to Major J. G. Barnard (1852) the natives on the Isthmus of Tehuantepec "sometimes use fire to kill them."

Folkes says the method he first employed was to cut them out, but, as most patients were afraid of the knife, he adopted the following:—"I have never failed; it is the most rapid manner. On one occasion, I removed 14 in less than two minutes. After putting a little chloroform into a hypodermic syringe I insert the point of a fine needle into the orifice and then into the body of the worm. A few drops will paralyse the worm, which can be squeezed out in a moment. Simply washing the wound and putting on a little piece of cotton are the dressings required. In a few days no evidence of the former tenant can be found."

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Prevention.

In Europe, where the ovipositing Œstrid flies occur for about two or three months only during the year, where the myiasis is almost entirely restricted to domesticated cattle, and where the herds are usually small and fully under control, prevention is comparatively easy. Indeed, in many instances judicious measures, such as the prevention of oviposition by means of sticky or noxious-smelling substances smeared over the animals, the killing of the maggots in the warbles, and the housing of the herds, or their confinement in appropriate sheds, during the season of oviposition, and especially during the hottest hours of the day, when the flies are active, has given good results. But the difficulties are far greater in the case of the neotropical Œstrid, whose activity lasts practically the whole year, whose strongholds are inaccessible virgin forests, whose reservoirs are numerous wild mammals and birds, and who, aided by insect associates, has full sway over the large herds of semi-wild oxen which graze in the llanos of South America. However, even in tropical America the pest is being actively combated, and, just as in Europe we are aided by starlings, jackdaws, redstarts, hoopoes, thrushes, wagtails, and tit-mice, so also in America the cow-birds (*Molothrus*), the tick-birds (*Crotophaga*), and numerous other birds range themselves on the side of man, and should be carefully protected.

In speaking of the zoological distribution of *Dermatobia hominis*, I have mentioned the remarkable immunity of the white cattle of Antioquia. Here, therefore, I should like to point out that, with regard not only to myiasis, but to all tropical diseases and conditions, it may not be always altogether wise to endeavour to improve local stock by means of animals imported from abroad, and thus possibly destroy valuable immunities and adaptations which may have taken centuries to become established.

LOUIS W. SAMBON.

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APPENDIX VIII.

Reports on work carried out in Colonial Laboratories.

No. 1.

MALAY STATES.

THE HIGH COMMISSIONER to THE SECRETARY OF STATE.

(Received 24th January, 1914.)

SIR, Government House, Singapore, 31st December, 1913.

WITH reference to my despatch of the 4th June, 1913,* I have the honour to transmit a report on the work done at the Institute for Medical Research, Kuala Lumpur, for the period 1st April to 30th September, 1913.

I have, &c.,

ARTHUR YOUNG.

Enclosure in No. 1.

REPORT FROM THE INSTITUTE FOR MEDICAL RESEARCH FOR THE PERIOD 1ST APRIL TO 30TH SEPTEMBER, 1913.

UNPOLISHED RICE AND THE PREVENTION OF BERI-BERI.

SINCE the publication of our completed report on the etiology of beri-beri in 1912 various communications have been published by investigators who have sought to isolate from rice polishings the substance or substances which are of value in the prevention of beri-beri.

We found that by the extraction of polishings with acidulated alcohol a preparation was obtained which was effective in preventing the occurrence of polyneuritis in fowls fed on polished rice, and of curing that disease in these animals. It is to extracts prepared by this method, or similar ones—for an effective extract can also be prepared by means of acidulated water—that physiological chemists have devoted their efforts.

In this domain much work has been done by Funk, who tested the value of the various substances which he isolated on pigeons suffering from polyneuritis induced by the consumption of polished rice. To a curative substance prepared by him he assigned the name "vitamine," and gave it a formula calculated from the results of a single analysis; this formula he subsequently amended. As the molecular weights are unknown, and as in the case of complex substances from the results of a combustion several formulæ can usually be worked out, it is obvious that the formulæ cannot be accepted without question. Moreover, from the variety of formulæ he has given it is suggested that the substances were impure, and, but for the fact that he has reduced the volume of the material in which the active substance or substances are contained, a proprietary name might quite as reasonably have been applied to the curative fraction isolated by us and known to be a mixture of substances. Indeed, Tsuzuki has applied the name "Anti beri-berin" to the moist, black, sticky residue obtained on evaporation of the alcoholic extract.

Reasonable allowances for the magnitude and difficulties of the task confronting physiological chemists must be made, but the methods employed in the work require improvement; those now in use are crude and are sources of errors because of the incomplete separations they effect, and because of the decomposition they so constantly produce. It may well be that the substance or substances which prevent beri-beri are elusive bodies and may never be isolated in a state of purity, but these problems in no way concern the physician or administrator, whose work deals with the prevention and cure of beri-beri.

The fact that the continuous consumption of polished rice as the staple of diet gives rise to beri-beri in man rests on quite other testimony than that derived from experiments on fowls and pigeons, and the fact is equally well established that when rice-eaters substitute unpolished rice for polished rice the disease does not occur.

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* Page 202 of [Cd. 7261], March, 1914.

Appendix VIII.

Reports on work carried out in colonial laboratories.

Further valuable confirmatory evidence has recently been obtained from the results of the expedition conducted by Dr. Wollaston and Mr. Kloss into the interior of Dutch New Guinea, where they had as their objective the exploration of the Snow Mountains.

The task which confronted them was, as both of them well knew, a formidable and an arduous one. Previous experience had shown them that the occurrence of beri-beri among them meant failure; thus the Goodfellow expedition of 1909-1911, undertaken to explore the Snow Mountains, was decimated by disease, and Dr. Wollaston, the Medical Officer to that expedition, has recorded that "in the six months from the beginning of June to the end of November, 39 men showed definite signs of beri-beri, and seven deaths were directly attributable to this cause." The staple of diet was polished rice.

A similar fate befell all previously recorded expeditions into that country, save the one conducted by Moszkowski, and in which unpolished rice was used, but as his expedition only numbered ten men the results were inconclusive.

Convinced, therefore, that the work of the expedition could not be accomplished if their camp-followers and guard were fed on polished rice, Dr. Wollaston and Mr. Kloss decided that only unpolished rice should be used.

Here another difficulty confronted them. The only variety of unpolished rice which can be purchased in the Malay Peninsula in the open market is that known as parboiled rice. To that variety of rice the natives of India who immigrate to this country are accustomed, and it is preferred by them. It has, however, an objectionable odour and appearance; irritating properties have been ascribed to it, and it has even been thought to predispose to dysentery and the like disease. Parboiled rice can be prepared free from these objectionable properties, but the manufacturers will not do so, and abundant practical experience has shown that the use of parboiled rice is not the solution of the problem of beri-beri prevention.

Braddon held that parboiled rice was a preventive of beri-beri, because it had been "cured," and that white rice was harmful because of some poisonous substance contained in it. The brilliant results obtained by the use of parboiled rice in the Government institutions of Malaya confirmed the accuracy of his view that such rice was a preventive of beri-beri, but when we proved that white rice was harmful because, by the process of polishing, the sub-pericarpal layers were removed, and that parboiled rice was only a variety of unpolished rice, the problem was entirely altered, and the prevention of beri-beri was established on a rational basis.

Chinese, Malays, Javanese, and the like may, when deprived of their liberty in prison, be compelled to partake of parboiled rice, but on regaining their liberty they will not continue its use. If, on the other hand, an ordinary unpolished rice, or "kampong" rice, were in use in such places, a demand would be created for that rice, which would then become available commercially. In this way some real progress might be recorded towards the eradication of a preventable disease. Fortunately, in Java, where the use of parboiled rice is unknown, Dr. Wollaston and Mr. Kloss were able to obtain a supply of unpolished rice adequate for the needs of their expedition. In addition, acting on the suggestion of the writers, they took with them as an additional safeguard a supply of our remedial agent, the use of which we have advocated in the prevention and cure of beri-beri.

The expedition consisted of 204 natives of the Malayan Archipelago, who were rice-eaters, together with two Europeans and four Eurasians.

They left Batavia about the end of August, 1912, and reached Dutch New Guinea in the middle of September. After reaching the coast, the explorers constructed canoes and ascended the Utakwa River. They went as far as they could go by water, the journey taking two days. They then proceeded overland by stages, each stage occupying three days. Depôts had to be constructed at each stage, an undertaking of considerable magnitude, which occupied much time.

Four and a half months after they had arrived at the coast they reached the Snow Mountains, and then commenced their return journey to the coast, which was reached in two months.

The expedition was in all of seven months' duration, and, despite the laborious nature of the work, among the 204 rice-eating natives no single case of beri-beri occurred. The general health conditions of the expedition are reported to have been excellent.

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The daily ration issued to the natives was as follows:—

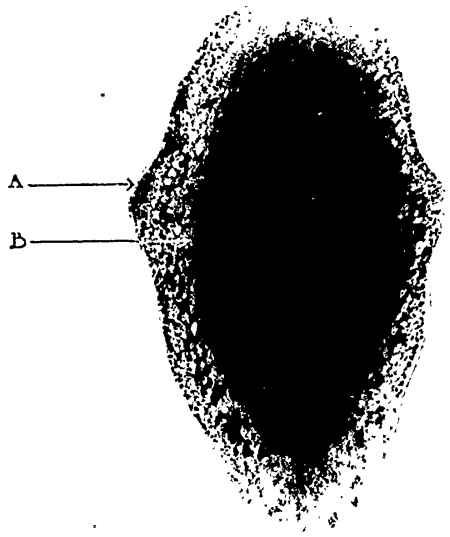
Rice	700 grms.
Fish or meat on alternate days	150 grms.
Kachang idju	200 grms.
Javanese sugar	50 grms.
Coffee	20 grms.
Tea	5 grms.
Salt occasionally	20 grms.

Two varieties of unpolished rice were used, one with a red pericarp during the first five months and one with a silvery pericarp during the last two months. Neither rice could be considered satisfactory from the cosmetic stand-point. In the case of the red variety only a partial attempt had been made to remove the pericarp, and in the case of the silvery variety no attempt had been made to remove this valueless layer of the grain.

Despite the appearance no objections were raised by the natives to the use of these rices, but steps ought to be taken to induce manufacturers to remove the pericarp, and so improve the appearance of the grain.

In this connexion attention must again be directed to the valueless character of this structure. In previous reports the evidence has been furnished on which this statement is based, but writers, with but one or two notable exceptions, refer to the pericarp as the structure whose removal makes the rice harmful, whereas, in fact, it is the removal of the subpericarpal layers which is attended with this undesirable result.

The photograph of a transverse section of a selected grain, which was prepared by the method described on a previous occasion, shows clearly the position of these structures. No real progress in the application of preventive measures can be made until there is available commercially an unpolished rice from which the pericarp has been removed.



TRANSVERSE SECTION OF A GRAIN.

Selected from the rice used on Wollaston-Kloss Expedition.

A = Pericarp (valueless).
B = Subpericarpal Zone, the removal of which, in the process of polishing, converts a harmless into a harmful one.

Zeiss-Microplanar, 20 mm.

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Samples of both the rices used were analysed here with the following results :—

	Red variety Per cent.	Silvery variety. Per cent.
Protein	9.22	9.41
Fat	1.14	2.10
Carbohydrate	78.64	76.57
Ash	1.06	1.50
Moisture	9.94	10.42
P^2O^5 in ash	0.54	0.79

It has been consistently advocated that a rice which yields not less than 0.4 per cent. of phosphorus pentoxide may safely be regarded as a harmless one, and both of these rices are considerably over this standard, but only in the red variety did any of the grains show a partial removal of the subpericarpal layers and in the silvery variety the grain had only been deprived of its husk.

Had the enterprise of manufacturers so far progressed as to remove the pericarp and embryos from these grains, the results would have been equally satisfactory as regards the prevention of disease, the analysis would still have yielded results in accordance with the standard of safety, and the cosmetic appearance of the food-stuff would have been greatly improved.

No fresh fish or meat was available during the expedition, but only salt fish and dried, spiced beef.

Based on the standards we have previously adopted, the ration was ample, and the scientific findings are thus in complete accordance with the actual facts.

The results of this expedition as regards beri-beri are in striking contrast with those which obtained in all previous large expeditions into Dutch New Guinea, and taken in conjunction with the observations and experiments previously recorded by us, the absence of beri-beri on this occasion can only be explained in one way, that is, the absence of polished rice from the diet.

In 1909, we demonstrated—

1. That beri-beri as it exists in the Malay Peninsula is caused by the continuous consumption, as the staple of diet, of rice from which all or the greater part of the subpericarpal layers has been removed by the process of polishing.
2. That a satisfactory measure of the degree of polishing to which a rice has been subjected is the estimation of its total phosphorus in terms of phosphorus pentoxide.
3. That a rice which yields less than 0.4 per cent. of phosphorus pentoxide cannot safely be permitted to form the staple of a diet in man.

The evidence now submitted is a complete confirmation of the accuracy of these statements, which, as we have repeatedly affirmed, were the logical deductions derived from systematic research.

Recently writers from Southern Nigeria and Brazil have disputed the accuracy of these conclusions, but we are unaware of any systematic observations having been carried out in these countries which would permit of a decided statement being made. When these are made it will be essential to determine that the disease known to them as beri-beri is the same as the disease which is known by that name here. After all, beri-beri is only a form of polyneuritis, and students of this disease know that not only forms of polyneuritis of different origin have been called beri-beri, but that diseases of which polyneuritis may not be a prominent feature, such as "epidemic dropsy," "Ceylon beri-beri," and the like, have been included under this name.

We have shown the mode of operation of the factors concerned in the etiology of beri-beri as it occurs in the Malay Peninsula. The painstaking researches of Highet and his colleagues have proved that the disease is of similar origin in Siam, whilst the work of Strong and Cromwell has furnished similar evidence for the Philippine Islands. In the Netherlands India these results are in complete accordance with those obtained by the very able Dutch investigators.

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There is, then, in the countries mentioned an endemic and epidemic disease which presents certain clinical features, and is known to clinicians in these countries as beri-beri. For the occurrence of that disease an explanation has been given. The disease can be prevented and, as we have shown elsewhere, may be cured. But remembering the old adage that "prevention is better than cure," it is necessary to consider the practical application of preventive measures.

While fully appreciating the work of the scientists who seek to advance our knowledge on this subject, we must be practical and attempt to reduce, if not abolish, the heavy toll which is yearly exacted by this disease.

We have consistently advocated the preparation of an unpolished rice, that is a rice from which the husk and the pericarp have been removed, and which shall yield not less than 0.4 per cent. of phosphorus pentoxide. Such a rice can be and has been produced in Siam, but in the absence of a demand for it its preparation was not continued. The Governments of the countries concerned can create such a demand by making its use compulsory in all gaols and public institutions. In the Malay Peninsula that form of unpolished rice known as parboiled rice is used in practically all such places, but, for the reasons we have mentioned, the use of that rice cannot be extended among the people, and an unobjectionable, palatable, unpolished rice must be substituted.

A clause in Government contracts requiring the delivery of an unpolished rice conforming to the standard would give opportunity for observing how such a standard worked in practice, and aid in popularizing a safe and wholesome food-stuff among the people. No one believes that the introduction of such a measure would be accompanied by the immediate disappearance of beri-beri, but it is the only way in which progress in its prevention seems possible, and it would bring such prevention within the sphere of practical politics.

In striking contrast with the brilliant results of the Wollaston-Kloss expedition are the disastrous results of an expedition undertaken in 1913 to the mountain called Gunong Tahan, where the creation of a hill station for the Federated Malay States is contemplated. The expedition consisted of a survey party and comprised a surveyor with about fifty native assistants and labourers. These natives will not eat parboiled rice, but, for the reasons already stated, no other variety of unpolished rice was available commercially. They were therefore obliged to consume polished rice, and an outbreak of beri-beri occurred.

The Cure of Beri-Beri.

In the report presented for the period in 1912 corresponding to the one now under review, experimental evidence was given in favour of a remedial agent which had proved of value in the cure of *polyneuritis gallinarum*. It was proposed to extend the use of that preparation to patients suffering from beri-beri and to determine, if possible, its usefulness in this connexion.

It is a simple matter to put forward a remedy for disease and to assert that it is of value, but it is desired to ascertain by observation if the remedy possesses a real value, and, if so, to establish its use on a rational basis.

For that purpose conditions are required which are now non-existent and apparently unattainable. The work cannot, therefore, be carried out.

Leprosy.

In the two previous reports accounts have been given of experiments carried out with a view to the cultivation of the bacillus of leprosy. The results obtained were uniformly negative, and a paper dealing with these researches up to the end of June, 1913, was prepared by Dr. Fletcher and myself. It was presented at the 17th International Congress of Medicine in London. A copy of that paper is appended to this report.

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The following further experiments have since been undertaken. In these experiments the procedure originally described for obtaining leper tissue was followed, but the use of iodine as a disinfectant was omitted. Our technique has now been made sufficiently perfect to enable us, with the aid of a local anæsthetic, to dissect up a flap of a skin from a case of leprosy and to remove from the subjacent tissue a portion free from contamination by extraneous organisms.

Further experiments with serum-agar.

It is a common experience that parasitic organisms when first induced to lead a saprophytic existence do not grow profusely, but that on repeated sub-cultivation luxuriant cultures are eventually obtained.

In view of the possibility of this being true of the leprosy bacillus, the following experiment was carried out.

From a nodule situated in the left scapular region of a case of nodular leprosy (Case No. 25) a portion was excised, and from it ten tubes of + 10 nutrient agar mixed with an equal quantity of human serum were inoculated. Each tube received a portion which varied in size from a millet seed to a rice grain. The tissue swarmed with leprosy bacilli. The inoculated tubes were incubated at 37°C., and from each tube the nodule was removed after intervals varying from seven to ten days and reinoculated on a fresh tube of the medium. The process of sub-culture was repeated regularly for three months. The maximum number of sub cultures prepared from one nodule was eleven, and in all upwards of a hundred tubes were inoculated. Not one of them became contaminated, and not one of them showed a macroscopic growth. Persistence, but not proliferation, was invariably noted.

Experiments with serum+sterile agar.

In these experiments it was designed to substitute for the nutrient agar a medium of the following composition:—

Powdered agar	...	...	...	...	40 grms.
Distilled water	...	...	...	...	1000 c.cs.

The mixture was dissolved in the autoclave and clarified with egg-albumen in the ordinary way. Tubes were then prepared each containing 5 c.c. of the medium, and to each tube was added an equal quantity of human serum in the manner previously described.

From a nodule situated in the right lumbar region of a case of nodular leprosy (Case No. 35) a portion was excised and divided into pieces about the size of a rice grain. Five tubes of the serum-agar were inoculated with these nodules. From a nodule situated just below and internal to the angle of the right scapula of a case of nodular leprosy (Case No. 36) a portion was excised and with it six tubes of the serum-agar were inoculated as in the previous case.

The inoculated tubes have been incubated at 37°C. for three months. None of them have become contaminated and a culture of the *bacillus leprœ* has not been obtained.

Experiments with English proof-agar.

With this medium luxuriant growths of various fungi can be obtained.

Five tubes were inoculated with pieces of leper tissue obtained from Case No. 35 and five tubes were inoculated with similar pieces obtained from Case No. 36.

The tubes have been incubated for three months at 37°C. None of them have become contaminated and no culture has been obtained.

Experiments with Clegg's medium.

In his first communication Clegg claimed to have grown the leprosy bacillus in symbiosis with amœbæ, a culture of which had been obtained from a case of dysentery.

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Attempts made here to cultivate amœbæ have been uniformly unsuccessful and support the view of investigators who state that the pathogenic amœbæ have not been cultivated on artificial media.

In his second communication Clegg states that he employed cultures of amœbæ obtained from water. By the methods he describes, a culture of amœbæ was prepared from water contained in a tank in the Institute and grown in pure culture with the vibrio of cholera.

Following exactly the procedure employed by him, twenty tubes of his medium were inoculated with the mixed culture of amœbæ and cholera vibrios. The inoculated tubes were incubated for twenty-four hours at 37°C. and then inoculated with leprous material.

From a nodule on the upper part of the left ear of Case No. 37, a portion was excised and emulsified with salt solution. The emulsion contained leprosy bacilli in great abundance and from it five of the tubes were inoculated, one of the tubes receiving a small piece of the tissue which had not been properly emulsified. A second portion of the nodule was excised, cut into pieces the size of rice-grains, and five of the tubes were inoculated with the fragments. From a nodule on the upper part of the left ear of Case No. 38, a portion was exercised and emulsified with salt solution. The emulsion contained leprosy bacilli in great abundance, and from it five of the tubes were inoculated.

From the same nodule a second portion was excised, cut into pieces the size of rice grains, and the remaining five tubes inoculated.

The twenty inoculated tubes were then incubated for one week at 37°C. On the expiry of that period reinoculations were made from each tube on to fresh tubes of Clegg's medium. The tubes which had been inoculated with nodules of tissue had the nodules removed to the fresh tubes along with a loopful of the amœbæ cholera culture. From the tubes inoculated with emulsion a loopful of the mixture of organisms was removed and inoculated on the fresh tubes. Smears were then prepared from each of the old cultures, stained, and examined.

The procedure was repeated once a week for six weeks.

Examination of original cultures after incubation.

The cultures which had been inoculated with nodules of tissue from Case No. 37 showed the presence of cholera bacilli, amœbæ, and acid-fast bacilli, the latter showing no change in morphology.

The cultures which had been inoculated with the emulsion prepared from Case No. 37 showed cholera bacilli, amœbæ, and acid-fast bacilli, but the latter were not so numerous as in the cultures inoculated with nodules of tissue.

The cultures prepared from Case No. 38 gave exactly similar results.

Examination of first subcultures.

In the subcultures which had been prepared with nodules of tissue from Case No. 37 many acid-fast bacilli were found. In two of them the bacilli were present in enormous numbers.

In two of the subcultures which had been inoculated with emulsion prepared from Case No. 37 acid-fast bacilli were not found, in one they were extremely scanty, in one a few scattered bacilli were observed, and in one acid-fast bacilli were quite numerous, mostly in clumps. The latter tube was the one previously referred to which had been inoculated with a nodule of tissue as well as with emulsion.

In the subcultures which had been prepared with nodules of tissue from Case No. 38 acid-fast bacilli were plentiful in each of the five tubes.

In the subcultures which had been prepared with emulsion from Case No. 38 acid-fast bacilli could be found only by a prolonged search; the bacilli were scattered, from two to five being found in a smear.

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Examination of second subcultures.

In order to facilitate reference to these and subsequent cultures, each tube was numbered.

In the subcultures which had been prepared with nodules from Case No. 37 the results were:

1. Acid-fast bacilli were present but not very numerous. There were plenty of amœbæ, both as vegetative forms and as cysts. Cholera bacilli present.
2. A few scattered acid-fast bacilli were found. There were plenty of both forms of amœbæ. Cholera bacilli present.
3. Acid-fast bacilli present, but not very numerous. There were a few of both kinds of amœbæ. Cholera bacilli present.
4. Acid-fast bacilli were scanty. Amœbæ and cholera bacilli scanty.
5. Acid-fast bacilli scanty. Both forms of amœbæ and cholera bacilli were present in moderate numbers.

In the subcultures which had been prepared from emulsion-cultures from Case No. 37 the results were:

1. No acid-fast bacilli were found.
2. Acid-fast bacilli were very numerous, but this is the culture which had a nodule of leper tissue.
3. No acid-fast bacilli were found.
4. No acid-fast bacilli were found.
5. No acid-fast bacilli were found.

There were numerous vegetative forms of amœbæ and cholera bacilli present in each film.

In the subcultures which had been prepared with nodules from Case No. 38 the results were:

1. Acid-fast bacilli present but not numerous, some scattered and a few in clumps. Cysts of amœbæ present, but no vegetative forms.
2. Acid-fast bacilli present, but not numerous, chiefly small globi. Cysts of amœbæ numerous and a few vegetative forms.
3. A few acid-fast bacilli present. Both forms of amœbæ numerous.
4. A few acid-fast bacilli present. Both forms of amœbæ numerous.
5. A few acid-fast bacilli present. Both forms of amœbæ present but scanty.

In the subcultures which had been prepared from emulsion cultures from Case No. 38, the results were:

1. No acid-fast bacilli present. Both forms of amœbæ abundant.
2. Two unaltered acid-fast bacilli found. Cysts of amœbæ numerous.
3. No acid-fast bacilli present. Both forms of amœbæ abundant.
4. No acid-fast bacilli present. A few cysts of amœbæ but no vegetative forms.
5. No acid-fast bacilli present. Both forms of amœbæ abundant.

Examination of third subcultures.

In the subcultures which had been prepared with the nodules from Case No. 37 the results were:

1. Acid-fast bacilli numerous in small clumps. Both forms of amœbæ were plentiful and cholera bacilli were fairly numerous.
2. Acid-fast bacilli numerous in small clumps. Both forms of amœbæ were plentiful and cholera bacilli were fairly numerous.
3. Acid-fast bacilli present but not very plentiful. Both forms of amœbæ present, the vegetative form being very numerous. Cholera bacilli fairly abundant.
4. Acid-fast bacilli few and scattered. Both forms of amœbæ present and cholera bacilli fairly numerous.
5. Acid-fast bacilli few and scattered. Both forms of amœbæ present and cholera bacilli fairly numerous.

In the subcultures which had been prepared from the emulsion subcultures (Case No. 37) the results were:

1. No acid-fast bacilli present. Both forms of amœbæ were present and the cholera bacilli were scanty.
2. Acid-fast bacilli were fairly numerous, small clumps. Both forms of amœbæ were present and cholera bacilli were very scanty.
3. No acid-bacilli were present. Both forms of amœbæ were present and cholera bacilli were very plentiful.
4. No acid-fast bacilli were present. Both forms of amœbæ were present and cholera bacilli were scanty.
5. No acid-fast bacilli were present. Both forms of amœbæ were present and cholera bacilli were scanty.

In the subcultures which had been prepared with the nodules from Case No. 38 the results were:

1. Acid-fast bacilli present, scattered, and a few small clumps. Both forms of amœbæ present.
2. Acid-fast bacilli present, scattered, and a few small clumps. Both forms of amœbæ present.
3. Only two small clumps of acid-fast bacilli found. Both forms of amœbæ present and cholera bacilli very numerous.
4. Scattered acid-fast bacilli present and a few small clumps. Both forms of amœbæ present. Cholera bacilli scanty.
5. Scattered acid-fast bacilli present and a few small clumps. Both forms of amœbæ and cholera bacilli scanty.

In the subcultures which had been prepared from the emulsion subcultures (Case No. 38), the results were:

1. Acid-fast bacilli absent. Both forms of amœbæ present and cholera bacilli very numerous.
2. Acid-fast bacilli absent. Both forms of amœbæ present and cholera bacilli very numerous.
3. Acid-fast bacilli absent. Both forms of amœbæ present, vegetative forms and cholera bacilli scanty.
4. Acid-fast bacilli absent. Both forms of amœbæ present, cholera bacilli scanty.
5. Acid-fast bacilli absent. Both forms of amœbæ present. Cholera bacilli scanty.

Examination of fourth subcultures.

In the subcultures which had been prepared with the nodules from Case No. 37, the results were:

1. Acid-fast bacilli present as numerous small clumps and few scattered bacilli. Amœbæ, both forms, present. Cholera bacilli few.
2. Acid-fast bacilli as in 1, but less numerous. Amœbæ, both forms, present. Cholera bacilli few.
3. Acid-fast bacilli present. A few small clumps, cysts of amœbæ numerous, vegetative forms scanty. Cholera bacilli very few.
4. Acid-fast bacilli present, a few small clumps. Both forms of amœbæ present. Cholera bacilli fairly numerous.
5. A few scattered acid-fast bacilli present. Both forms of amœbæ present, but vegetative forms scanty. Cholera bacilli very few.

In the subcultures which had been prepared from the emulsion subcultures (Case No. 37) the results were:

1. Acid-fast bacilli absent. Cysts of amœbæ present but no vegetative forms. Cholera bacilli scanty.
2. A few small clumps of acid-fast bacilli. Both forms of amœbæ present. Cholera bacilli few.

3. Acid-fast bacilli absent. Both forms of amœbæ numerous. Cholera bacilli numerous.
4. Acid-fast bacilli absent. Cysts of amœbæ numerous but vegetative forms absent. Cholera bacilli few.
5. Acid-fast bacilli absent. Both forms of amœbæ numerous. Cholera bacilli very few.

In the subcultures which had been prepared with the nodules from Case No. 38, the results were:

1. Acid-fast bacilli very scanty. Cysts of amœbæ present but vegetative forms absent. Cholera bacilli very few.
2. A few clumps of acid-fast bacilli present. Both forms of amœbæ present but vegetative forms few. Cholera bacilli very few.
3. A few acid-fast bacilli present. Cysts of amœbæ present but vegetative forms absent. Cholera bacilli plentiful.
4. Acid-fast bacilli present, both clumps and scattered cysts of amœbæ present but vegetative forms absent. Cholera bacilli very few.
5. Acid-fast bacilli present, both clumps and scattered. Both forms of amœbæ present but vegetative forms scanty. Cholera bacilli very few.

In the subcultures which had been prepared from the emulsion subcultures (Case No. 38), the results were:

1. Acid-fast bacilli absent. Both forms of amœbæ present, but vegetative forms not numerous. Cholera bacilli very few.
2. Acid-fast bacilli absent. Both forms of amœbæ present, but vegetative forms few. Cholera bacilli very few.
3. Acid-fast bacilli absent. Both forms of amœbæ present, but vegetative forms few. Cholera bacilli very few.
4. Acid-fast bacilli absent. Both forms of amœbæ present. Cholera bacilli few.
5. Acid-fast bacilli absent. Both forms of amœbæ present. Cholera bacilli few.

Examination of fifth subcultures.

In the subcultures which had been prepared with the nodules from Case No. 37, the results were:

1. Acid-fast bacilli present, a few small clumps and scattered bacilli. Both forms of amœbæ present. Cholera bacilli plentiful.
2. Acid-fast bacilli present, a few small clumps and scattered bacilli. Both forms of amœbæ numerous. Cholera bacilli very plentiful.
3. A few scattered acid-fast bacilli present. Both forms of amœbæ present, but vegetative forms scanty. Cholera bacilli very plentiful.
4. A very few small clumps of acid-fast bacilli present. Both forms of amœbæ present. Cholera bacilli very plentiful.
5. A very few small clumps of acid-fast bacilli present. Both forms of amœbæ present. Cholera bacilli very plentiful.

In the subcultures which had been prepared from the emulsion subcultures (Case No. 37), the results were:

1. Acid-fast bacilli absent. Both forms of amœbæ present, but vegetative forms scanty. Cholera bacilli very plentiful.
2. Acid-fast bacilli present, a few small clumps. Both forms of amœbæ plentiful. Cholera bacilli very numerous.
3. Acid-fast bacilli absent. Both forms of amœbæ numerous. Cholera bacilli very numerous.
4. Acid-fast bacilli absent. Both forms of amœbæ present. Cholera bacilli present.
5. Acid-fast bacilli absent. Both forms of amœbæ present. Cholera bacilli very numerous.

In the subcultures which had been prepared from the nodules from Case No. 38, the results were:

1. Acid-fast bacilli present in fairly numerous clumps, one very large globus. Both forms of amœbæ very numerous. Cholera bacilli numerous.
2. Acid-fast bacilli present, a few small clumps. Both forms of amœbæ numerous. Cholera bacilli very numerous.
3. Acid-fast bacilli present, numerous clumps and scattered bacilli. Both forms of amœbæ present. Cholera bacilli present.
4. Acid-fast bacilli present, a few clumps and scattered bacilli. Both forms of amœbæ present. Cholera bacilli scanty.
5. Acid-fast bacilli present, a few scattered small clumps. Both forms of amœbæ present. Cholera bacilli very numerous.

In the subcultures which were prepared from the emulsion subcultures (Case No. 38) the results were:

1. Acid-fast bacilli absent. Both forms of amœbæ present, vegetative forms very numerous. Cholera bacilli very numerous.
2. Acid-fast bacilli absent. Both forms of amœbæ present. Cholera bacilli present.
3. Acid-fast bacilli absent. Both forms of amœbæ present, vegetative forms very numerous. Cholera bacilli numerous.
4. Acid-fast bacilli absent. Both forms of amœbæ numerous. Cholera bacilli numerous.
5. Acid-fast bacilli absent. Both forms of amœbæ numerous. Cholera bacilli numerous.

Examination of sixth subcultures.

In the subcultures which were prepared with the nodules from Case No. 37, the results were:

1. Acid-fast bacilli present, numerous large clumps. Both forms of amœbæ numerous. Cholera bacilli present.
2. Acid-fast bacilli present, numerous clumps. Both forms of amœbæ present, but vegetative forms few. Cholera bacilli present.
3. Acid-fast bacilli present, a few small clumps. Both forms of amœbæ present, but motile forms few. Cholera bacilli plentiful.
4. Acid-fast bacilli present, clumps and scattered bacilli. Both forms of amœbæ present, cysts plentiful. Cholera bacilli present.
5. A few acid-fast bacilli present. Both forms of amœbæ present. Cholera bacilli present.

In the subcultures which had been prepared from emulsion-subcultures (Case No. 37), the results were:

1. Acid-fast bacilli absent, only amœbæ cysts present. Cholera bacilli few.
2. A few acid-fast bacilli present. Both forms of amœbæ present, but vegetative forms few. Cholera bacilli scanty.
3. Acid-fast bacilli absent. Both forms of amœbæ present, cysts numerous. Cholera bacilli very numerous.
4. Acid-fast bacilli absent. Both forms of amœbæ present. Cholera bacilli present.
5. Acid-fast bacilli absent. Both forms of amœbæ present. Cholera bacilli present.

In the subcultures which had been prepared with nodules from Case No. 38, the results were:

1. Acid-fast bacilli present, a few small scattered clumps. Both forms of amœbæ present. Cholera bacilli present.
2. Acid-fast bacilli present, a few small scattered clumps. Both forms of amœbæ present. Cholera bacilli present.

3. Acid-fast bacilli present, two or three small groups, only amœbæ cysts present. Cholera bacilli very numerous.
4. Acid-fast bacilli present, a very few small clumps. Both forms of amœbæ present but vegetative forms scanty. Cholera bacilli present.
5. Acid-fast bacilli present; a very few small clumps. A few amœbæ cysts present. Cholera bacilli scanty.

In the subcultures prepared from the emulsion-subcultures the results were:

1. Acid-fast bacilli absent. Both forms of amœbæ present. Cholera bacilli present.
2. Acid-fast bacilli absent. Both forms of amœbæ present. Cholera bacilli present.
3. Acid-fast bacilli absent. Both forms of amœbæ present. Cholera bacilli present.
4. Acid-fast bacilli absent. Both forms of amœbæ present. Cholera bacilli present.
5. Acid-fast bacilli absent. Both forms of amœbæ present. Cholera bacilli present.

The sub-cultures in this series in which acid-fast bacilli were found, that is those prepared with nodules of tissue, were heated for half an hour at 60°C. Clegg states that by so doing the amœbæ and cholera bacilli are killed, but that the leprosy bacilli are unaffected.

Subcultures were prepared from the heated cultures and incubated for one week at 37°C. No growth of acid-fast bacilli was obtained but there was some proliferation of the amœbæ. Thus by following in detail the directions given by Clegg we have failed to obtain a culture of the leprosy bacillus. As has been observed in every one of our experiments, there was persistence but no evidence of proliferation.

		2nd sub-cultures.	3rd sub-cultures.	4th sub-cultures.	5th sub-cultures.	6th sub-cultures.	
Case No. 37.	1	+	+	+	+	+ +	
	2	+	+	+	+	+ +	
Nodules of	3	+	+	+	+	+	
leper tissue.	4	+	+	+	+	+	
	5	+	+	+	+	+	
Case No. 37.	1	—	—	—	—	—	
	2	+ +	+	+	+	+	On these tubes there was a nodule of leper tissue.
Emulsion of	3	—	—	—	—	—	
leper tissue.	4	—	—	—	—	—	
	5	—	—	—	—	—	
Case No. 38.	1	+	+	+	+	+	
	2	+	+	+	+	+	
Nodules of	3	+	+	+	+	+	
leper tissue.	4	+	+	+	+	+	
	5	+	+	+	+	+	
Case No. 38.	1	—	—	—	—	—	
	2	+	—	—	—	—	
Emulsion of	3	—	—	—	—	—	
leper tissue.	4	—	—	—	—	—	
	5	—	—	—	—	—	

Experiments with Carrel's Medium.

Carrel, in a series of papers published in the *Journal of Experimental Medicine*, has described the technique by which the cultivation of tissues *in vitro* may be accomplished. Connective tissue, he states, can be successfully cultivated, and as the leprosy bacilli with which we are working is contained in connective tissue, it was considered possible that by this procedure a culture of the *bacillus leprœ* might be obtained.

The leper tissue was obtained on the 9th September, 1913, from a nodule on the upper part of the left ear of a case of nodular leprosy (Case No. 39). Smears

prepared from a portion of this tissue showed the presence of enormous numbers of leprosy bacilli.

The tissue was cut into small pieces. Two dishes were inoculated direct with these small pieces and a third dish was inoculated with a suspension of them in Ringer's fluid. The dishes were of the type devised by Gabritschewski, and the medium was human plasma diluted with two-fifths its volume of sterile distilled water. The peripheral portion of the lower plate received sterile distilled water, and the plates were sealed with vaseline. Incubation was carried out at 38°C. Carrel has stated that the life of a tissue *in vitro* is very short; he has devised methods by which this life can be prolonged, and these methods we have employed.

After incubation it was noted that each nodule was surrounded by a hyaline area which contrasted sharply with the turbid coagulated plasma. On examination under a low-power (the only one possible on account of the thickness of the dish-covers) there was no evidence of outgrowths from the nodules. The hyaline areas were caused by liquefaction of the plasma.

On the 13th September, the nodules were removed from the Gabritschewski's dishes to plates containing Ringer's fluid and placed in the ice-box.

The liquefied areas were not apparently contaminated—at least, smears prepared from these areas did not show the presence of contaminating micro-organisms. The liquefaction must, therefore, be attributed to the nodules of tissue, but whether due to the tissue or to the acid-fast bacilli it is impossible to say.

When the nodules had been for one and a quarter hour in Ringer's fluid at a temperature of 0°C. they were re-inoculated on to dilute plasma spread on Gabritschewski's dishes and again incubated at 38°C.

After incubation no hyaline areas were observed round the nodules, and there was no apparent liquefaction of the medium. On the 18th September, the nodules were again transferred to Ringer's fluid and washed in it for one hour at 0°C. After which they were re-inoculated on to dilute plasma and incubated at 38°C. On incubation, the three plates showed minute whitish spots, and it was suspected that contamination had occurred.

On the 24th September the nodules were removed and washed in Ringer's fluid for one hour and twenty minutes at 0°C. Films were then prepared from the whitish spots and no micro-organisms were found. After washing, the nodules were re-inoculated on dilute plasma and incubated as before.

On the 29th September the nodules were washed for two and a half hours and then re-inoculated.

The experiment is still in progress. Films were prepared from each of the Gabritschewski's dishes, but in no instance has evidence been obtained of proliferation of the acid-fast bacilli and none of the plates were contaminated.

Experiments on Animals.

The following additional experiments have been carried out:—

On the 24th June a rabbit (No. 21) was inoculated in the anterior chamber of the right eye with a piece of leper tissue, which had been removed three hours previously from a case of nodular leprosy (Case No. 33). Another piece of the same leper tissue was heated for twenty minutes in the autoclave at 120°C. and then inoculated into the anterior chamber of the right eye of a rabbit (No. 22). On the same day a rabbit (No. 23) was inoculated in the anterior chamber of the right eye with a piece of leper tissue which had been removed three hours previously from a case of nodular leprosy (Case No. 34). Two other pieces of the same tissue were heated for twenty minutes in the autoclave at 120°C. and then inoculated as before in the right eyes of two rabbits (Nos. 24 and 25).

On the 10th July a piece of leper tissue was excised from a nodule situated in the right lumbar region of a case of nodular leprosy (Case No. 35) and divided into small pieces. Each of the three guinea-pigs (Nos. 26, 27 and 28) received one of these portions in the anterior chamber of the right eye. On the same day a large piece of leper tissue was excised from a case of nodular leprosy (Case No. 36) and emulsified in salt solution. Three male guinea-pigs (Nos. 29, 30 and 31) each received into the left testicle about 1 c.c. of the emulsion. The leper tissue used on this occasion contained but few bacilli, so few, indeed, that we failed to find them in the emulsion prepared from it. In all the other experiments the material employed contained vast numbers of acid-fast bacilli.

Appendix VIII.

Reports on work carried out in Colonial Laboratories.

On the 9th September a large piece of leper tissue was obtained from a case of nodular leprosy (Case No. 39) and emulsified in salt solution. The emulsion was rich in leprosy bacilli. The guinea-pigs (Nos. 17, 18, 20, 29, 30, and 31) were each re-inoculated in the left testicle with 0.5 c.c. of the emulsion. Three rabbits (Nos. 32, 33 and 34) each received an intraperitoneal inoculation of 0.5 c.c. of the emulsion, and three rabbits (Nos. 35, 36 and 37) each received an injection into the left testicle of 0.5 c.c. of the emulsion.

Each experimental animal is confined in a separate cage. It is intended that the animals shall be kept under observation until death occurs. Up to the present it has only been found necessary on one occasion to depart from this arrangement, and that was in the case of a rabbit (No. 13). On the 11th March this animal had been inoculated in the anterior chamber of the right eye with a piece of leper tissue. On the 10th April it was observed that a prolapse had occurred at the site of the incision through which there protruded a fungating mass measuring 4 m.m. in length by 3 m.m. in breadth. The animal was therefore killed.

Number of Experiment.	Animal.	Date of inoculation.	Site of inoculation.	Material inoculated.	Interval between removal from body and inoculation.	Patient's number.	Remarks.
1	Rabbit	27 December, 1912	Anterior chamber of right eye	Portion of leproma	1 hour	24	—
2	Rabbit	27 December, 1912	,, ,,	,, ,,	,,	24	—
3	Gibbon F.	22 August, 1912	Supraorbital region	Emulsion of juice expressed from erythematous patch	½ hour	20	Reinoculated 27 December, 1912, in right supraorbital region with portion of leproma from case 24. Died 21 January, 1913.
4	Wild rat	27 December, 1912	Root of tail	Portion of leproma	1½ hours	24	Died 28 December, 1912. Trypanosomiasis.
5	Wild rat	27 December, 1912	,, ,,	,, ,,	,,	24	Died 4 September, 1913
6	Rabbit	7 March, 1913	Anterior chamber of right eye	,, ,,	24 hours	28	Died 11 June, 1913.
7	Rabbit	7 March, 1913	,, ,,	,, ,,	½ hour	29	—
8	Rabbit	7 March, 1913	,, ,,	,, ,,	¼ hour	30	—
9	Rabbit	7 March, 1913	,, ,,	,, ,,	2 hours	30	—
10	Rabbit	11 March, 1913	,, ,,	,, ,,	1⅛ hours	31	—
11	Rabbit	11 March, 1913	,, ,,	,, ,,	1½ hours	31	Died 11 a.m., 30 June, 1913.
12	Rabbit	11 March, 1913	,, ,,	,, ,,	2 hours	31	—
13	Rabbit	11 March, 1913	,, ,,	,, ,,	,,	31	Fungating growth noted at site of incision, 10 April, 1913, rabbit killed.
14	Rat M.	11 March, 1913	Scrotum	,, ,,	2¼ hours	31	—
15	Rat F.	11 March, 1913	Root of tail	,, ,,	2¾ hours	31	Died 10.50 a.m., 10 September, 1913.
16	Rat F.	11 March, 1913	,, ,,	,, ,,	3 hours	31	Found dead in cage, 30 June, 1913.
17	Guinea-pig M.	12 March, 1913	Scrotum	,, ,,	1 hour	32	Reinoculated 9 September, 1913, in left testicle, with 0.5 c.c. of emulsion rich in leprosy bacilli from case 39.
18	Guinea-pig M.	12 March, 1913	Tunica vaginalis	,, ,,	,,	32	Reinoculated 9 September, 1913, as in case 17
19	Rabbit	12 March, 1913	Anterior chamber of right eye	,, ,,	1¼ hours	32	Died 21 April, 1913. Coccidiosis.
20	Guinea-pig M.	12 March, 1913	Tunica vaginalis	,, ,,	1½ hours	32	Reinoculated 9 September, 1913, as in case 17.
21	Rabbit	24 June, 1913	Anterior chamber of right eye	,, ,,	3 hours	33	—

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Number of Experiment.	Animal.	Date of inoculation.	Site of inoculation.	Material inoculated.	Interval between removal from body and inoculation.	Patient's number.	Remarks.
22	Rabbit	24 June, 1913	Anterior chamber of right eye	Portion of leproma which had been heated 20 minutes at 120°	4 hours	33	Died 6 September, 1913.
23	Rabbit	24 June, 1913	" "	Portion of leproma	3 hours	34	—
24	Rabbit	24 June, 1913	" "	Portion of leproma which had been heated 20 minutes at 120°	4 hours	34	—
25	Rabbit	24 June, 1913	" "	" "	"	34	—
26	Guinea-pig M.	10 July, 1913	" "	Portion of leproma	1 hour	35	—
27	Guinea-pig M.	10 July, 1913	" "	" "	1½ hours	35	—
28	Guinea-pig M.	10 July, 1913	" "	" "	3 hours	35	—
29	Guinea-pig M.	10 July, 1913	Left testicle	Emulsion of leproma	2 hours	36	Reinoculated 9 September, 1913, as in case 17.
30	Guinea-pig M.	10 July, 1913	" "	" "	"	36	" " "
31	Guinea-pig M.	10 July, 1913	" "	" "	"	36	" " "
32	Rabbit F.	9 September, 1913	Intraperitoneal inoculation	½ c.c. of emulsion rich in leprosy bacilli	3 hours	39	—
33	Rabbit M.	9 September, 1913	" "	" "	"	39	—
34	Rabbit M.	9 September, 1913	" "	" "	"	39	—
35	Rabbit M.	9 September, 1913	Intratesticular inoculation L	" "	"	39	—
36	Rabbit M.	9 September, 1913	" "	" "	"	39	—
37	Rabbit M.	9 September, 1913	" "	" "	"	39	—
38	Rabbit F.	18 September, 1913	Anterior chamber of right eye	Piece of normal subcutaneous tissue	1 hour	—	—
39	Rabbit M.	18 September, 1913	" "	" "	"	—	—

As regards the animals which have died, in addition to those previously recorded, rabbit No. 19 died of coccidiosis on the 21st April, that is, forty days after inoculation; rabbit No. 22 died on the 6th September, that is, seventy-four days after inoculation; rabbit No. 6 died on the 11th June, that is, ninety-six days after inoculation; rabbit No. 11 died on the 30th June, that is, one hundred and eleven days after inoculation; rat No. 16 died on the 30th June, that is, one hundred and eleven days after inoculation; rat No. 15 died on the 10th September, that is, one hundred and eighty-three days after inoculation; rat No. 5 died on the 4th September, that is, two hundred and fifty days after inoculation.

In the case of every dead animal a detailed examination has been made. In no instance have we been able to convince ourselves that multiplication of the acid-fast bacilli has occurred, and in no instance has dissemination of the organisms been found.

A Suggestion.

At the Seventeenth International Congress of Medicine, the question of the cultivation of the *bacillus leprœ* formed the subject of a discussion. From the report of the proceedings it is to be inferred that no satisfactory conclusion was reached, a result attributable in part to the inherent difficulties of the problem and in part to the paucity of investigators present who had had practical experience of the

subject. I am convinced that it is impossible for those who have not worked at the cultivation of the *bacillus leprœ* to express an opinion of value.

As regards the investigators, Duval frankly admitted that he had been mistaken. Bayon asserted that he was right and that Rost was wrong. Rost naturally defended his work and found fault with that of Bayon. Clegg made no communication to the Congress, neither did Kedrowski; and Twort's work has not advanced beyond a preliminary communication to the Royal Society.

The work done here has not confirmed the findings of investigators. We do not consider that our results are conclusive, but we are of opinion that the present position is a hopeless one and can only create an endless series of fruitless discussions.

Those who are acquainted with the clinical aspects of leprosy must be familiar with the terrible condition of the afflicted. Leprosy is common in, but is not confined to, tropical countries, and is the most important tropical disease on which the least satisfactory progress has been accomplished. We therefore suggest that steps might be taken by the Tropical Diseases Research Committee with a view to the organization of an international commission composed of the various investigators who have worked at this disease. It may be found to be impracticable, but it is worthy of trial, and I know of no other scientific body which could more fittingly initiate the work.

Nothing can be accomplished by mere comparison and examination of the various cultures claimed to be those of the *bacillus leprœ*. If the various investigators were induced to meet in a place where there are numbers of lepers and suitable facilities for research and each of them afforded an opportunity to repeat his work, then it might be possible to remove the existing mass of inconsistencies beneath which there may be a substratum of fact.

It may be contended that the question of finance alone makes the proposal a prohibitive one, but in a matter of such importance that difficulty could surely be overcome.

A central place would no doubt be selected for the work. In this country the most excellent facilities are already in existence, and we believe that the Government of the Federated Malay States would assist in every way possible.

PARASITOLOGY.

Dr. Stanton furnishes the following report:—

Studies of the larval and pupal stages of Anopheles, Stegomyia and other genera of mosquitoes have been continued. Specimens bred from ova laid by females in captivity have formed the basis of this study, and it is hoped by this means to avoid those inaccuracies which are liable to result in the absence of such experimental work. The larval forms not hitherto described of the following species have thus been dealt with:—*Anopheles tessellatus*, Theobald; *Anopheles kochi*, Dönitz; *Stegomyia nivea*, Ludlow; *Skeiromyia fusca*, Leicester; *Tæniorhynchus* (*culex*) *ager*, Giles; *culex mimeticus*, Noe.

At the suggestion of the Director of the Imperial Bureau of Entomology data have been collected as to the distribution of the various species of *Stegomyia* in this and neighbouring countries. It is considered that this information will be of value in connexion with any measures which it may be decided to undertake to prevent the spread of yellow fever to the Orient.

The larvæ of the three common species of *Stegomyia* in this country, *fasciata*, *scutellaris*, and *nivea* have been studied in detail. It has been found that the characters usually given by authors for the differentiation of species of larvæ in the *Stegomyia* group are practically valueless for this purpose. In the mature larvæ of this group, as in *Anopheles*, the form and arrangement of the clypeal hairs and other hairs on the dorsum of the head afford a ready and reliable means of identifying the species. Details of these observations will be given in a later report.

The genus Phlebotomus (*sand flies*), members of which have been shown in India and elsewhere to be transmitting agents of dengue-like fevers, is found to be represented in Malaya by at least one species, namely, *Phlebotomus perturbans*, Meijere. This is the first record of *Phlebotomus* in the Malay Peninsula.

Appendix VIII.

Reports on work carried out in Colonial Laboratories.

Specimens of mosquitoes and biting flies and other insects have been sent to the King Institute, Madras, the London School of Tropical Medicine, the British Museum, and the Imperial Bureau of Entomology. Besides the Federated Malay States material has been received for identification from Kelantan, the Straits Settlements, and Borneo.

Anopheles and malaria in the Orienial region.

Dr. Stanton has continued his researches on this subject and furnishes the following report:—

Though the anopheles factor is only one in a complex of conditions which result in severe or epidemic malaria, it is happily one that is open to attack by public measures. It is of high importance, therefore, that we should be acquainted with the species of anopheles, their relationship to man and to those parasites of man which they transmit.

This study has been much hampered by the uncertain state of nomenclature in the group. It has been found, on the one hand, that identical mosquitoes are known under different names in different countries, and on the other hand that different mosquitoes are known under the same name. This question of accuracy or at least uniformity in nomenclature of species is of importance to the sanitarian, for it is probable that the same or similar species will be found to have similar habits and habitat in whatever country they are found, and so the knowledge gained of malaria-carrying species in one country can be turned to account in others.

Some attempt in the direction of this uniformity has already been made by James and myself, in regard to India and the Malay Peninsula, and lately, through the courtesy of Dr. Schuffner, in regard to Sumatra and the Malay Peninsula. The inclusion of Indo-China, the Philippine Islands, Formosa, and other countries in a scheme for the systematic study of Oriental species of anopheles would, I am convinced, do much to advance knowledge and thereby to increase the effectiveness of preventive measures against malaria.

In the record of anopheles from the Malay Peninsula thirty-five species-names occur in the literature, but not more than eighteen of these are of valid species which exist in that area. In the following lists I give: (I.) the names of those Malayan species which are now regarded as valid; (II.) the species-names occurring in the literature which are regarded as synonyms; (III.) the names of those valid species which are believed to have been erroneously recorded from the Malay Peninsula.

I. *Valid species.*

aitkeni, James.
albirostris, Theobald.
albotaeniatus, Theobald.
aurirostris, Watson.
asiaticus, Leicester.
barbirostris, Van der Wulp.
fuliginosus, Giles.
kochi, Dönitz.
leucosphyrus, Dönitz.
ludlowi, Theobald.
maculatus, Theobald.
nigrans, Stanton.
rossi, Giles.
sinensis, Wied.
tessellatus, Theobald.
umbrosus, Theobald.
watsoni, Leicester.
wellingtonianus, Alcock.

II. *Synonyms.*

annularis, Van der Wulp.	=	*sinensis*, Wiedemann.
elegans, James.	=	*leucosphyrus*, Dönitz.
fragilis, Theobald.	=	*aitkeni*, James.
halli, James.	=	*kochi*, Dönitz.
karwari, James.	=	*nigrans*, Stanton.
leucophyrus, Leicester.	=	*leucosphyrus*, Dönitz.
minutus, Theobald.	=	*sinensis*, Weidemann.
nivipes, Theobald.	=	*fuliginosus*, Giles.
ocellatus, Theobald.	=	*kochi*, Dönitz.
peditœniatus, Leicester.	=	*sinensis*, Weidemann.
separatus, Leicester.	=	*sinensis*, Weidemann.
preacherii, Leicester.	=	*aitkeni*, James.
vanus, Walker.	=	*sinensis*, Weidemann.

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III. *Errors in identification.*

listoni, Liston	for	*albirostris*, Theobald.
punctulatus, Dönitz	for	*tessellatus*, Theobald.
willmori, James	for	*maculatus*, Theobald.

A few words with reference to those species which are common to Sumatra and Malaya may not be inopportune. Professor Dönitz was engaged in describing the anopheline fauna of Sumatra and Java at about the same time that Mr. Theobald was engaged on that of Malaya. The consequence was that many species now known to be identical were described under different names. English-speaking workers in India and elsewhere have for the most part adopted the nomenclature of Mr. Theobald, in some cases neglecting the fact that Professor Dönitz's descriptions were published first. I have recently had the opportunity of examining some of Dönitz's preparations preserved in the British Museum and of comparing Malayan with Sumatran specimens.

I find, for example, that Dönitz *Anopheles kochi* is identical with the species known as *Christophersia halli* in India, and which James and I found to be identical with Malayan specimens. Theobald considered that the peculiar position of the abdominal scale tufts in this species warranted the creation of a new species and a new genus for its reception. Dönitz's description of *kochi* is, however, perfectly clear on this point. He notes that the scale tufts lie ventrally and diverge from the middle line. The correct name for this species is therefore *kochi*, Dönitz. Similarly *elegans*, James, is identical with *leucosphyrus*, Dönitz; *leucopus*, Dönitz, and *nivipes*, Theobald, are identical with *fuliginosus*, Giles; *deceptor*, Dönitz, with *tessellatus*, Theobald; while *aconitus*, Dönitz, is very near, if not identical with, Theobald's *albirostris*.

Records of malaria infection in anopheles.

James enumerates the following species as proved carriers of malaria in India: *culicifacies*, Giles; *fuliginosus*, Giles; *listoni*, Liston; *maculipalpis*, James and Liston; *stephensi*, Liston. To this list must be added the species *willmori* found infected by Mrs. Adie in the Kangra valley.

Christophers states that in the Andamans *ludlowi* is the carrier of malignant malaria.

From Sumatra Schuffner (1902) has reported that he has observed the development of malaria parasites in an anopheline species referred to by him as Anopheles I. and which Eysell claims to be *rossi*. De Vogel (1910) also reports the successful infection of *rossi* bred from salt water pools.

From Formosa, Miyajima and Kinoshita have recorded that *listoni* and *annulipes* are carriers of malignant malaria and *sinensis* of benign tertian. Tsuzuki found a species which he refers to as *A. formosœnsis* to be a carrier.

In the Federated Malay States Leicester has reported negative results in feeding experiments with *rossi*, *sinensis*, and *barbirostris*. Watson has recorded *willmori*, *karwari*, and *umbrosus X* as carriers; he notes that he found both zygotes and sporozoites in *willmori*, but the details of observations or experiments with other species are not given. James and I have recorded natural and experimental infection in the species *albirostris*. I have found *maculatus*, *fuliginosus*, and *sinensis* naturally infected, and have observed the development of the parasites of malignant malaria in *albirostris*, *fuliginosus*, and *maculatus*.

Having thus cleared the way by a statement of the recorded instances of malaria infection in anopheles, the evidence on which the claims of authors are based may now be reviewed.

The listoni group.

The three species and *listoni*, *culicifacies*, *albirostris* may conveniently be taken together. The first two have been shown by several observers, Stephens and Christophers, James and others to be important agents in the spread of malaria in India. The species *listoni* is also stated to occur in Indo-China and Formosa, and in these countries also has been found to be a very dangerous species.

Major James and I reported at the last meeting of the Far Eastern Association of Tropical Medicine that the parasites of malignant tertian malaria readily undergo development in the species *albirostris* and that we had found this species infected in nature.

Of seventy-eight specimens of *albirostris* taken in nature three were found to be infected. Of twenty-two specimens fed on blood containing malignant tertian gametocytes nine were found infected. In one specimen which had fed several times, more than two hundred zygotes were counted. Zygotes developed up to full maturity but the completed cycle with sporozoites in the salivary gland was not observed. Major Lalor has reported finding sporozoites in the salivary glands of a specimen of *listoni var. alboapicalis* in Burmah—this species is, I believe, *albirostris*.

Tsuzuki's *A. formosœnsis*, which he found to be a carrier in Formosa, is said by Dönitz to be only a variety of his *aconitus*. As I have already said, this species is probably identical with Malayan *albirostris*. *Albirostris* possesses the distinctive character of absence of flecking on the third long vein which Dönitz laid stress upon as diagnostic of his *aconitus*, and in other features it closely corresponds to *aconitus*.

Albirostris has also been reported from Calcutta and the Andaman Islands under the name of *brahmacharii*. I have also examined specimens taken in Burmah.

The "Nyssorhynchus" group.

Anopheles fuliginosus.—First incriminated as a malaria-carrier by Stephens and Christophers. Adie found sporozoites in the salivary glands of specimens taken in the Punjab.

It is a common species in the Malay Peninsula, where it has been known as *nivipes*. Comparison of Malayan *nivipes* with Indian *fuliginosus* has shown that they are the same species. Christophers, however, prefers to regard the Andamans type as a variety of *fuliginosus*.

Its larvæ are common in pools and lakes with weedy margins.

In my experiments with this species, of twenty-three specimens taken in nature one showed zygotes, and of ten fed on blood containing gametocytes of malignant tertian malaria, two developed zygotes.

Anopheles maculatus.—A common species in India and the Malay Peninsula, originally described from specimens taken in Hong Kong. It occurs also in Sumatra and Formosa.

It has been redescribed by Leicester from the Malay States under the name *willmori*. *Maculatus* and *willmori* are, however, two distinct species. In examining the type specimens of the species *maculatus* in the British Museum, I found that the male and female types were of two different species, the male only being of the species usually known to students of the Oriental group as *maculatus*. In this circumstance lies the explanation of the confusion which has existed regarding the nomenclature of this and closely allied forms.

It was proved to be a carrier by Watson in the Federated Malay States, who showed also that it was associated with severe malaria in hilly country.

In my experiments, of 32 specimens taken in nature and dissected, two were infected, and of seven specimens fed on blood containing malignant tertian gametocytes, one developed zygotes.

The species *maculipalpis*, *willmori*, and *stephensi*, which also belong to the "Nyssorhynchus" group, have been proved to be carriers in India. What relationship *annulipes* of Formosa bears to other Oriental species, I have been unable to determine.

The species umbrosus and sinensis.

Anopheles umbrosus.—This species has been found infected in nature by Watson in the Federated Malay States, but the details of his observations have not been published. I am informed by Colonel Alcock that *umbrosus* has also been found infected in Borneo. In my own experiments six dissections and five feeding experiments were negative.

Anopheles sinensis.—Tsuzuki has shown that this species, referred to by him as *A. jesœnsis* is a carrier of benign tertian malaria in Japan. Kinoshita also in Formosa found it to be a carrier of benign tertian and quartan, but not of malignant tertian malaria.

In eighty-seven dissections I found two specimens infected with full-grown zygotes—the species of parasite could, therefore, not be determined. In eleven specimens fed on crescent-containing blood none developed zygotes.

Appendix VIII.

Reports on work carried out in Colonial Laboratories.

The rossi group.

I come now to the consideration of a group of anopheles about which there has been much argument—the *rossi* group. The three types *rossi*, *indefinatus*, and *ludlowi*, which are variously regarded by some as a single species, by others as one species and two varieties, and by others as three distinct species, are obviously closely related. One or other of them is a common species in every country of the Oriental region. What part do they play in malaria transmission?

In India the work of many competent observers over a series of years warrants the conclusion that *rossi* as here defined is not a carrier. Bentley, from his extensive investigation in Bombay, concludes that this species is naturally refractory to malaria infection.

The commonest type of *rossi*-like anopheles in the Malay Peninsula is that species or variety known as *indefinatus*. It differs slightly from typical Indian *rossi* in the palpal markings. One hundred and fourteen dissections of the mid gut and salivary glands of Malayan specimens taken in nature showed no infected individuals, and of twenty-two specimens fed on blood containing numerous crescents none became infected. It seems improbable, therefore, that this variety of *rossi* is a carrier in the Malay Peninsula.

Eysell cites Kinoshita, Banks, De Vogel, and Schuffner in support of his contention that *rossi* is an important agent in the transmission of malaria. His citation of Kinoshita is an error, as *rossi* was not one of the species which that author found to carry malaria in Formosa. Banks experimented with the species *ludlowi*, though he afterwards concluded that this species was identical with *rossi*; his description has been held to suggest doubts as to the nature of the bodies which he believed to be malaria parasites. DeVogel says that he was able to infect only specimens which had bred from salt water. It is now known that *ludlowi* breeds by preference in such situations, and it has been suggested that it was with this species that DeVogel dealt. Schuffners' anopheles I., Eysell says, is identical with *vagus*, Dönitz, and, therefore, with *rossi*, Giles.

Major Christophers, working in the Andamans, records finding two infected specimens of *ludlowi* out of fifty-three examined, and from his study of the conditions there concludes that "the chief carrier of malaria in the settlement is *ludlowi*, a species which breeds in and about salt swamps."

It must be admitted that the evidence with regard to these *rossi*-like mosquitoes is very unsatisfactory, and as they are common species everywhere in the Orient their relationship to malaria is deserving of further study.

In addition to the species dealt with above, I have carried out experiments with the following species with negative results.

	Dissections.	Feeding Experiments.
Nigrans	20	—
Barbirostris	16	8
Kochi	7	4

This survey of what is known of the distribution of anopheles in the Oriental region, and of their relationship to malaria, reveals the fact that the most important agents in the spread of malignant malaria are that group of small brown anopheles which includes *listoni*, *culicifacies*, and *albirostris*. These are hardy species, voracious blood-suckers, and intimate in their association with man. Next in general importance is the "Nyssorhynchus" group, which comprises *maculatus*, *fuliginosus* and *stephensi*. The part played by such species as *ludlowi*, *sinensis*, and *umbrosus* is less clearly defined and seems to warrant further inquiry.

Blackwater fever.

Dr. Fletcher has continued his researches on this disease, and furnishes the following report:—

Eight cases of blackwater fever were reported during the six months under consideration. Where it was possible these cases were visited and the urine and blood examined.

The subjoined table, in which are set out the main features of these cases, is followed by accounts of them in greater detail.

Serial letter	Date.	Age.	Nationality.	Place.	Occupation.	Previous attack of blackwater.	History of malaria.	History of quinine.	Quinine immediately.	Amount of urine.	Treatment.	Result	Remarks.
N	4 April 1913	20	Tamil	Tanjong Malim, Perak	Rubber estate	—	Twice during month of attack	Quinine, grains five daily	Grains five as usual	Plentiful	Quinine in large doses	Urine cleared 3rd day. Recovered	
O	21 May 1913	26	European	Seremban, Negri Sembilan	Rubber estate	—	Only once during 3 months previous to attack. Before that much fever.	Took quinine irregularly	?	Scanty	Quinine in large doses	Died	
P	2 August 1913	30	European	Gopong, Perak	Tin mine	One, nine months before	Very frequent attacks	No quinine	None	Admitted unconscious and died soon afterwards	...	Died	No quinine taken before the attack.
Q	7 August 1913	32	Malayalum	Raub, Pahang	Rubber estate	One, three years before	Only one attack in last three years. Frequent before	No quinine	None	Plentiful	Quinine in large doses	Urine cleared 4th day. Recovered	No quinine taken before attack.
R	8 August 1913	42	Chinese	Seremban, Negri Sembilan	Rubber estate	—	Very frequent attacks	Took quinine irregularly	Grains thirty the day before the attack	Plentiful	Quinine in large doses	Urine cleared 4th day. Recovered	
S	6 September 1913	37	Chinese	Rembau, Negri Sembilan	Goldsmith	—	Frequent attacks	Took quinine whenever he had fever	Grains ten shortly before the attack	?	Quinine in large doses	Urine cleared 6th day. Recovered	
T	19 September 1913	30 (?)	European	Kuala Selangor, Selangor	Rubber estate	One, two years before	Frequent attacks	Took grains fifteen daily	Quinine as usual	Plentiful	Quinine grains fifteen daily	Urine cleared 6th day. Recovered	
U	21 September 1913	26	Chinese	Seremban, Negri Sembilan	Shop (carpenter)	—	Frequent attacks	Took quinine irregularly	Grains ten intra-muscular 3 hours before attack	Plentiful	Quinine in large doses	Urine cleared in twenty-four hours. Recovered	Subtertian rings were found in the blood on the day before the attack.

In two of the cases, P and Q, quinine is excluded as an exciting cause of the disease. All the patients, excepting one who died very soon after admission, and another who received only fifteen grains daily, were treated with large doses of quinine, that is to say, twenty grains or more daily, and of the cases so treated only one died.

In case U subtertian rings were found in the blood on the day before the attack, but none were found after the onset of the blackwater. All the patients, except possibly Case N, had suffered from severe malaria for many months or for several years, though two of them had been comparatively free from it for some time before the attack of blackwater. Three of them had suffered from a previous attack of blackwater fever. There was a relative increase in the numbers of the large mononuclear leucocytes in all the cases, the average number being 14.5 per cent.

Oxyhæmoglobin was present in the urine of every case. Methæmoglobin, in small quantities, was recognised in three.

Clinical details of Cases.

N. April 4th, 1913.

A Tamil coolie, aged 20 years, from the Tanjong Malim Rubber Estate at Tanjong Malim in Perak.

This man had suffered twice from "fever" during the two months prior to his attack of blackwater. He was in the habit of taking five grains of quinine daily as a prophylactic.

When seen, he had been suffering from blackwater fever for two days. He was anæmic and jaundiced, and his spleen was enlarged. The urine at this time was the colour of claret; it contained a small amount of amorphous blood debris, uric acid crystals and a little albumen. No casts were seen. The patient was passing a fair quantity of urine. Spectroscopic examination showed the presence of oxyhæmoglobin and a small quantity of methæmoglobin.

This patient was treated with bihydrochloride of quinine, three grains every three hours. The urine became clear on the third day, and he recovered.

O. May 21st, 1913.

A European, planter, aged 26 years, from a rubber estate (Bute) in Negri Sembilan. He had suffered frequently from malaria for several years in Assam, in Johore, and in Malacca, before he came to Negri Sembilan three months prior to his attack of blackwater fever. He was in the habit of taking quinine fairly regularly, and during the last three months he had had only one attack of fever.

Five days before his urine was examined at this Institute he had a rigor, and shortly afterwards passed very dark urine. Two days later, when he was admitted to the Seremban hospital, he was passing a small amount of bloody urine; he was very restless and vomited almost incessantly. Over his abdomen, shoulders, and elbows there were dark purpuric blotches. He was treated with intramuscular injections of quinine and also received injections of normal saline solution and horse serum. This case terminated fatally.

A spectroscopic examination of the urine demonstrated the presence of oxyhæmoglobin. The deposit was composed of blood debris, bacteria, and numerous desquamated cells.

No parasites were found in the blood smears. The white cells were in the following proportions:—

Polymorphonuclears	54
Small lymphocytes	30
Large mononuclears	14
Eosinophiles	1
Mast cells	1

P. August 2nd, 1913.

A European miner, aged 30, from Gopeng in Perak. This patient had suffered a great deal from subtertian malaria and he drank alcohol to excess. He had a previous attack of blackwater eight months before. He was not in the habit of taking quinine and he had been suffering from fever for some time when he suddenly became unconscious while at work. On the following day he was admitted to Batu

Gajah hospital in a condition of delirium, and he died about twenty-four hours later. A sample of urine, taken on the day of his admission to hospital, was of a dark mahogany colour. It contained a small quantity of oxyhæmoglobin. There was a copious deposit, consisting of blood-debris, hæmatoidin needles, "hæmoglobin" casts, granular and fatty casts, and a few epithelial cells. The urine showed a cloud of albumen on boiling.

In a sample of urine taken on the following day no hæmoglobin bands could be detected by spectroscopic examination, and no blood debris could be seen in the deposit, which consisted largely of fatty and granular casts, containing a few epithelial cells.

No parasites were found in the blood, which showed a moderate degree of poikilocytosis and the presence of a few nucleated red cells. A differential count of the white cells gave the following result:—

Polymorphonuclears	51
Small lymphocytes	32
Large mononuclears	17
Eosinophiles	0

All the organs received for examination were in an advanced stage of putrefaction, so that sections made from them could not be stained for microscopical examination.

The liver showed a quantity of free iron in the centre of the trabeculæ of the portal zones of the lobules. Towards the middle of the lobules, also in the centre of the trabeculæ, there was pigment of a golden colour. There were abundant granules and lumps of malarial pigment in and near the walls of the capillaries. The liver was so much altered by post-mortem changes that little could be learned from stained sections. The central part of many of the lobules had undergone necrosis with fragmentation of the trabeculæ.

The spleen-pulp was crowded with putrefactive organisms, the nuclei and cells had lost all power of differential staining, and the histological structure of the organ had been destroyed by decomposition. Large blocks and fine granules of malarial pigment were present in abundance.

In the kidney, putrefaction had advanced too far for anything to be learned from sections of that organ.

Q. August 3rd, 1913.

A Malayalum coolie, aged 32, from a rubber estate (Sungei Bulit) in Pahang. He had lived seven years in Pahang, and before that, for three years, he was in Penang and Province Wellesley.

This man had suffered from blackwater fever three years before his present attack, when he was working on another estate (Cheroh). On that occasion his urine was black for ten days. Since that time he had been employed on a more healthy estate and had only once had fever. The first symptom of his present attack was the passing of black urine; two hours later he had rigor and felt feverish. He had taken no quinine before he passed the black urine. On the following day he was admitted into Raub hospital. On the third day of his illness no malarial parasites were found in his blood, but the Medical Officer in charge of the case reports that he found them on the fourth and fifth days of the attack. Blood-smears made on the evening of the fifth day and examined here, contained no parasites.

The white cells were in the following proportions:—

Polymorphonuclears	50
Small lymphocytes	31.5
Large mononuclears	16
Eosinophiles	2.5

The urine became clear at the end of the fourth day. A specimen passed at 3 p.m., and examined here was the colour of porter and contained oxy- and methæmoglobin, hæmoglobin casts, and a few epithelial cells. When boiled the specimen was almost solid with albumen. Urine passed five hours later contained a little less albumen and no blood could be recognized by spectroscopic examination. In a specimen passed at midnight the amount of albumen was slightly reduced, granular casts and degenerate epithelial cells were present, but no blood.

This patient was treated with quinine, thirty grains a day by the mouth, and he was given saline injections. He recovered.

R. August 8th, 1913.

A Chinese coolie, aged 42, from a rubber estate (Gedong Lalang) in Seremban. This man had lived for twenty years in the Malay States, and for some time he had suffered from malaria almost continuously. He took quinine irregularly, and the day before his attack of blackwater began he had taken thirty grains.

The urine and blood of this patient were examined here on the first day of his attack. The urine was a dark port-wine colour; it contained oxyhæmoglobin, a little methæmoglobin, and a deposit which consisted of amorphous blood-debris and a few epithelial cells. On boiling a dense cloud of albumen appeared.

In the blood no parasites were found. A differential count of the white cells gave the following result:—

Polymorphonuclears	74
Small lymphocytes	7.4
Large mononuclears	16.75
Eosinophiles	1.85.

This patient was treated with quinine, thirty grains of the bihydrochloride by intramuscular injection, each day. Calcium chloride and adrenalin were also given. His urine became clear on the fourth day and he recovered.

S. September 6th, 1913.

A Chinese goldsmith from Rembau in Negri Sembilan. This man had suffered from frequent attacks of fever, for which he took quinine irregularly. Three days before his urine was examined here he took ten grains of quinine, and when he next passed water it was black. Two days later he was admitted to the Seremban hospital. No parasites were found in his blood. The slides sent to this Institute were damaged in transit, so that a reliable estimation of the numerical proportions of the white cells could not be made. The urine was almost black. It contained oxyhæmoglobin, "hæmoglobin" casts with a few adherent epithelial cells, and, on boiling, it was almost solid with albumen.

This patient was treated with quinine, twenty grains of the bihydrochloride by intramuscular injection, every day. The temperature became normal and the urine clear on the sixth day.

T. September 19th, 1913.

A European planter, aged about 30, from an estate (Jalan Acob) in Kuala Selangor.

This patient had suffered from frequent attacks of malaria for several years. Two years ago he had suffered from a previous attack of blackwater. During the four weeks immediately preceding his present illness he had been suffering from fever and had been taking ten or fifteen grains of quinine every day, when the attack began with vomiting, diarrhœa, and the passing of black urine.

No parasites were found in his blood. The result of a differential count was as follows:—

Polymorphonuclears	57.72
Small lymphocytes	30.00
Large mononuclears	9.71
Eosinophiles	2.57

The urine examined on the third day of this patient's illness was so dark that it appeared to be black until it had been diluted. It contained oxyhæmoglobin, granular "hæmoglobin" casts with adherent epithelial cells, and a large amount of albumen. The patient was treated with quinine, fifteen grains of the bihydrochloride every day, and saline injections. On the fifth day there was still a cloud of albumen when the urine was boiled, and a trace of oxyhæmoglobin could be detected by spectroscopic examination; there were also a few small casts and some large epithelial cells in the urine. On the following day the urine was clear of hæmoglobin, but there was still a trace of albumen, and granular casts were still present on the eighth day. His illness ended in recovery.

Appendix VIII.

Reports on work carried out in Colonial Laboratories.

U. September 22nd, 1913.

A Chinese carpenter, aged 26, from Seremban town. This man had worked on a rubber estate in Singapore, where he had suffered much from malaria. During the five months prior to his present attack he had been living in Seremban, where he had been ill with malaria nearly the whole time, and had taken quinine irregularly. He was admitted to the Seremban hospital on 20th September with a wound on his foot, and during the night he had an attack of fever. His blood was examined, subtertian rings were found and quinine administered. He received an intramuscular injection of ten grains of the bihydrochloride on the afternoon of 21st September, and a second injection the next morning. Three hours after the second dose he passed black urine. The injections of quinine were not discontinued: another dose of ten grains was given four hours after the appearance of the blackwater, and twenty grains were injected during the course of the following day (23rd September). The urine had cleared by the next morning (24th September), within twenty-four hours of the commencement of the attack. One more injection was given and thereafter thirty grains a day by the mouth.

No parasites were found in the blood-smears made on 24th September. White cells were present in the following proportions:—

Polymorphonuclears	60
Small lymphocytes	26
Large mononuclears	13
Eosinophiles	0.5
Mast cells	0.5

A sample of the urine passed on September 22nd was of a dark mahogany colour. Spectroscopic examination showed the presence of oxyhæmoglobin, and there was an abundant sediment of blood-debris containing large "hæmoglobin" casts and a few epithelial cells. This deposit, washed in the centrifuge, contained a trace of iron in organic combination. The urine became solid with albumen when it was boiled.

Wassermann reaction.

For this reaction the method of Browning and Mackenzie was employed, modified by the use of a human hæmolytic system.

Sixteen doubtful or latent cases and four active tertiary cases were examined. Six of the former and all of the latter gave positive reactions.

Widal reaction.

Seventy-two specimens of blood were examined for the presence of agglutinins, with the following results:—

	Positive.	Negative.
B. typhosus	17	51
B. paratyphosus A.	0	2
B. paratyphosus B.	0	2

The very high proportion of negative reactions suggest that Medical Officers tend to make this test a substitute for clinical work.

Rabies.

Examinations were made of the brains of four dogs suspected to have suffered from rabies and Negri's bodies were found in all of them. Two of the cases were sent from Raub in the State of Pahang, one from Kuala Pilah in Negri Sembilan, and one from Malacca.

Plague.

A few rats, fifty-eight in all, were sent from time to time by the Health Officer of Kuala Lumpur. None of them was plague-infected. There were no cases of human plague.

Tumours.

Of the tumours examined, three were uncommon; an epithelioma of the cornea in a Sikh, sent by the Medical Officer of the District hospital, Kuala Lumpur; a primary sarcoma of the ileum, sent by the Medical Officer, Seremban; and a primary sarcoma of the liver which occurred in a Tamil woman, aged 35, and of which the following is a description:—

Appendix VIII.

Reports on work carried out in Colonial Laboratories.

On 24th September there were received from the Medical Officer, Kuala Kubu, the liver, spleen, stomach, lung, uterus, heart, and kidney of a Tamil woman aged 35. All these organs had been preserved in a solution of formalin. The uterus and kidney appeared to be normal. The liver was an enormous irregular mass, with irregular bosses on its surface. It weighed 181 ounces. The normal contour of the organ was lost and the limits of its several lobes were no longer definable. The gall-bladder, which was small, shrunken, contained a little bile. The outer parts of the liver were very tough and hard, but the centre had undergone degeneration and was in a pultaceous, encephaloid condition. No traces of liver tissue could be recognized by the naked eye. The organ appeared to consist entirely of new growth, in which there were numerous hæmorrhages and areas of necrotic-softening. In histological sections it was seen that the liver consisted of interlacing bands and whorls of large spindle-cells. In some areas there was a moderate development of fibrous tissue, in others, there was necrosis. The tissue was nowhere very vascular. In a few places there were strands of necrotic liver cells.

The lungs appeared to be normal except for the presence of a few small nodules on the surface which were about the size of miliary tubercules, but less well defined. The examination of microscopical sections showed that the lungs were full of metastatic deposits, similar in structure to the new growth in the liver. These occurred in the deep layer of the pleura, in the adventitia of the blood vessels and bronchioles, and in the septa. These deposits were nearly all of microscopic size; they were not encapsuled, but merged with the surrounding tissues, so that their limits were ill defined. The capillaries of the lung were slightly congested, but the deposits of new growth excited no localized inflammatory reaction, they were surrounded by no small cell infiltration.

On the surface of the spleen there were a few small white nodules less than 1 cm. in diameter. These consisted of new growth similar to that found in the liver; the tissue in the centre of each had undergone degeneration. The nodules were well defined, but they were not encapsuled, they appeared to have pushed aside the tissue of the spleen.

On the outer surface of the right auricular appendix there was a small white nodule 2 mm. in diameter. The structure of this was the same as that of the other growths.

Within the stomach, on its posterior wall, there were three flat, umbilicated, white nodules, the largest of which measured 1 cm. in diameter. These tumours were of the same nature as those already described. They were sharply demarcated from the surrounding tissues, which they did not infiltrate, but had thrust aside in their growth. They were imbedded in the mucosa which overlapped their margins but was not continuous over their free surfaces, which projected into the cavity of the stomach. They were superficial to the *muscularis* which had atrophied beneath them.

The chief point which arises in connexion with this case is whether the primary growth had its origin in the liver or in the stomach. The new growth in the liver had entirely destroyed the tissues of that organ except a few strands of degenerate liver cells near the surface; the centre of the viscus was necrotic and semi-fluid. The growths in the stomach were small, they had undergone no degeneration, and they were not fibrotic. These are points in favour of the tumour in the liver being the parent growth, yet it is difficult to see how a primary growth in the liver could give rise to metastatic deposits in the mucosa of the stomach, though the reverse occurs frequently. The spindle-cells in some parts of the tumours were very large so that it was a matter of difficulty to decide whether they were fibres of unstriped muscle or only large spindle-cells. It is possible, therefore, that the primary growth may have been a malignant myoma of the stomach. On the other hand, the small size of the gastric tumours, the absence of degeneration or differentiation into fibrous tissue, and the absence of ulceration over them are all points in favour of the liver tumour having been the primary growth.

Other routine work.

Material forwarded by medical and veterinary officers has included specimens for examination for cholera, diphtheria, cerebro-spinal meningitis, piroplasmosis, &c.

Appendix VIII.

Reports on work carried out in Colonial Laboratories.

Chemistry.

Mr. Blair furnishes the following report:—

The total number of analyses performed during the six months was 589, which may be classified as follows:—

1.	Waters	62
2.	Milks	118
3.	Chandu and chandu dross	71
4.	Morphine	44
5.	Counterfeit coins and materials	171
6.	Articles examined for blood stains	10
7.	Articles examined for poison	47
8.	Liquors	45
9.	Miscellaneous	21
10.	Special Analyses.	

1. Waters.

The examination of the Taiping supply was continued, and, from the results of the analyses, there is a slight improvement. The presence of spirogyra has only occurred in one sample since 1st April, 1913; and the absence partially proves that the filter beds are working satisfactorily.

Six samples from the Gombak and Klang rivers, which flow through Kuala Lumpur, were examined and, from the results, the river at Kampong Attap bridge was found to show the greatest pollution. The remaining samples of water examined were sent from different places in the Federated Malay States, and the majority of these samples were satisfactory from a chemical standpoint.

2. Milks.

One hundred and eighteen samples of milk were examined, the majority consisting of fresh milk samples collected by the Sanitary Board Inspector. Eighteen were found to be adulterated with water. The majority of the samples consisted of buffaloes' milk.

3. Chandu and Chandu Dross.

The majority of these samples were examined with a view to discovering whether the chandu present was of Government manufacture or not.

Five samples were found to contain chandu other than that manufactured by Government; the other samples were derived wholly or in part from Government chandu.

The dross in all cases was derived from Government chandu.

4. Morphine.

Of the samples examined for morphine hydrochloride, seven samples contained no morphine hydrochloride or salt of morphine, the remaining thirty-seven gave positive results. The amount of morphine hydrochloride varied from 50 per cent. to 60 per cent., the other constituent being as a rule milk sugar. Cinchonine hydrochloride has been found in a few of these samples.

5. Counterfeit Coins and Materials.

Sixty-three coins were examined and all were found to be counterfeit, being composed of an alloy of copper, antimony, and tin, obtained from britannia metal spoons. The materials for making these counterfeit coins consisted of plaster of paris moulds, occasionally containing metal castings, and liquids containing acid for cleaning purposes.

6. Articles Examined for Blood Stains.

Three of these articles gave negative results for blood, the articles consisting chiefly of clothes.

7. Articles Examined for Poison.

Thirty-one of these consisted of stomach contents and viscera, fourteen gave positive results. The poisons found were opium (five), and arsenic (nine). Five cases of arsenical poisoning were received from Kuala Kubu, the victims had eaten "white ant powder," a granular mass resembling a Malay cake, for which it was mistaken. "White ant powder" consists mainly of arsenic and sulphur.

Three specimens of "ringut," the fruit of *epipremnum giganteum*, Scott, were submitted for examination.

8. LIQUORS.

Complete analyses were made of twenty nine spirits and partial analyses of sixteen samples of various liquors, some of these analyses are carried out for excise purposes.

Sixteen samples of toddy were examined and none of the samples could be said to be adulterated.

9. MISCELLANEOUS.

These included the following: Six Malay medicines, none of which were found to contain alkaloids. Four anti-opium samples, of which two contained a small proportion of morphine hydrochloride.

A sample of tea, supposed to have been adulterated, was examined, but no adulteration was found.

10. SPECIAL ANALYSES.

A large number of samples of milk have been collected both in the early morning between 3.30 a.m. to 5.30 a.m. and in the afternoon between 2 and 4 p.m., with a view to determining the average composition of the milk obtained from buffaloes and cows. This work will be continued as time permits.

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ANNEXURE.

THE BACILLUS LEPRÆ: HAS IT BEEN CULTIVATED?

By HENRY FRASER, M.D., Aberdeen, Director, Institute for Medical Research, Kuala Lumpur, Federated Malay States, and
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During recent years various investigators have recorded the successful cultivation of the bacillus lepræ on artificial media. The means by which it is stated that the saprophytic existence can be induced vary considerably. Some assert that the organism will grow on ordinary media, others that media resembling in composition the tissues and fluids of the body are indispensable, while others claim that the cleavage products of proteins are essential. There is a lack of agreement in regard to the characters which the bacillus is said to exhibit in culture. Some writers state that the organism is consistently acid-fast, others are of opinion that it is not. Some claim that the organism becomes converted into a streptothrix, others contend that it becomes a non-acid-fast bacillus. In order to reconcile the inconsistencies and discrepancies, it has been asserted that the leprosy bacillus is a "pleomorphic organism." The introduction of this term is unfortunate, since it has enabled various workers to assert that organisms which have no genetic relationship with the bacillus lepræ have evolved from that organism.

There are difficulties in inducing strongly parasitic organisms to adapt themselves to saprophytic conditions. When investigators overcome these difficulties it is customary for them to describe their methods in detail, so that their work can be repeated by anyone possessed of the necessary facilities and skill. The claims made by the original investigators are tenable provided that their accuracy is thus independently confirmed and the results obtained are uniformly consistent; this is not the case with the work which has recently been recorded in connexion with the cultivation of the leprosy bacillus. During the past eighteen months work has been carried on here with a view to the cultivation of the bacillus lepræ. The experiments represent a uniform series of failures to obtain a growth of this bacillus, and it therefore appears desirable that they should be recorded.

Method of obtaining material.

The leper asylum is situated within half a mile of the Institute, and contains more than two hundred and fifty patients. From among these, non-ulcerating cases were invariably selected; from dirty, ulcerating cases it is possible to cultivate all manner of organisms. The patients came willingly to the Institute for observation, so that the work was done under much more favourable conditions than would have been the case had necessity compelled us to transport our materials to the leper

asylum. In the first experiments bacilli were obtained by disinfecting the skin over a nodule, which was then punctured. On applying pressure to the punctured nodule blood exuded; this was wiped off, and the pressure continued until a serous fluid was obtained. This fluid, rich in leprosy bacilli, was inoculated on the media by means of a platinum loop. The procedure was not successful—all the tubes were contaminated. Aspiration of fluid from the nodules was next tried; only small amounts of juice were obtained, and the inoculated tubes were all contaminated. Normal saline solution was injected into the nodules, which were then massaged, and afterwards an attempt was made to aspirate fluid from the nodules. Only small quantities of fluid were obtained, and the inoculated tubes were contaminated.

The following procedure was eventually adopted with excellent results:—

1. The skin over and around the nodule was painted with tincture of iodine prepared with 70 per cent. alcohol.
2. Sterile solution of cocaine was injected into the tissues surrounding the nodule.
3. A sterile suture of silkworm gut was passed through the peripheral part of the nodule.
4. A second application of tincture of iodine was made.
5. When the skin had dried, a horseshoe-shaped incision was made around the nodule and a flap of skin reflected from the subjacent tissues.
6. The skin flap was held back by means of the silkworm gut suture and from the subjacent tissues small pieces were excised; these were inoculated directly on to the media.
7. When a sufficient amount of tissue had been excised the skin flap was returned and sutured. Healing by first intention can invariably be obtained.

In a number of experiments conducted recently nodules on the ear have been selected. In these cases a simple incision has been made and the wound made to gape by means of sutures inserted on each side of the incision. From the depth of the wound pieces of tissue were excised. In every case a portion was excised for microscopical examination. Abundance of leprosy bacilli was invariably found, so that no objection can be raised on the ground that an insufficient number was inoculated.

Nutrient agar.

In experiments with blood, with serum, and with placental extracts, these fluids were mixed with equal parts of nutrient agar of the following composition:—

Powdered agar	40 grms.
Peptone	10 grms.
Salt	5 grms.
Glycerine	60 c.c.
Meat extract to	1000 c.c.

The preparation was carried out in accordance with the methods described in Eyre's "Bacteriological Technique." The medium was titrated with N/10 NaOH. When a medium of reaction + 10 was required the calculated amount of N. NaOH. was added. When an alkaline or -10 medium was required, the calculated amount of $N.Na_2CO_3$ was added; only by this procedure can an alkaline nutrient agar be prepared (1).

Incubation.

With the exception of some experiments carried out in accordance with the methods employed by Duval (2), incubation was invariably effected in Hearson's incubators at a temperature of 37°C.

It is stated (2) that the bacillus lepræ requires an abundant supply of oxygen and therefore cannot be grown in rubber-capped tubes; certainly no culture of the organism has been obtained by us when this procedure was employed. If the tubes are incubated in the ordinary way, evaporation proceeds and the medium becomes unsuitable. To obviate this, incubation in moist chambers has been recommended, but, in our experience, this procedure is unsatisfactory; moulds rapidly form on the plugs and, unless great precautions are taken, the media become contaminated. Satisfactory results are obtained by incubation in the ordinary way, and from time to time adding, by means of sterile Pasteur pipettes, sterile distilled water to replace the water of condensation lost by evaporation.

APPENDIX VIII.

REPORTS ON WORK CARRIED OUT IN COLONIAL LABORATORIES.

Experiments with blood-media.

In a previous series of experiments (3) carried out in connexion with the cultivation of the gonococcus, the Koch-Week's bacillus and the diplobacillus of Morax-Axenfeld, it was found that these organisms could be cultivated readily on a +10 nutrient agar which had been mixed with sterile unheated ovarian or ascitic fluids. It was further found that ovarian fluid was more suitable than ascitic fluid. The ovarian fluid was apparently superior because of its higher albumen-content and the presence of blood-derivatives. Following up the train of thought suggested by these experiments citrated ox-blood was employed in place of ovarian fluid and found to yield equally luxuriant cultures of these organisms.

The excellent results obtained by the use of these media suggested the probability of their usefulness in the cultivation of the bacillus lepræ.

Sterile ox-blood is not readily obtainable in this country, because of the method by which cattle are slaughtered, and ovarian tumours are rarely met with in the hospitals.

We therefore decided to employ citrated human blood. Test-tubes each containing 0.0125 gramme of sodium citrate dissolved in 0.5 c.c. of distilled water were sterilized in the autoclave for twenty minutes at 120°C. Under aseptic precautions blood was removed from the median-cephalic vein, and 5 c.c. added to each test-tube containing sodium citrate. Tubes each containing 5 c.c. of the + 10 nutrient agar were melted and cooled to 45°C. To each tube 5 c.c. of citrated blood were added, the contents mixed, sloped and cooled rapidly by means of ice and salt.

The tubes were incubated for two days in order to test their sterility.

In the first instance, the suitability of this medium for the growth of the tubercle bacillus was tested. Sputum from a case of pulmonary tuberculosis was inoculated into the groin of a guinea pig. Three weeks later the animal was killed and, under aseptic precautions, the spleen was removed; it was not apparently tubercular, and a cursory examination of a stained smear did not reveal the presence of tubercle bacilli.

Pieces of the spleen were inoculated into six blood-agar tubes, which were then capped and incubated at 37°C. Three of the tubes were contaminated, but, in the other three, growth of tubercle bacilli slowly occurred, and by the fourth week the growth was distinct. Subcultures were made on the blood-agar, and profuse growths obtained. Only a relatively small number of bacilli were inoculated into the original tubes. In our experiments with leprosy bacilli it was designed to inoculate large numbers of organisms because of the possibility, which has been suggested, that many of the bacilli found in the tissues are dead.

Clegg (4) in his experiments claims to have cultivated the organism in symbiosis with amœbæ. He employed a 1 per cent. alkaline agar. Duval (2) claims to have confirmed the accuracy of Clegg's work. An alkaline blood-medium was therefore prepared.

Tubes containing 5 c.c. of the −10 nutrient agar were melted and cooled to 45°C. To each tube was then added 5 c.c. of citrated blood; after mixing, the tube was sloped and the contents cooled rapidly by means of ice and salt. The sterility of the tubes was tested by incubation for two days.

Tubes containing + 10 blood-agar with 0.5 per cent. glucose and tubes containing −10 blood-agar with 0.5 per cent. glucose were prepared for anærobic cultures.

These tubes were inoculated with material obtained from seventeen non-ulcerating nodular cases of leprosy. From any one nodule the minimum number of tubes inoculated was four and the maximum number thirteen. In all 82 inoculations were made on + 10 blood-agar and 62 inoculations on −10 blood-agar. Every tube received a piece of tissue, on an average, equal in size to that of a rice-grain and swarming with leprosy bacilli.

The tubes were incubated anærobically and ærobically.

The maximum period of anærobic cultivation was two months and there was no apparent prolification of the bacilli.

The maximum period of ærobic cultivation was nine months. From no tube incubated ærobically has a culture of the bacillus lepræ been obtained: the organisms persist but, in our opinion, do not proliferate. They retain their form and their acid-fastness.

Appendix VIII.

Reports on work carried out in colonial laboratories.

Experiments with blood serum.

Under aseptic precautions, blood was collected from normal individuals and lepers. The blood, in quantities of 10 c.c., was placed in sterile test-tubes and, after coagulation had taken place, the serum was transferred to sterile test-tubes and inactivated by heating at 56°C. for thirty minutes. Twelve tubes containing leper-serum and twenty containing normal serum were prepared in this way. Two nodular cases of leprosy furnished the material with which the tubes were inoculated.

Six inoculated tubes of leper-serum and nine inoculated tubes of normal serum were incubated anærobically. Once a week, or thereabouts, the cultures were removed and examined. Sterile distilled water was then added to the tubes requiring it, in order to bring the fluid up to its original volume, and anærobiosis was restored. One tube was found to be contaminated with a stout non-acid-fast bacillus on the occasion of the first examination, the remaining tubes showed neither macroscopically nor microscopically that proliferation of the bacilli had occurred.

Six inoculated tubes of leper-serum and eleven inoculated tubes of normal serum were incubated ærobically. The original volume of fluid contained in each tube was restored from time to time by the addition of sterile distilled water. In none of the tubes has proliferation of the leprosy bacilli been observed. These experiments were discontinued after six months.

Experiments with serum-agar.

Serum was obtained in the manner described under experiments with blood-serum.

Alkaline nutrient agar, with and without one per cent. glucose, and +10 nutrient agar, with and without glucose, contained in tubes in quantities of 5 c.c., were melted and cooled to 60°C.; each tube then received 5 c.c. of serum. The mixtures were allowed to set as slopes. After incubation for forty-eight hours to test their sterility, each tube received a portion of a leproma.

The tubes containing glucose-media were incubated anærobically and the others ærobically.

Eight tubes of −10 serum-agar were inoculated from four cases, and eight tubes of −10 serum-glucose-agar were inoculated from four cases.

Eight tubes of +10 serum-agar were inoculated from four cases, and eight tubes of +10 serum-glucose-agar were inoculated from four cases.

On incubation several of the tubes of +10 serum-agar showed minute dew-drops either adjacent to, or at some distance from, the nodule. On examination the dew-drops were found to contain leprosy bacilli. The question arose, were these dew-drops colonies or merely droplets of moisture exuded from nodules swarming with lepra bacilli? Further observations have confirmed the accuracy of the latter view.

Experiments with Rost's medium.

For his initial cultures (5) this investigator employed a medium of the following composition:—

Distilled volatile alkaloid of rotten fish ...	250 c.c.
Weak Lemco-broth without salt or peptone	250 c.c.
Milk	50 c.c.

Burmese preserved fish was not available. Williams (5) has shown that distilled water may be substituted for the fish-distillate. It was not therefore considered necessary to obtain this kind of fish and to dismantle an autoclave for the purpose of preparing the distillate. As, in addition, it is directed that the medium should be sterilized in the autoclave, it is difficult to see that much, if any, of this volatile alkaloid can remain in the medium.

Rost's medium was prepared in accordance with Williams's modification.

Rost prepared his cultures by incubation at 30°C., but Williams has shown that incubation at 37°C. is equally effective; the latter procedure was therefore adopted. Rost states that leprosy bacilli proliferate when incubated at 30°C. along with blister-fluid contained in pipettes. Our experiments with serum did not confirm this observation.

The method employed by him, of squeezing out the fluid from a nodule exposed under aseptic precautions, appeared to us likely to increase the risks of contamination, and was therefore not adopted.

Six tubes were inoculated with leprous tissue obtained from one patient, and six tubes were inoculated with tissue from another patient. None of them were contaminated, and films prepared from time to time did not show that the bacilli had proliferated.

After incubation for two and a half months most of the media had evaporated and the pieces of tissue were transferred to fresh tubes.

A month later films were prepared from all the tubes, but in no single instance was there evidence of proliferation. The organisms were acid-fast and their appearance corresponded in every way with the acid-fast bacilli seen in films prepared from a fresh leprous nodule. Bizarre forms were never seen.

Experiments with Williams's medium.

This investigator claims (5) to have obtained initial cultures of the leprosy bacillus on ordinary nutrient broth when incubated at room-temperature and on potato-broth when incubated at 37°C.

He gives no special directions for the preparation of potato-broth; it was, therefore, prepared in the ordinary way. Pieces of tissue were obtained in the manner already described, and twelve tubes were inoculated from two cases of leprosy; six tubes from each case.

The tissue from both cases swarmed with acid-fast bacilli. The tubes were incubated, as recommended by Williams, at 37°C. The cultures were examined from time to time, but proliferation of the bacilli was never observed.

After incubating for two and a half months, as the media had almost entirely evaporated, the pieces of tissue were transferred to fresh tubes. A month later this experiment was ended. Films were prepared from the culture fluid in each of the twenty-four tubes. The films were stained and examined; only occasionally were bacilli met with, and these were invariably acid-fast.

Films were prepared from the inoculated pieces of tissue. The cells had entirely disappeared. Bacilli, invariably acid-fast, were present in great abundance. They invariably showed the ordinary form of the leprosy bacillus, bizarre forms were never seen, and there was nothing to indicate that the bacilli were more numerous than in the tissue originally inoculated; in short, there was no evidence of proliferation.

Experiments with Duval's media.

Clegg (4) claims to have grown the bacillus in symbiosis with amœbæ. Duval (2) states that he has confirmed the accuracy of Clegg's work.

He (6) found that symbiosis with amœbæ was not essential and that, in symbiosis with organisms capable of decomposing proteins, a culture of the bacillus lepræ could be obtained on ordinary media. He (2) also found that the bacillus could be cultivated on media containing amino-acids; tryptophane and cystein are said to be the most important of these substances.

Casein was not available here and an attempt was made to prepare tryptophane from condensed milk, but the quantities obtained were insufficient for experimental purposes. As, in addition, he has stated (6) that trypsinized egg-medium will yield equally good results the work of preparing amino-acids was abandoned.

We therefore prepared tubes of Dorset's egg-medium and inoculated them with pieces of leprous tissue. The surface of the medium was then covered with a sterile solution of trypsin. Duval at first laid stress on the importance of incubation at 32°C., but later he appears to cultivate the organism quite readily at 37°C. Twenty-two tubes in all were inoculated; half of them were incubated at 32°C. and the other half at 37°C.

After some days the media in the tubes had been digested into a slushy mass. No evidence was obtained from any of the tubes that proliferation of the bacilli had occurred.

Again following Duval, egg-albumen in Petri-dishes was inspissated for three hours at 70°C. and each plate then received a piece of leprous tissue. The surface of the medium was covered with a sterile solution of trypsin and the plates incubated at 37°C. Most of them became contaminated, but in the few which remained uncontaminated there was no evidence of proliferation.

Still later, Duval and Wellman (7) (8), following Kedrowsky, recommended the use of placental agar. The method of preparation differs in some respects from that employed by Bayon (9).

Thirty tubes of placental agar, prepared by their method, were inoculated direct with leprous nodules excised from two lepers. The tubes were incubated at 37°C. and after a few days two of them were observed to be contaminated. The remaining twenty-eight tubes have now been under observation for more than six months. A moist condition of the media has been maintained by the procedure described in connexion with blood-media. In none of these tubes is growth apparent macroscopically, and films prepared from the inoculated nodules show, in our opinion, persistence but not proliferation of the acid-fast bacilli.

Experiments with Bayon's medium.

This investigator has employed various media (9), among others placental agar, prepared according to the manner described by Kedrowsky.

Bayon, in his published works, does not state the method of preparing the placental agar, but in reply to a communication addressed to him we were furnished with the necessary particulars, which are as follows:—"A fresh placenta is chopped up fine, mixed with its weight of sterile distilled water and then frozen hard for twelve hours. It is then thawed rapidly at a little over room temperature, say 20°C., and the juice squeezed out with a meat press. The resulting liquid is rapidly passed through a paper filter and then put through a tandem arrangement of Berkfeld and Doulton filters. It ought now to be absolutely sterile and has to be mixed with equal quantities of 4 per cent. glycerine-agar under aseptic precautions. The tubes cannot be heated, those that are found to be contaminated have to be thrown away".

Attention must be directed to the question of contaminated tubes. When the process described is accurately followed there should be, as was the case in our experiments, no contaminated tubes.

Twenty tubes of this medium were inoculated from one case of leprosy and fifteen from another. The tubes have now been incubated for over six months, a moist condition being maintained by the method already described. Not one of them shows contamination and not one of them shows a culture of the leprosy bacillus.

Experiments with serum-water.

Blood was drawn from the jugular vein of a sheep and the serum separated. The serum was mixed with distilled water in the proportion of one of the former to three of the latter. The serum-water was filled into tubes and, in the case of those destined for anærobic cultures, a thick layer of oil (*paraffinum liquidum B.P.*) was poured on the surface. The media were sterilized by heating for half an hour at 100°C. on three successive days.

Eight tubes, for ærobic culture, were inoculated with pieces of leper-tissue obtained from four cases, and thirteen tubes for anærobic culture were inoculated from five cases. The inoculated tubes have now been under observation for three months and no culture has been obtained.

Experiments with salt-solution.

Tubes containing salt-solution were prepared for ærobic culture and for anærobic culture with oil as described in the previous section.

Five tubes for ærobic culture were inoculated from three cases and eight tubes for anærobic culture were inoculated from four cases. The inoculated tubes have now been under observation for three months and no culture has been obtained.

Experiments with Ringer's fluid.

Tubes containing Ringer's fluid were prepared for ærobic culture and for anærobic culture with oil as described under serum-water.

Five tubes for ærobic culture were inoculated from three cases and eight tubes for anærobic culture were inoculated from four cases.

The inoculated tubes have now been under observation for three months and no culture has been obtained.

Experiments with milk-agar.

Alkaline-agar was mixed with fresh milk in equal proportions. The mixture was transferred to tubes and sterilized.

Nineteen slopes of this medium were inoculated from three cases. The inoculated tubes have now been under observation for three months and no culture has been obtained.

Milk does not form a homogeneous preparation with + 10 agar and the mixture did not appear suitable.

Contaminating micro-organisms.

These may, for convenience, be grouped into:

1. Contaminating micro-organisms introduced with, or at the time of introducing, the nodule.
2. Contaminating micro-organisms introduced subsequently either by growing through the cotton-wool-plug or during the manipulations entailed by the moistening of the media.

In the early stages of our investigations and before sufficient technical skill had been acquired it not infrequently happened that contaminated nodules were inoculated.

On incubation the presence of these organisms was demonstrated by the occurrence of a macroscopic growth, visible as a rule within a few days. Colonies of staphylococci call for no special comment. In some instances the nodule showed, on blood-media, a brownish growth; at first limited, but gradually spreading over the surface of the medium either as a continuous growth or as isolated colonies. On examination these growths were found, in certain instances, to consist of a slender non-motile rod mixed with large coccoid spores. This organism is of importance, because it would appear that observers have mistaken such spores, when stained by the Ziehl-Neelsen method, for acid-fast organisms. This bacillus grows freely on ordinary agar, forming a yellowish crinkled growth.

In this connexion reference must be made to Bayon's "acid-resisting" and acid-fast organisms (9). Anyone who has worked with acid-fast organisms must be aware of the power with which these germs retain the carbol-fuchsin. It is wrong to describe germs as "acid-resisting" because they retain the carbol-fuchsin after momentary immersion in weak acid. It is an attempt to explain his transition stages from a non-acid-fast streptothrix to an acid-fast bacillus; and is, in our experience, unsound and misleading.

In common with other workers we have isolated diphtheroid organisms, but these are ubiquitous and demand no special consideration.

Granting that either of these contaminating bacilli has a genetic relationship with the bacillus of leprosy, how are the results observed in the following experiment to be explained? Ten tubes of blood-agar were inoculated with pieces of leprous tissue from one nodule swarming with acid-fast organisms. On incubation there developed in one of the tubes a culture of a non-acid-fast organism. In the remaining nine tubes no cultures were obtained. It is impossible to believe that in this nodule there was only one part of it in which a living acid-fast germ was present and that that germ should on proliferation give rise to a non-acid-fast organism growing freely on ordinary media.

In other instances the growth was found to consist of a streptothrix which grows readily but slowly on + 10 nutrient-agar in the form of orange-red colonies and on −10 nutrient agar in the form of greyish-brown striated colonies.

Smears prepared from nodules which have become contaminated with either a streptothrix or a bacillus invariably show masses of leprosy bacilli, because these organisms are so abundant in the tissues employed. If a tube of nutrient agar be inoculated with an emulsion prepared from such a nodule a growth will readily be obtained and smears prepared from this may show the presence of some acid-fast bacilli among the contaminating organisms because the former have been so numerous in the inoculated material. In the second subculture on nutrient agar acid-fast bacilli may or may not be found; most probably not.

The fact that these contaminating organisms grow in the first subculture on + 10 nutrient agar is strong evidence against them having originated from leprosy bacilli, and from the numerous examinations made we have no hesitation in stating that they have no connexion with the leprosy bacillus. Several investigators have described in detail the gradual transformation of the acid-fast bacilli

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into non-acid-fast organisms. They must have been led into error by the mechanical transference of non-proliferating acid-fast organisms along with freely-growing non-acid-fast saprophytes. We know of no organism with strongly parasitic characters and whose saprophytic existence can only be stimulated by the use of special media which will grow freely in the first subculture on ordinary media.

The organisms belonging to the second group are similar to those mentioned in the first group. Very infrequently moulds have been met with.

As a type of the contaminations met with, the following instance may be quoted. On the 9th September, 1912, eight tubes of —10 blood-agar were inoculated with pieces of leproma rich in bacilli. On the 16th September a growth appeared on and around the piece of tissue in one of the tubes. Smears showed the presence of a spore-bearing bacillus and groups of acid-fast-bacilli. The contaminator grew freely on + 10 nutrient agar.

On the 6th January, 1913, another of the tubes was observed to be contaminated. A brownish growth spread upwards from the water of condensation, but there was an interval of about three-quarters of an inch between the upper margin of the growth and the piece of leprous tissue. That interval was free from the growth, which examination proved to consist of staphylococci and a streptothrix. In smears prepared from the nodule there was the usual abundance of acid-fast bacilli, but no non-acid-fast bacilli and no streptothrix. Clearly, therefore, the streptothrix could not have originated from the lepra-bacillus.

Subcultures on + 10 nutrient agar were prepared and the streptothrix isolated. An entire culture in + 10 bouillon, seven days old, was injected into the peritoneal cavity of a guinea-pig. The animal did not become in any way affected. Forty days later it was killed, and all the organs appeared healthy.

An entire culture in + 10 bouillon, fourteen days old, was injected into the peritoneal cavity of a second guinea-pig. This animal died ten days later.

The animal was well nourished and presented no external lesions. On opening the abdomen the great omentum was found to be rolled up and matted together, forming a sausage-shaped mass. This mass was full of caseous and purulent tubercles, mostly about the size of a pin's head. There was a small tubercle on the surface of the bladder, two on the right seminal vesicle, and a group of them on the under surface of the diaphragm. The superior mesenteric glands were enlarged and contained caseous and suppurating tubercles. The spleen was enlarged and studded with nodules. The kidneys and suprarenal capsules were congested and swollen but contained no nodules.

On opening the thorax the upper part of the right lung was found to be solid and caseous. In the centre of the inferior lobe there was an aggregation of tubercles surrounded by congested lung-tissue.

Smears from the omentum showed the presence of the streptothrix mixed with cell debris and cocci. The streptothrix stained by Gram's method, but it stained poorly and had a granular, degenerate appearance.

The tubercles in every instance showed the same histological characters. The microscopic appearance of those in the lung was similar to that of the nodules which were found in the mesenteric glands and omentum. They consisted of sharply defined masses of irregular necrotic nuclei, imbedded in amorphous debris, which stained pink with eosin. They were not surrounded by epithelioid cells, fibrous tissue or small cell infiltration. Except in the lung, they were surrounded by healthy tissue and did not appear to have given rise to any inflammatory reaction. No blood vessels penetrated the substance of the tubercles, and there were no pathological changes in the capillaries of adjacent tissues.

The tubercles within the mesenteric glands were situated in the neighbourhood of the divisions of the afferent lymphatic vessels which supply the cortex.

In the liver there were no macroscopic lesions, but microscopically numbers of tubercles were found in the portal spaces and in the portal zones of the lobules. It was possible to recognize the remains of degenerate liver cells lying amidst the necrotic material which formed these minute nodules, but the trabeculæ surrounding the tubercles appeared normal.

Within the lung, the nodules did not lie in healthy tissue, but were surrounded by a zone of consolidation in which the alveoli and bronchioles were blocked by masses of catarrhal cells. External to this the capillaries were intensely congested and the alveoli were filled with a fluid exudate.

The presence of the streptothrix was not demonstrated in the lung, but it was found in sections of the lymphatic glands, mesentery, and liver where it was similar in character to that seen in the smears made from the fresh organs. No acid-fast organisms were found in any of the sections or smears.

Summary.

Material for purposes of cultivation on various media has now been obtained from thirty-two non-ulcerating nodular cases of leprosy and three hundred and seventy-three inoculations made on the various culture-media.

It is curious, in view of the findings of other investigators, that we have consistently failed to obtain a culture of the bacillus lepræ. There can be no doubt but that material swarming with bacilli has been employed on each occasion. This was clearly demonstrated by the microscopical examinations which were made in every case.

From the examinations made of nodules, which have been incubated on culture-media for periods ranging from a few days to nine months, no evidence has been obtained that the bacilli had increased or lessened in number.

Those investigators who have recorded an increase in the number of organisms as a result of miscroscopical examination must surely have failed to observe the bacterial richness of the material employed for inoculation.

Anyone who has examined smears prepared from freshly excised leper-tissues must be struck with the enormous masses of acid-fast bacilli present, and we are unable to comprehend how it is possible to state in a case where no macroscopic growth is apparent that an increase recognizable only by the microscope (2) (6), has occurred.

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APPENDIX VIII.

REPORTS ON WORK CARRIED OUT IN COLONIAL LABORATORIES.

No. 2.

HONG KONG.

REPORT ON WORK (OTHER THAN ROUTINE WORK) DONE IN THE BACTERIOLOGICAL INSTITUTE DURING THE SIX MONTHS—1ST JULY TO 31ST DECEMBER, 1913.

(Received 6th March, 1914.)

THE investigation of the mosquitoes in Hong-Kong mentioned in my last report of the 20th August, 1913,* has been continued, and another year's work will be required before it is completed.

The method of carrying out this work has already been described.

Up to date, 4,171 different samples of larvæ have been collected, and from these samples 12,763 mosquitoes have been bred and pinned.

After being arranged and classified as far as practicable, 5,736 of these specimens have been forwarded to the Director of the Imperial Bureau of Entomology —British Museum (Natural History)—and the remaining 7,027 specimens are being got ready as quickly as possible for forwarding.

As these mosquitoes will be finally classified in the British Museum, it is unnecessary for me to give my provisional classification at this stage.

As regards the collection of larvæ, the arrangements made for larvæ other than stegomyia appear to me to be satisfactory. It is only a matter of time till a representative collection will be got together.

The stegomyia collection, on the other hand, is quite unsatisfactory, and some other arrangements will have to be made if that part of the investigation is to be thoroughly carried out.

At present two separate samples of *Stegomyia fasciata* have been found widely separated from each other in the city of Victoria. All the other samples of stegomyia are apparently *Stegomyia scutellaris*, but confirmation on this point will be supplied by the Director of the Imperial Bureau of Entomology in due course.

If *Stegomyia fasciata* had been a common mosquito in Hong Kong—or had not been found at all—the position would be a simple one, but as it is only the most thorough search will now put matters on a satisfactory basis.

So far no collections have been made from junks or sampans in the harbour. Judging from the results obtained in Bombay and elsewhere this search should certainly be made. Search should, I consider, also be made of ships coming daily into the harbour from ports infected with *Stegomyia fasciata*, *e.g.*, Singapore, Java, etc., to see if they ever bring specimens here.

HAROLD MACFARLANE,
Government Bacteriologist.

Bacteriological Institute,
Hong Kong, 28th January, 1914.

No. 3.

HONG KONG.

THE GOVERNOR to THE SECRETARY OF STATE.

(Received 26th October, 1914.)

SIR, Government House, Hong Kong, 7th September, 1914.

I HAVE the honour to transmit the enclosed copy of a report by the Government bacteriologist on the work, other than that of a routine nature, done in the Bacteriological Institute during the first half year of the year 1914.

2. You will observe that the presence in the Colony of *Stegomyia fasciata* and *Stegomyia scutellaris*, which was referred to in paragraph 5 of your despatch of the 22nd August, 1913,† has now been definitely established. Further investigations in this direction are being prosecuted.

I have, &c.,
F. H. MAY,
Governor.

* Page 158 of [Cd. 7261], March, 1914. † Not printed.

Appendix VIII.

Reports on work carried out in Colonial Laboratories.

Enclosure in No. 3.

Report on Work other than Routine Work done in the Bacteriological Institute, Hong Kong, for the First Half-Year, 1914.

The investigation of the mosquitoes of Hong Kong, mentioned in my previous report,† has been continued, and arrangements have been made to carry on this work till the end of this year.

It is therefore undesirable at this stage to attempt anything more than a brief summary of the work so far done.

The total number of samples of larvæ collected and brought to this institute for breeding out now amounts to 11,671.

From these samples of larvæ, 28,000 adult mosquitoes have been bred out and pinned.

Twenty-two thousand six hundred and seventy-one of these specimens have been forwarded to the Director, Imperial Bureau of Entomology (British Museum), for determination, and 12,731 out of the 22,671 specimens have already been named by the Bureau.

These 12,731 specimens have been classified by the Bureau as follows:—

**Anopheles indiensis*, Theo.
**Anopheles jeyporiensis*, Theo.
**Anopheles karwari*, James.
Anopheles maculatus, Theo.
Anopheles maculatus, Theo. var.
Anopheles minimus, Theo.
Anopheles minimus, Theo. var.
**Anopheles rossi*, Theo. var. *indefinatus*, Ludl.
Anopheles sinensis, Theo.
**Anopheles tesselatus*, Theo.
Armigeres obturbans, Walk.
**Culex bitæniorhynchus*, Giles.
**Culex bitæniorchus*, var, *domesticus*, Leic.
Culex concolor, R.D.
Culex fatigans, Wied.
**Culex fuscocephalus*, Theo.
**Culex mimeticus*, Noe.
**Culex sinensis*, Theo.
**Culex sitieus*, Wied.
Culex tritæniorhynchus, Giles.
**Culex virgapites*, Edw., sp. nov.
**Culex vishnui*, Theo.
**Culiciomyia pallidothorax*, Theo.
**Ficalbia minima*, Theo.
**Lophoceratomyia minutissima*, Theo.
**Lophoceratomyia aubithoracis*, Leic.
**Mansonioides uniformis*, Theo.
**Micraëdes malayi*, Leic.
**Ochlerotatus greeni*, Theo.
**Ochlerotatus macfarlanei*, Edw. sp. nov.
**Uranotænia macfarlanei*, Edw. sp. nov.
Stegomyia scutellaris, Walk.
**Stegomyia fasciata*, F.
**Stegomyia W. alba*, Theo.

All species marked * are new to Hong Kong.

Stegomyia fasciata is definitely present in the Colony, especially on the Kowloon side of the harbour from Yaumati to Shamshuipo, but apparently never in large numbers like *Stegomyia scutellaris*. However, as the search for *Stegomyia fasciata* still continues, it would be premature to make any definite statements at present.

† No. 2.

Appendix VIII.

Reports on work carried out in Colonial Laboratories.

Tabanidæ.—A collection of the Tabanidæ of Hong Kong, started originally by Mr. Adam Gibson, M.R.C.V.S., Colonial Veterinary Surgeon, and then carried on in partnership with me, has been undertaken.

One thousand five hundred and eight specimens have been forwarded to the Director of the Imperial Bureau, and a preliminary list dealing with 395 of these specimens has been received from him, and is as follows:—

Chrysops dispar, F.—168 ♀
C. striata, Wulp.—39 ♂
Tabanus crassus, Walk.—11 ♀
T. ditæniatus, Macq.—6 ♀
T. hilaris, Walk.—2 ♂ 7 ♀
T. hybridus, Wied.—2 ♀
T. indianus, Ric.—33 ♀
T. jucundus, Walk.—1 ♂ 10 ♀
T. negativus, Ric.—1 ♀
T. sanguineus, Walk.—90 ♀
Tabanus sp. nov., near *birmanicus*, Big.—3 ♀
Tabanus sp. nov., near *inobservatus*, Ric.—22 ♀

Harold Macfarlane,
Government Bacteriologist.

5th August, 1914.

No. 4.

CEYLON.

The GOVERNOR to the SECRETARY OF STATE.

(Received 14th March, 1914.)

Sir, The Queen's Cottage, Nuwara Eliya, Ceylon, 21st February, 1914.

With reference to Mr. Stubbs's despatch of 13th August, 1913,* I have the honour to forward herewith, for transmission to the Advisory Committee of the Tropical Research Fund, a report (with photographs)† by Dr. Aldo Castellani on research work carried out at the Clinic for Tropical Diseases and Bacteriological Institute, during the period from 1st July, 1913, to 31st January, 1914.

I have, &c.,
ROBERT CHALMERS,
Governor, &c.

Enclosure in No. 4.

Report of Investigation Work Carried Out at the Clinic for Tropical Diseases and Bacteriological Institute during the Period extending from 1st July, 1913, to 31st January, 1914, by Aldo Castellani, M.D., Director Clinic for Tropical Diseases and Bacteriological Institute.

Researches have been carried out on the following subjects:—

(1) Cases of fever due to *Bacterium columbense* (Cast. 1905).
(2) *Vibrio kegallensis* (Cast. 1913).
(3) Further researches on the mixed typhoid + paratyphoid A + paratyphoid B vaccine.
(4) Further case of entoplasmosis.
(5) A probably new type of ulcerative dermatitis.
(6) Skin disease with gummata, due to a fungus.
(7) A peculiar yellow pigmentation of the skin.

I wish to express my indebtedness to Mr. E. Burgess, Assistant Bacteriologist, for the very valuable assistance rendered during these investigations. My thanks are also due to Dr. Fernando, my house physician.

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* Page 131 of [Cd. 7261]. † Not reproduced.

APPENDIX VIII.

REPORTS ON WORK CARRIED OUT IN COLONIAL LABORATORIES.

NOTE ON CASES OF FEVER DUE TO BACTERIUM COLUMBENSE (CAST. 1905).

In 1905 I described a case of fever due to a germ which I called *B. columbense.* Later, having been impressed by the sugar reactions of the germ being not very characteristic, I no longer considered it a separate species, and in my subsequent publications I identified it—wrongly—with *B. paratyphosus B.* Recently, I have had opportunity of isolating the same germ in two cases, and of studying it more completely, and I have been forced to the conclusion I came to years ago, *viz.*, that the germ is a separate species. The experiments have been carried out on three strains which I have in my hands—one, the original strain isolated in 1905, and two strains isolated recently. The three strains are absolutely identical, and therefore I will refer to them simply as *B. columbense,* the name I gave to the organism in 1905. The term may not be a very appropriate one, but, according to the laws of nomenclature, cannot be changed.

Remarks on the cases.—The cases clinically were very similar to typhoid of medium severity; the fever lasted from three to five weeks, ending by lysis; in one case there were several relapses: pulse varying from 90 to 120, spleen enlarged in two cases, impalpable in the third; constipation present in two cases, slight diarrhœa in one. In one case severe bacilluria occurred, which lasted several months after the fever had ceased.

Microscopical and bacteriological examination of the foregoing cases. A slight degree of oligocætemia present in all; nothing important to be noted with regard to the leucocytic formula; the number of large mononuclear cells was not increased, varying from 3 to 10 per cent. Laveran's parasites always absent, Widal test constantly negative. Agglutination test for paratyphoid A and B, *Micrococcus melitensis,* and *B.asiaticus* repeated in each case several times, always negative. The germ, of which I will again give a description presently, was grown from stools (plated in the usual way) of all three cases, from the urine of one, and the blood of one. From the blood it was isolated by using the dilution method, introduced by me some years ago for typhoid. Five ccs. of blood were taken from an arm vein by means of a sterile syringe, using the ordinary aseptic precautions. The blood was inoculated at once into several large flasks containing each 300 ccs. of broth. The flasks were incubated at 35°C. After two days two out of the six flasks showed growth of the germ.

Characters of Bacterium columbense (Cast. 1905). Rods 2 to 5 micron in length closely resembling the typhoid and paratyphoid bacilli, motile. It is easily stained by the ordinary aniline dyes, but not by Gram.

Cultural Characters:—

Broth.—Abundant growth with diffuse turbidity; after twenty-four to forty-eight hours a delicate pellicle is generally present.

Agar.—The growth may be typhoid-like, but generally the germ grows more luxuriantly than is the case with typhoid.

Gelatine.—Typhoid-like or at times *B.coli*-like, medium not liquefied.

Serum.—Nothing characteristic, the medium is not liquefied.

Litmus Milk.—It may be said that in general it becomes acid at first and alkaline later, and that bleaching of the medium is of very frequent occurrence, but occasionally the medium is rendered permanently acid. After three weeks the medium, if tubes are capped with rubber caps, may occasionally become thickened, or even real clotting, though of very rare occurrence, may take place.

Sugar broths and action on lactose.—The sugar reactions are collected in the following table. Some remarks may be made on the action of the germ on lactose, when the germ is freshly isolated from the stools or urine it has no action on lactose, but after several transplantations it may very slightly ferment this sugar at times, while it does not touch it at other times, using the usual technique with Durham tubes; the experiment has been repeated many times and all precautions have been taken to avoid mistakes as far as possible. It is notable that on Mackonkie's lactose red agar the colonies are always permanently white.

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Reports on work carried out in colonial laboratories.

	Motility.	Litmus Milk.*	Lactose.*	Saccharose.	Dulcite.	Mannite.	Glucose.	Maltose.	Dextrin.	Raffinose.	Arabinose.	Adonite.	Inulin.	Sorbite.	Galactose.	Laevulose.
B. Columbense (1905) . .	+	A vs. / Alk. D	O or AGS	O	A G	A G	A G	A G	As Gs	O	A G	O	O	A G	A G	A G

	Inosite.	Salicin.	Amygdalin.	Isodulcite.	Erythrite.	Glycerine.	Indole.	Voges-Prosk.	Redn: Nitrates.	Neutral Red.	Gram.	Gelatine.	Serum.	Broth.	Peptone Water.
B. Columbense (1905) ...	O	A G	O	A G	O	A G	+	O	O	O	O	O	O	G T P	G T Pvs

Abbreviations used in this table:—A=acid, G=gas, C=clot, D=decolourized, Alk=alkaline, S=slight, A/alk=acid then alkaline, GT=general turbidity, P=pellicle, vs=very slight, O=negative result, viz.:—neither acid nor gas in sugar media, neither acid nor clot in milk, non-production of indole, non-motile or non-liquefaction of gelatine or serum, as the case may be, +=positive result, ‡=sometimes positive, sometimes negative.

Biological reactions.—Strain I. (1905) was agglutinated by the patient's blood in dilution up to 1 in 80. The strain was agglutinated also by the blood of the two recent cases (1913), in one up to a dilution of 1 in 40, in the other up to a dilution of 1 in 160. As I have already stated, the blood of none of these patients agglutinated *B. typhosus, paratyphosus A and paratyphosus B* even in a dilution of 1 in 20. Normal blood does not agglutinate the bacillus.

Strain II. (1913) was agglutinated by the blood of the patient from whom it was isolated in a dilution of 1 in 40, and from the blood of Case 3 (1913) in approximately the same dilution. Normal blood has no action on the germ.

Strain III. (1913) was agglutinated by the blood of the patient from whom it was isolated up to a dilution of 1 in 160. It could not be tested with the blood of Case 2. Normal blood does not agglutinate the strain.

Agglutination reactions with sera derived from hyperimmunized animals.—The following table shows the agglutination reactions of the three strains with sera derived from rabbits inoculated with them:—

Table.

Sera		Agglutination limits with Strain I	Strain II	Strain III
Serum of rabbit inoculated with Strain	I.	1,000	800	800
Serum of rabbit inoculated with Strain	II.	600	800	800
Serum of rabbit inoculated with Strain	III.	600	500	600

These agglutination reactions, and the result also of some absorption tests, carried out, clearly show that the three strains are identical. Here it may be added that all three strains have been repeatedly tested with typhoid serum, paratyphoid A serum, paratyphoid B serum, derived from patients suffering and convalescent from such diseases, as well as from hyper-immunized animals, always with absolutely negative results, the tests being always negative, even using dilution of 1 in 20. The strains have been tested also with very powerful paratyphoid A and paratyphoid B sera obtained from the Berne Institute, with the same result, *viz.*, no agglutination whatever is observed. The absorption tests completely confirmed the agglutination tests. There cannot be any doubt, therefore, that the germ is neither

* See remarks in the text.

paratyphosus A nor paratyhosus B. The germ has been tested also with several different coli and coli-like sera I have prepared, always with negative results.

Botanical position of the Bacterium. This bacterium is difficult to classify, owing to its inconstant action on lactose. As already stated, all possible precautions to avoid a mistake have been taken, and the conclusion arrived at is that the same strain, while at times a non-lactose fermenter, at other times feebly ferments lactose with very slight production of gas. When it does not ferment lactose its sugar reactions are practically identical to those of *B. paratyphosus B*; when it ferments lactose it is closely related to *B. coli.* Agglutination and absorption tests clearly show that the germ is a separate species, as it is never agglutinated by paratyphoid A and B sera, even powerful ones as those imported from the Berne Institute, nor from any coli and coli-like serum I have prepared.

Bacterium columbense cannot be identified with *B. paratyphosus C* of Uhlenhuth, as the latter is culturally identical to *B. suipestifer*, and in man, at least, is apparently not pathogenic. It cannot, of course, be excluded that *B. columbense* may be identical with one of the so-called paratyphosus D, &c., paracolon bacilli, &c., isolated by certain authors, as I have not in my hands the whole series of such germs to enable me to carry out comparative researches: even if such were the case, however, according to the rules of nomenclature the term *B. columbense* (Cast. 1905) would have to stand, owing to priority of description and name.*

VIBRIO KEGALLENSIS.

This vibrio was isolated from stools of a patient of Kegalle, suffering from a cholera-like diarrhœa. True cholera being present at the time in other districts of the Island a very complete examination of the stools was carried out. No true cholera vibrois were found—instead a vibrio was isolated, of which I give here a brief description:

Microscopical examination.—Films from the stools stained with diluted fuchsin contained numerous vibrios, the same shape as the true cholera one, but somewhat larger.

Motility.—The vibrio is very motile, like the cholera vibrio.

Staining reactions.—Easily stained by the usual aniline dyes. Gram-negative.

Cultural characters.—On agar and gelatin the growth has a certain resemblance to true cholera. Gelatine is liquefied, serum is also liquefied, milk is rendered acid and clotted. The following table gives the principal cultural characteristics and sugar reactions of the micro-organism.

	Motility.	Litmus Milk	Lactose.	Saccharose.	Dulcite.	Mannite.	Glucose.	Maltose.	Dextrine.	Raffinose.	Arabinose.	Adonite.	Inulin.	Sorbite.	Galactose.
V. Kegallensis	++	A S	D/A S	A	O	A D	A	A	A	O D	A D	O D	O D	O D	A

	Laevulose.	Inosite.	Salicin.	Amygdalin.	Isodulcite.	Erythrite.	Glycerine.	Indole.	Voges-Prosk.	Redn: Nitrates.	Neutral Red.	Gram.	Gelatine.	Serum.	Broth.	Peptone Water.
V. Kegallensis	A	O	O	O	O	O	O	O	O	O	O	O	+	+	G T	G T

Abbreviations used in the table:—A=acid, S=slight, GT=general turbidity, D=decolourized, O=negative result, viz.:—neither acid nor gas in sugar media, neither acid nor clot in milk, non-production of indole, non-motile or non-liquefaction of gelatine or serum, as the case may be, +=positive result.

* I shall be pleased to supply workers interested in the subject with cultures of the micro-organism.

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Agglutination.—This vibrio is not agglutinated by true cholera serum.

Pathogenicity.—Much further investigation is necessary to see whether this germ is in reality pathogenic to man. It does not seem to be very pathogenic to the lower animals unless injected in large doses.

Conclusion.—This vibrio differs from the true cholera vibrio as shown by cultural characters and agglutination tests. I have suggested for it the term *Vibrio kegallensis.*

Further Researches on the Mixed Typhoid + Paratyphoid B + Paratyphoid A Vaccine.

In my previous report I gave the result of some experimental work on the mixed typhoid + paratyphoid A + paratyphoid B vaccine, the vaccine which I have used on a fairly large scale in Ceylon since 1908. The vaccine consists of an emulsion of typhoid and paratyphoid A. and B. bacilli killed by heat, and standardized so that one cubic centimetre contains approximately 500 millions of typhoid bacilli and 250 millions each of paratyphoid A. and B. For the first dose, half to 0·6 cubic centimetre should be injected with aseptic precautions under the skin, preferably in the arm. The inoculation is followed after three to four hours by some pain and tenderness at the site of injection, and in four to eight hours by fever (100° or 101°F.) and general malaise. All these symptoms have usually disappeared in thirty-six hours.

A second injection of from one to 1·2 cc. should be given seven to ten clear days after the first inoculation. It is often followed by a less local reaction. A third injection—the same dose as the second—may be given with advantage after a further interval of seven to ten days.

I have continued experiments on the production of agglutinins by this vaccine during the last six months. I give a table containing the complete agglutination results obtained in the individuals inoculated on the 14th June, 1913; this table completes the one given in my previous report. From the table it will be seen that the individuals inoculated with a mixed typhoid + paratyphoid A + paratyphoid B vaccine, produced agglutinins for all three germs, and that on the average the amount of agglutinins produced for each germ was not much smaller than in individuals inoculated with one germ only, although the latter had a much larger dose of the germ. As regards the length of time during which agglutinins were present in the inoculated individuals, the results did not differ much; if anything, they were rather in favour of the mixed vaccines. Although, of course, one cannot gauge the actual immunization obtained by simply studying the agglutination, there can be no doubt that to a certain extent agglutination is a rough index for immunization.

It seems to me that the same conclusion may be arrived at as in my previous reports, *viz.*, that it is highly advisable to use—instead of the usual simple typhoid vaccine—the mixed typhoid + paratyphoid A + paratyphoid B vaccine in countries where the three diseases are met with.

Limits of Agglutination.

Name.	Vaccine Used for Inoculation.	B. Typhosus. Weeks After 1st Inoculation.											
		1	2	3	4	5	6	7	8	9	11	13	15
David	Mixed "Dead"	0	1/100	1/200	1/200	1/400	1/50	1/50	1/50	1/50	1/50	1/50	1/50
Fernando	,, ,,	0	1/400	1/400	1/400	1/400	1/400	1/100	1/50	1/50	1/50	1/50	1/50
Peter	Typhoid ,,	1/10	1/800	1/800	1/400	1/400	1/100	1/100	1/100	1/100	1/10	1/10	0
Singho	Paratyph : A ,,	0	0	0	0	0	0	0	0	0	0	0	0
Asson	Paratyph : B ,,	0	0	0	0	0	0	0	0	0	0	0	0
A. E. de Silva ...	Mixed "Live"	1/10	1/400	1/800	1/400	1/400	1/100	1/100	1/50	1/50	1/10	1/10	0
D. C. P. Gunesekera	,, ,,	0	1/800	1/800	1/400	1/400	1/100	—	—	—	—	1/50	1/50
Isaac	Typhoid ,,	0	1/400	1/400	1/400	1/400	1/400	1/400	1/200	1/200	1/400	1/100	1/50
Wellan	Paratyph : A ,,	0	0	0	0	0	0	0	0	0	0	0	0
Karuppen	Paratyph : B ,,	0	0	0	0	0	0	0	0	0	0	0	—

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Name.	Vaccine Used for Inoculation.	B. Paratyphosus A. — Weeks After 1st Inoculation.											
		1	2	3	4	5	6	7	8	9	11	13	15
David	Mixed "Dead"	0	1/50	1/50	1/50	1/100	1/50	1/50	1/50	1/50	1/50	1/20	1/20
Fernando	,, ,,	0	1/50	1/50	1/20	1/50	1/50	1/50	1/50	1/50	1/20	1/20	1/20
Peter	Typhoid ,,	0	0	0	0	0	0	0	0	0	0	0	0
Singho	Paratyph: A ,,	1/20	1/50	1/20	1/20	1/50	1/50	1/50	1/50	1/20	1/20	1/20	0
Asson	Paratyph: B ,,	0	0	0	0	0	0	0	0	0	0	0	0
A. E. de Silva ...	Mixed "Live"	0	1/20	1/20	1/20	1/20	1/20	1/20	1/20	1/20	1/20	0	0
D. C. P. Gunesekera	,, ,,	0	1/50	1/20	1/20	1/20	1/20	—	—	—	—	1/20	1/20
Isaac	Typhoid ,,	0	0	0	0	0	0	0	0	0	0	0	0
Wellan	Paratyph: A ,,	0	1/100	1/50	1/50	1/50	1/50	1/50	1/50	1/50	1/50	1/50	1/50
Karuppen	Paratyph: B ,,	0	0	0	0	0	0	0	0	0	0	0	—

Name.	Vaccine Used for Inoculation.	B. Paratyphosus B. — Weeks After 1st Inoculation.											
		1	2	3	4	5	6	7	8	9	11	13	15
David	Mixed "Dead"	0	1/20	1/20	1/20	1/50	1/20	1/20	1/20	1/20	1/20	1/20	1/20
Fernando	,, ,,	0	1/20	1/50	1/50	1/50	1/50	1/20	1/20	1/20	1/20	1/20	1/20
Peter	Typhoid ,,	0	0	0	0	0	0	0	0	0	0	0	0
Singho	Paratyph: A ,,	0	0	0	0	0	0	0	0	0	0	0	0
Asson	Paratyph: B ,,	0	1/50	1/50	1/50	1/50	1/50	1/50	1/50	1/50	1/50	0	1/50
A. E. de Silva ...	Mixed "Live"	0	1/20	1/20	1/20	1/20	1/20	0	0	0	0	0	0
D. C. P. Gunesekera	,, ,,	0	1/20	1/50	1/50	1/50	1/20	—	—	—	—	1/20	1/20
Isaac	Typhoid ,,	0	0	0	0	0	0	0	0	0	0	0	0
Wellan	Paratyph: A ,,	0	0	0	0	0	0	0	0	0	0	0	0
Karuppen	Paratyph: B ,,	0	1/20	1/50	1/50	1/50	1/20	1/20	1/20	0	0	0	—

Further Case of Entoplasmosis.

In my previous report I described a peculiar protozoal organism found in three cases of dysenteric colitis in which amœbæ and bacilli of the dysentery group were absent. Since then I have come across another case, a passenger from Burma. The patient complained of severe griping pains and diarrhœa with mucopus and blood in the stools. When I saw him these symptoms had started two days previously, on board. The temperature was 100°, general condition good: the stools contained a large amount of mucus, practically no fæcal matter I prescribed a saline mixture, and I directed the patient to pass a stool in a large sterile petri dish I supplied him with. A stool was examined microscopically thirty minutes after having been passed. Protozoal bodies identical to those described in my previous report were found. There is no need to give here again a full description of them, but I may mention again that these bodies were actively motile, with the body showing only slight changes of shape while moving, and no pseudopoda, and with the anterior portion extremely shaken—so to speak—by very rapid vibratory-like movements making one suspect at once the presence of flagelli. On closer examination no such organs were found, either in fresh or stained preparations. In this case, in addition to the Giemsa method of staining, I employed the Hydenheim iron hæmat, with, of course, previous wet fixing. One preparation so stained came out beautifully, showing clearly that the group of granular or coccus-like bodies observed in preparations stained with Giemsa is a nucleus, this confirming Professor Mesnil's opinion. No flagelli or cylia were visible. Of course, I do not deny that such organs may be present, but so far in none of my preparations have I been able to detect them, nor have any of my colleagues to whom I have shown the slides. How to

classify this organism? Professor Mesnil and all other authorities consider it a new organism, though differing in the zoological position to be given to it. Personally, I consider it to represent a new genus, for which I proposed in previous papers the term "Entoplasma."

A PROBABLY NEW TYPE OF ULCERATIVE DERMATITIS.

Since several years I have noted in Ceylon a peculiar ulcerative condition of the skin affecting mostly Europeans, but until now I have never published my cases. Recently I have had the opportunity of studying more completely such condition of which I give here a brief account.

The disease starts with several superficial dusky-red, not raised, slightly itching spots, which are generally follicular and perifollicular: they are, as a rule, situated on the feet and legs. The patient usually takes these spots for mosquito-bites. Some of the spots disappear while others become slowly larger, raised, infiltrated, and often somewhat cupoliform; the size of a pea to a cherry; there is no pustulation; after a time the centre breaks down and an ulcer forms with reddish fundus and undermined edges. (See photograph.*)

These ulcerative lesions are somewhat painful and very slow to heal, complete spontaneous cure seldom taking place in less than four to six months; on healing, patches of hyperpigmentation often remain.

Etiology.—If the initial dusky-red follicular non-elevated spots are pricked and a droplet of blood collected and films made, one only sees numerous red blood cells with few leucocytes and here and there a few cocci arranged in pairs. If agar tubes are inoculated a streptococcus-like germ grows in pure culture from the non-ulcerated lesions, while from the ulcerated lesions staphylococci and other germs may be grown in addition to the streptococcus. This streptococcus is biologically different from the usual streptococci, and I have named it *Streptococcus tropicalis*. I give in the following table its principal characters.

	Motility.	Litmus Milk.	Lactose.	Saccharose.	Dulcite.	Mannite.	Glucose.	Maltose.	Dextrine.	Raffinose.	Arabinose.	Adonite.	Inulin.	Sorbite.	Galactose.	Laevulose.	Inosite.	Salacin.	Amygdalin.	Isodulcite.	Erythrite.	Glycerine.	Indole.	Voges Prosk.	Redn: Nitrates.	Gram.	Gelatine.	Serum.
Streptococcus tropicalis ...	O	A	A	A	O	O	A	A	A	O	A	C	A	O	A	A	O	A	O	O	O	O	O	O	O	+	O	O

Abbreviations used in the table:—A=acid, C=clear, +=positive result, O=negative result, viz.:—neither acid nor gas in sugar media, non-production of indole, non-motile, non-liquefaction of gelatine or serum, as the case may be.

The malady may be experimentally reproduced by inoculating pure cultures of the germ into the hair follicles, or around them, by means of a very fine needle, provided a recently isolated strain be used.

Diagnosis.—The affection, when well developed, is recognizable by the presence of raised, hard, rather large nodules, cupoliform with central ulcer, presenting undermined edges. The affection must be distinguished from *Pyosis tropica*, ecthyma, purulent folliculitis, veldt sore, barkoo rot, oriental sore, blastomycosis, ulcers of syphilitic origin, &c. In *Pyosis tropica* the ulcers do not show undermined margins. In ecthyma there are initial discrete flat pustules with inflamed haloes, and the margins of the ulcers are not, as a rule, undermined. The absence of leishmania distinguishes at once the affection I have described from oriental sore; and the absence microscopically and culturally of fungi separates the disease from blastomycosis, apart from different clinical signs.

The microscopical examination and the utter uselessness of mercury, potassium iodide, and salvarsan, distinguishes the affection from syphilitic lesions. In barkoo rot the crust covering the ulcer is very hard and difficult to remove. In *Ulcus infantum* a diphtheria-like germ is found. In veldt sore the ulcerative lesions are generally very superficial and the edges of the lesions are not undermined and the exudation

* Not reproduced.

dries into a thin crusty mass. In purulent folliculitis of the legs there are no ulcers but numerous pustules, each pierced by a hair. The affection I have described might be called *dermatitis ulcerativa tropica* or *dermatitis cupoliformus.*

Treatment.—Treatment with antiseptic lotions (hydr. perch., hydr. perox, &c.) followed by a balsam of Peru ointment, though useful, is very slow in its effects. The best treatment is by far the use of an autogenous vaccine. Cases which have resisted external treatment for six months may become cured practically in a few days.

PECULIAR SKIN DISEASE WITH GUMMATA-LIKE SWELLINGS DUE TO A FUNGUS.

This disease (see photographs*) was observed in a planter who had resided for many years in Ceylon. When I saw the patient the affection was dating from about two years, and practically the whole body was covered with numerous ulcers and some nodules with the appearance of gummata. These swellings were rather hard: on opening them a sort of slough could be removed; none apparently had undergone a true suppurative change. The patient had had a very energetic mercurial treatment without receiving any benefit. He denied ever having had syphilis, and the Wasserman test taken two months after discontinuing the mercury had been negative.

Bacteriological examination.—The skin of one of the non-ulcerated swellings was painted with tinc. iodine, then an incision made, and a large slough-like portion of tissue removed aseptically from the inside. It was divided into small portions, each of which was sown into glucose broths and glucose agars. A fungus was grown, the complete study of which has not yet been finished; it grows best on glucose agar giving rise to large colonies of a greyish-greenish colour. Microscopically a large amount of mycelial elements are seen, while free spores seem to be absent. I have been unable so far to classify this fungus, the investigation of which, as already stated, is in the preliminary stage.

THE "YELLOW DISEASE": A PECULIAR SKIN PIGMENTATION.

I have seen three cases of an extremely peculiar yellow pigmentation of the skin in Europeans, called by the patients the "yellow disease." The first case, which I observed nearly ten years ago, was a planter, the other two cases were a European lady and her baby eighteen months old. The face, arms, hands, and at times practically the whole body, is of a bright yellow or saffron colour. The pigmentation was in my cases most marked on the palms of the hands, arms and face. The yellow colour, as already stated, is bright yellow or saffron yellow or even canary yellow, and quite different from the yellow colour of jaundice. The sclerotiæ remain completely white, the urine is of normal colour and composition, the sweat is not coloured, the stools are of normal colour, in fact, the general health is in no way affected, but, naturally, the patients object to the disfigurement. In the case of the lady and her child the pigmentation disappeared every time on going to the hills, to reappear again in a few days after coming back to Colombo. The pigmentation has recently gradually disappeared, though not completely.

Etiology.—This is absolutely unknown. A parasitic cause was at first suspected, but no pigment-producing germ of any kind has been found.

Diagnosis.—As already stated, the bright yellow colour is quite different from what one sees in jaundice, moreover the sclerotiæ remain white, the urine and stools are of a normal colour, the condition of the liver is normal, and the general health quite good. My patients do not appear to have been cases of chromidrosis, as the sweat was not coloured and the clothes were not stained by it.

In *Xantoderma areatum*, a condition I described some years ago, the yellow patches remain localized to the legs, and are permanent. In ochronosis, which is generally congenital, there is alcaptonuria and the ligaments and cartilages become blackened. In *tinea flava* a fungus is present.

Treatment.—On the hypothesis that the condition might be parasitic I advised my patients to use a formalin spirit lotion (1 per cent.) regularly. They thought it slightly improved the condition, but I could not satisfy myself that it was really so. The only successful measure seems to be to send the patients up-country, where the pigmentation disappears almost completely.

ALDO CASTELLANI.

* Not reproduced.

APPENDIX VIII.

REPORTS ON WORK CARRIED OUT IN COLONIAL LABORATORIES.

No. 5.

CEYLON.

THE GOVERNOR to THE SECRETARY OF STATE.

(Received 25th August, 1914.)

SIR, The Queen's House, Colombo, Ceylon, 3rd August, 1914.

WITH reference to my despatch of 21st February, 1914,* I have the honour to forward herewith, for transmission to the Advisory Committee of the Tropical Research Fund, a report by Dr. Aldo Castellani on research work carried out at the Clinic for Tropical Diseases and Bacteriological Institute during the period from 1st January to 30th June, 1914.

I have, &c.,
ROBERT CHALMERS,
Governor, &c.

Enclosure in No. 5.

REPORT ON INVESTIGATION WORK CARRIED OUT AT THE CLINIC FOR TROPICAL DISEASES AND BACTERIOLOGICAL INSTITUTE, FROM 1ST JANUARY TO 30TH JUNE, 1914, BY ALDO CASTELLANI, M.D., Director, Clinic for Tropical Diseases and Bacteriological Institute, Colombo, Ceylon.

DURING the last six months the routine work of the Bacteriological Institute has been even heavier than usual—this being due to the outbreak of plague in Colombo—and has practically occupied the whole of my official time. I have been able, however, to do some further research work—mostly outside office hours—on the following subjects:—

1. Combined vaccinations:
2. Fungi found in sprue.

I wish to express my indebtedness to Mr. E. Burgess, Assistant Bacteriologist, for the valuable assistance rendered. My thanks are also due to Mr. K. Vallipuram and Mr. W. R. De Silva, Laboratory Assistants to the Bacteriological Institute.

Combined Vaccinations.

Since 1905 I have prepared and used in man several combined vaccines, basing their preparation on the experimental work I carried out in Bonn in Professor Kruse's Laboratory during the years 1901 1902. I succeeded then in demonstrating that an animal (rabbit) inoculated with two different bacteria produced, at the same time, agglutinins and immune bodies for both, and that, provided a sufficient minimum quantity had been inoculated, the amount of agglutinins and immune bodies elaborated for each germ was about the same as in animals inoculated with one germ only. Moreover, I demonstrated that inoculating an animal (rabbit) with three different germs (*B. typhosus B, B. pseudodysentericus* No. 1 (Kruse), strain of *B. coli communis*) the amount of agglutinins and immune bodies elaborated for each germ is nearly the same as in animals respectively inoculated with one species only. In rabbits I found that by inoculating more than three species of micro-organisms no good results were obtained, but—in view of my recent work—if I had used animals of larger size, I might, and probably should, have found that good results can be obtained even using more than three species. I showed that when immunization is obtained by a single inoculation, provided the minimum dose sufficient to obtain the maximum immunization be given, the amount of agglutinins and immune bodies elaborated by the inoculated animals is not in proportion to the amount of cultures injected. A series of rabbits inoculated with 2 c.c. of typhoid culture will give the same average agglutination limit, and the same amount of immune bodies, as a series of rabbits inoculated with 4 c.c.

Combined "Typhoid—Paratyphoid A—Paratyphoid B" Vaccine.

Since 1905 this vaccine has been extensively used by me with good results. Having already published several reports and papers on it (Centr. f. Bakt. 1909 and

* No. 4.

1913, British Medical Journal, 1913, etc.) I will limit myself to state here that my further investigation has confirmed my previous work, viz.: that this combined vaccine is harmless; that it gives a certain amount of protection for the three diseases; and that it is advisable to use it always instead of the simple typhoid vaccine in countries where paratyphoid A and B occur, besides typhoid. The advisability of using such a vaccine is shown by the fact that I have seen two cases of persons inoculated with simple typhoid vaccine before sailing from Europe, developing paratyphoid A three months after landing in Ceylon · the diagnosis being made by hæmoculture. Moreover, cases of mixed infection, typhoid and paratyphoid A or paratyphoid B, do occur, though not frequently. As a matter of fact, I have recently observed a case, which must be extremely rare, of contemporaneous triple infection: typhoid, paratyphoid A, and paratyphoid B. I hope soon to publish this case in detail, but I do not think there can be any doubt about the diagnosis, as the stools contained the three germs, the blood gave a strong agglutination for all three, and the absorption test showed that there were present specific agglutinins for each germ.

In previous reports I have given in detail the technique for the preparation of such vaccine: it suffices here to state that the vaccine consists of an emulsion of typhoid and paratyphoid A and B bacilli, killed by heat (53° C.) and standardized so that one cubic centimetre contains approximately 500 millions of typhoid bacilli, and 250 millions each of paratyphoid A and B. The vaccine may be prepared also without heating by emulsions from agar cultures in 0·75 per cent. salt solution to which 0·75 per cent. of carbolic has been added: the presence of 0·5 per cent. carbolic is sufficient to kill the germs. For the first dose 0·5 to 0·6 cubic centimetre should be injected with aseptic precautions under the skin, preferably in the arm. The inoculation is followed after three to four hours by some pain and tenderness at the site of injection, and in a few hours more by fever (100 or 101° Fahr.) and general malaise. All these symptoms have usually disappeared in 36 hours. A second injection of from 1 to 2 c.c. should be given seven to ten clear days after the first inoculation. It is often followed by less local reaction. A third injection (the same dose as the second) may be given with advantage after a further interval of seven to ten days.

Combined "Cholera-Plague" Vaccine.

On this combined vaccine I will say here only a few words, having already published the details of its preparation, etc., elsewhere. Given the presence in Ceylon at the same time of both cholera and plague, it occurred to me to prepare a combined cholera-plague vaccine, which should contemporarily give a certain amount of immunization for both diseases. The combined cholera-plague vaccine I prepare consists of an emulsion in carbolized (½ per cent.) normal salt solution, of plague bacilli and cholera vibrios from three days old cultures, standardized so that 1 c.c of the emulsion contains approximately one thousand millions of plague bacilli, and two thousand millions of cholera vibrios. Of this vaccine, in adults, one c.c. is inoculated the first time, subcutaneously in the arm, and two c.c. the second time, a week after the first injection. To date, 250 individuals have been so inoculated. I can confirm the conclusions I came to in my previous papers, viz.:—

1. The inoculation of the vaccine in the lower animals induces a production of protective substances for the plague bacillus and the cholera vibrio.

2. The inoculation of such vaccine in human beings is harmless: the reaction is rather less marked than after the inoculation of Haffkine, but more severe than after Lustig's vaccine.

3. A small amount of agglutinins, both for plague and cholera, appear in the blood of most of the inoculated persons. The agglutination for the plague bacillus is generally very slight (one in ten, one in twenty, or nil), but this is also the case when using a simple plague vaccine such as Haffkine's or Lustig's. The agglutination for cholera varies between the limits 1 in 20 and 1 in 60 (rarely higher) and is practically the same as in individuals inoculated with cholera vaccine only (see tables).

Appendix VIII.

Reports on work carried out in Colonial Laboratories.

Combined "Typhoid—Paratyphoid A—Paratyphoid B—Plague-Cholera" Vaccine.

This combined "five diseases" vaccine consists of a carbolized emulsion of typhoid, paratyphoid A, and paratyphoid B bacilli; cholera vibrios; and plague bacilli. The technique of its preparation is as follows:—

Agar cultures twenty-four hours' old are used in the case of typhoid, paratyphoid A, paratyphoid B, and cholera: agar cultures three days' old are used in the case of plague, as this germ grows slowly.

The growth of the typhoid agar cultures is washed off with 0·75 per cent. salt solution containing 0·5 per cent. carbolic acid, is stored at room temperature 18-24 hours and then tested for sterility and standardized in such a way that 1 c.c. of this carbolized typhoid vaccine will contain approximately one thousand millions of typhoid bacilli. The same procedure is carried out with paratyphoid A, paratyphoid B, and plague: each of these carbolized vaccines will, therefore, contain one thousand million germs per each c.c. The same technique is used to prepare the cholera vaccine, but this vaccine is standardized in such a way as to make it contain four thousand millions per c.c. After having prepared, standardized, and tested for sterility these five different vaccines, they are mixed together in the following proportions:—

Cholera	vaccine	...	...	...	2	parts	2 c.c.
Plague	do.	...	...	...	2	„	2 c.c.
Typhoid	do.	...	...	...	2	„	2 c.c.
Paratyphoid A	do.	...	...	...	1	„	1 c.c.
Paratyphoid B	do.	...	...	...	1	„	1 c.c.

The mixed vaccine will, therefore, contain per c.c.:—

Cholera	...	...	...	1,000	millions.
Plague	...	...	...	250	„
Typhoid	...	...	...	250	„
Paratyphoid A	...	...	...	125	„
Paratyphoid B	...	...	...	125	„

Method of Vaccination.

The inoculation is made subcutaneously in the arm, in the same manner as when using simple typhoid vaccine. In strong adults I give 1 c.c. the first time, and 2 c.c. a week later; in adults who do not appear to be very strong, or in individuals who fear the reaction, as also in women, I give half doses, viz., ½ c.c. the first time and 1 c.c. the second time. Children between 10 and 16 years receive one-third the adult dose. Children under 10 years of age I have not yet inoculated. The inoculation of the vaccine is followed in a few hours by a local reaction (redness and some infiltration) and general reaction (fever malaise, rheumatoid pains) which generally does not incapacitate one for work for more than twenty-four hours. The reaction may be said to be, as a rule, more severe than after the inoculation of simple typhoid, or the mixed typhoid—paratyphoid A—paratyphoid B, vaccine; a little severer also than after the inoculation with Lustig's simple plague vaccine; but certainly somewhat less severe, in my experience, than after using Haffkine's simple plague vaccine. It is to be noted that occasionally one comes across individuals who do not show practically any reaction.

Innocuity of the mixed "five diseases" vaccine.

Four persons who volunteered have been inoculated nine times at a week's interval with 1 c.c. the first time and 2 c.c. on all the following occasions. They have remained in good general health, though two have had somewhat severe general and local reactions. One person, who also volunteered, has been inoculated with a double strength mixed vaccine four times—a vaccine which per c.c. contained double the amount of germs than the one generally used. Apart from a more severe local reaction no untoward effects were noted.

Appendix VIII.

Reports on work carried out in colonial laboratories.

Immunization obtained in Man by the combined "five diseases" vaccine.

Lack of time has prevented the study of the amount of all protective substances produced in inoculated individuals. The investigation, therefore, has been limited to studying the amount of agglutinins produced in individuals inoculated with the mixed five diseases vaccine, and comparing the results with those noted in individuals inoculated with simple "one disease" vaccines. Of course, one cannot gauge the actual immunization obtained by simply studying the agglutinins, but it is generally admitted that to a certain extent agglutination is a rough index for immunization. The results are collected in the following tables:—

Table No. I.

Combined "Typhoid + Para-Typhoid A. + Para-Typhoid B. + Cholera + Plague" Vaccine (two inoculations: 1c.c. the first, 2c.c. the second).

Name.	Blood Tested Against.	Limits of Agglutination—Weeks after 1st Inoculation.								
		1	2	4	5	7	8	9	10	11
Kuppaswamy	B. Typhosus ...	1/10	1/1200	1/800	1/200	1/100	1/50	1/100	1/50	1/10
	B. Para-Typh. A....	1/20	1/800	1/200	1/100	1/20	1/20	1/50	1/10	1/20
	B. Para-Typh. B....	1/20	1/200	1/200	1/100	1/20	1/10	1/50	1/20	1/20
	V. Cholera ...	1/20	1/20	1/10	1/50	0	0	0	0	0
	B. Pestis	0	1/20	0	0	0	0	0	0	0
Periaswamy	B. Typhosus ...	1/10	1/1000	1/800	1/200	1/100	1/100	1/150	1/100	1/50
	B. Para-Typh. A....	1/20	1/200	1/200	1/100	1/100	1/10	1/50	1/20	1/20
	B. Para-Typh. B....	1/20	1/100	1/50	1/100	1/50	1/10	1/50	1/20	0
	V. Cholera ...	1/20	1/800	1/200	1/100	1/100	1/10	1/20	0	0
	B. Pestis	0	0	1/20	1/20	0	0	0	0	0

Table No. II.

Vaccination with Combined Plague + Cholera Vaccine (two inoculations: 1c.c. the first, 2c.c. the second).

Individuals Inoculated.	Blood Tested Against.	Limits of Agglutination—Weeks after 1st Inoculation.						
		1	2	3	4	5	6	7
Tamil coolie No. 3	B. Pestis	0	1/20	0	0	—	0	0
	Vibrio Choleræ ...	0	1/10	1/40	0	—	0	0
Tamil coolie No. 4	B. Pestis	0	1/20	1/20	0	0	0	0
	Vibrio Choleræ ...	1/20	1/10	1/80	1/80	0	1/20	0
Tamil coolie No. 5	B. Pestis	0	0	0	0	0	0	0
	Vibrio Choleræ ...	0	1/20	1/80	1/80	1/20	0	1/20

Table No. III.

Vaccination with Simple Plague Vaccine (Haffkine—one inoculation of 4c.c.).

Individuals Inoculated.	Limits of Agglutination for B. Pestis—Weeks after 1st Inoculation.							
	1	2	3	4	5	6	7	8
Tamil coolie No. 6	0	1/20	1/20	0	—	—	0	—
Singhalese No. 1...	0	0	0	—	—	—	0	—

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Table No. IV.

Vaccination with Simple Plague Vaccine (Lustig's—three inoculations).

Individuals Inoculated.	Limits of Agglutination for B. Pestis—Number of weeks after 1st Inoculation.					
	1	2	3	4	5	6
Tamil coolie No. 7	0	0	$\frac{1}{250}$	$\frac{1}{250}$	—	0
Tamil coolie No. 8	0	$\frac{1}{250}$	0	$\frac{1}{250}$	0	0
Tamil coolie No. 9	0	0	0	—	—	0

Table No. V.

Vaccination with Simple Plague Vaccine (Carbolized, two inoculations: 1c.c the first, 2c.c. the second).

	Limits of Agglutination for B. Pestis—Number of weeks after Inoculation.						
	1	2	3	4	5	6	7
Singhalese No. 2	0	0	—	—	0	—	0
Tamil coolie No. 10	$\frac{1}{250}$	$\frac{1}{250}$	$\frac{1}{250}$	0	$\frac{1}{250}$	0	0

Table No. VI.

Vaccination with Simple Carbolized Cholera Vaccine (two inoculations: 1c.c the first, 2c.c. the second).

	Limits of Agglutination for V. Choleræ—Weeks after 1st Inoculation.					
	1	2	3	4	5	6
Tamil coolie No. 11	$\frac{1}{250}$	$\frac{1}{150}$	$\frac{1}{250}$	$\frac{1}{250}$	0	0
Tamil coolie No. 12	0	$\frac{1}{150}$	$\frac{1}{150}$	0	$\frac{1}{250}$	0
Tamil coolie No. 13	$\frac{1}{250}$	$\frac{1}{800}$	—	$\frac{1}{600}$	$\frac{1}{250}$	0

Table No. VII.

Vaccination with Simple Typhoid Vaccines (two inoculations: 0·6c.c. the first, 1·2c.c. the second).

	Limits of Agglutination for B. Typhosus—Weeks after 1st Inoculation.										
	1	2	3	4	5	6	7	8	9	10	11
Singhalese No. 3 (carbolized vaccine) ...	$\frac{1}{250}$	$\frac{1}{800}$	$\frac{1}{800}$	$\frac{1}{1000}$	$\frac{1}{800}$	—	$\frac{1}{1000}$	—	$\frac{1}{600}$	$\frac{1}{600}$	$\frac{1}{600}$
Singhalese No.4 (ordinary heated vaccine) ...	$\frac{1}{250}$	$\frac{1}{600}$	$\frac{1}{600}$	$\frac{1}{800}$	$\frac{1}{600}$	$\frac{1}{1800}$	$\frac{1}{1800}$	$\frac{1}{1800}$	$\frac{1}{1800}$	—	$\frac{1}{600}$

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Table No. VIII.

VACCINATION WITH SIMPLE PARATYPHOID A. VACCINES (TWO INOCULATIONS: ½C.C. THE FIRST, 1C.C. THE SECOND).

	Limits of Agglutination for B. Paratyphosus A. Weeks after 1st Inoculation.										
	1	2	3	4	5	6	7	8	9	10	11
Tamil "Singho" ...	$\frac{1}{20}$	$\frac{1}{80}$	$\frac{1}{20}$	$\frac{1}{40}$	$\frac{1}{40}$	$\frac{1}{40}$	$\frac{1}{80}$	$\frac{1}{80}$	$\frac{1}{40}$	—	$\frac{1}{40}$
Singhalese "Wellan" ...	0	$\frac{1}{100}$	$\frac{1}{80}$	$\frac{1}{80}$	$\frac{1}{80}$	$\frac{1}{80}$	$\frac{1}{80}$	$\frac{1}{40}$	$\frac{1}{20}$	—	$\frac{1}{80}$

Table No. IX.

VACCINATION WITH SIMPLE PARATYPHOID B. VACCINES (TWO INOCULATIONS: 0·6C.C. THE FIRST, 1·2C.C. THE SECOND).

	Limits of Agglutination for B. Paratyphosus B. Weeks after 1st Inoculation.										
	1	2	3	4	5	6	7	8	9	10	11
Singhalese "Assou" ...	0	$\frac{1}{80}$	$\frac{1}{40}$	$\frac{1}{40}$	$\frac{1}{80}$	$\frac{1}{40}$	$\frac{1}{20}$	$\frac{1}{20}$	$\frac{1}{20}$	—	$\frac{1}{20}$
Tamil "Karuppen" ...	0	$\frac{1}{20}$	$\frac{1}{80}$	$\frac{1}{80}$	$\frac{1}{80}$	$\frac{1}{20}$	$\frac{1}{20}$	$\frac{1}{20}$	0	—	0

From the above tables it will be seen that the two individuals inoculated with the combined "five diseases" vaccine produced agglutinins in large amount for typhoid, paratyphoid A and paratyphoid B; in small amount for cholera, and in very small amount for plague.

If we compare these results with those obtained in individuals respectively inoculated with simple typhoid vaccine, paratyphoid A vaccine, paratyphoid B vaccine, cholera vaccine and plague vaccine, we see that the amount of agglutinins produced in the latter is not distinctly larger. In the control individuals inoculated with simple typhoid, paratyphoid A, paratyphoid B vaccines, the amount of agglutinins for such germs does not seem to be much higher; in individuals inoculated with simple cholera vaccine the amount of agglutinins present is small, in individuals inoculated with simple plague vaccine, whatever kind of vaccine is used (carbolized, Lustig's, or Haffkine's), it is also very small or absent.

Combined "Typhoid-Malta Fever" Vaccine.

This vaccine consists of an emulsion in carbolized (½ per cent.) normal salt solution (0·75 per cent.) of typhoid bacillus and *Micrococcus melitensis*. Agar cultures twenty-four hours' old are used in the case of typhoid; agar cultures three days' old in the case of Malta fever. The growth of the typhoid agar cultures is washed off with 0·75 per cent. salt solution containing 0·5 per cent. carbolic acid, is stored at room temperature 18-24 hours, and then tested for sterility and standardized in such a way that 1 c.c. will contain approximately 1,000 millions of typhoid bacilli. The same technique is used to prepare the Malta fever vaccine, but such vaccine is standardized so as to contain 4,000 millions per c.c. These two vaccines are mixed together in equal parts: the combined vaccine will contain per c.c. 500 millions typhoid and 2,000 millions Malta fever. I have inoculated this vaccine in eleven individuals with no untoward symptoms. The reaction is hardly more severe than after the inoculation of simple vaccine. I have not studied the agglutination week by week, as I have done in other combined vaccines, but the blood of inoculated individuals develops a large amount of agglutinins for the typhoid bacillus, and a certain amount of agglutinins for the Malta fever.

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Combined "Typhoid—Paratyphoid B—Paratyphoid A—Malta Fever" Vaccine.

This vaccine consists of an emulsion in carbolized (½ per cent.) salt solution (0·75 per cent.) of typhoid, paratyphoid A, paratyphoid B bacilli, and *Micrococcus melitensis*. Agar cultures twenty-four hours' old are used in the case of the first three germs mentioned, agar cultures three days' old of Malta fever. The growth of the typhoid agar cultures is washed off with 0·75 per cent. salt solution containing 0·5 per cent. carbolic acid, is stored at room temperature 18-24 hours, and then tested for sterility and standardized in such a way that 1 c.c. will contain approximately 2,000 millions typhoid. The same technique is used to prepare the paratyphoid A and paratyphoid B vaccines, each of these being standardized to contain 1,000 millions. The same technique is used to prepare the Malta fever vaccine, but this vaccine is standardized in such a way as to contain 4,000 millions per c.c.

After having standardized and tested for sterility these four different vaccines, they are mixed together in equal parts. Each c.c. of the mixture will contain the following:—

Typhoid	... ...	500 millions.
Paratyphoid A	... ...	250 „
Paratyphoid B	... ...	250 „
Malta fever	... ...	1,000 „

Of this vaccine 0·5 to 0·6 c.c. is injected subcutaneously in the arm the first time, and 1 c.c. to 1·2 c.c. the second time, after a week.

I have used this vaccine in a fairly large number of persons. I may say that the reaction was hardly severer than after the simple typhoid or mixed typhoid paratyphoid A and paratyphoid B vaccines. The blood of all the inoculated persons developed a large amount of agglutinins for typhoid, paratyphoid B, and paratyphoid A, and a certain amount for Malta fever. The amount of agglutinins produced for each germ was apparently not distinctly less than in control individuals inoculated with simple "one disease" vaccines. (See tables).

Table No. X.

VACCINATION WITH "TYPHOID+PARATYPHOID A+PARATYPHOID B+MALTA FEVER" VACCINE (TWO INOCULATIONS: 0·5 TO 0·6C.C. THE FIRST TIME, 1 TO 1·2C.C. THE SECOND TIME).

Names of Inoculated Individuals.	Agglutination for	Agglutination limits—Weeks after 1st Inoculation							
		1	2	3	4	5	6	7	8
Hamy	Typhoid	0	1/100	1/100	1/100	1/200	1/200	1/50	1/50
	Paratyphoid A. ...	0	1/200	1/50	1/50	1/50	1/100	1/100	1/100
	Paratyphoid B. ...	0	1/200	1/100	1/100	1/100	1/50	1/50	1/50
	Malta fever	0	1/20	1/40	1/100	1/100	1/50	1/100	1/100
Wellan No. 2 ...	Typhoid	0	1/500	1/500	1/500	1/500	1/200	1/200	1/50
	Paratyphoid A. ...	0	1/200	1/200	1/100	1/100	1/50	1/50	1/50
	Paratyphoid B. ...	0	1/200	1/50	1/100	1/100	1/100	1/50	1/50
	Malta fever	0	1/20	1/50	1/50	1/100	1/100	1/50	1/50

Table No. XI.

VACCINATION WITH SIMPLE MALTA FEVER VACCINE (TWO INOCULATIONS: 0·6C.C. THE FIRST TIME, 1·2C.C. THE SECOND).

Names of Inoculated Individuals.	Agglutination limits for M. Melitesnis—Weeks after 1st Injection.							
	1	2	3	4	5	6	7	8
Suppon (Tamil)	0	1/50	1/50	1/50	1/50	1/50	1/50	1/50
Mr. S. (European)	0	0	1/50	1/100	1/100	1/100	1/50	1/100

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Combined "Typhoid—Paratyphoid A—Paratyphoid B—B. columbensis—B. asiaticus" Vaccine.

There being in Ceylon cases of fever due to *B. columbensis* and *B. asiaticus*, I have prepared a combined vaccine containing also these two germs. This vaccine consists of an emulsion in carbolized (½ per cent.) salt solution (0·75 per cent.) of typhoid, paratyphoid A, paratyphoid B bacilli, *B. asiaticus* and *B. columbensis*.

The individual carbolized vaccines are prepared as stated in previous paragraphs and standardized as follows:—

Typhoid	2,500	millions per c.c.
Paratyphoid A	1,000	„ „
Paratyphoid B	1,000	„ „
Asiaticus	1,000	„ „
Columbensis	1,000	„ „

These vaccines are mixed together in equal parts so that each c.c. of the combined vaccine will approximately contain:—

Typhoid	500	millions.
Paratyphoid A	200	„
Paratyphoid B	200	„
Asiaticus	200	„
Columbensis	200	„

Of this combined vaccine 0·5 to 0·6 c.c. is inoculated the first time and 1 c.c. to 1·2 c.c. the second time, a week later. The reaction is not much more severe than after a simple typhoid or typhoid-paratyphoid vaccination. The inoculated individuals develop a large amount of agglutinins of typhoid, paratyphoid A and paratyphoid B, practically in the same amount as control individuals inoculated with simple "one disease" vaccines. Agglutinins for *B. asiaticus* and *columbensis* are, however, present in most cases in not very large amount, and may soon disappear.

Combined "Typhoid—Paratyphoid A—Paratyphoid B—Micrococcus Melitensis—B. columbensis—B. asiaticus" Vaccine.

This vaccine consists of an emulsion in carbolized (½ per cent.) salt solution (0·75 per cent.) of typhoid bacilli, paratyphoid A, paratyphoid B bacilli, *B. asiaticus, B. columbensis*, Malta fever micrococcus.

The individual vaccines are prepared as described in previous paragraphs and standardized as follows, per c.c.:—

Typhoid	2,400	millions.
Paratyphoid A	1,000	„
Paratyphoid B	1,000	„
Asiaticus	1,000	„
Columbensis	1,000	„
Malta fever	4,000	„

These vaccines are mixed in equal parts. The combined "six diseases" vaccine will, therefore, contain per c.c.:—

Typhoid	400	millions.
Paratyphoid A	166	millions (about).
Paratyphoid B	166	„
Asiaticus	166	„
Columbensis	166	„
Malta fever	666	„

I have inoculated numerous persons with this combined vaccine 0·5 to 0·6 c.c. the first time and 1 to 1·2 c.c. the second time, a week later. The inoculated persons have developed a large amount of agglutinins for typhoid, paratyphoid A and paratyphoid B, in fact, the large amount of agglutinins for *B. paratyphosus A* and *B. paratyphosus B* is indeed remarkable, being higher than in control individuals inoculated with simple paratyphoid A and paratyphoid B vaccines, a certain amount for Malta fever. Agglutinins for *B. asiaticus and B. columbensis* were produced in fairly large quantity but soon disappeared. This, however, is apparently the case also with control individuals inoculated with simple *B. columbensis* and *B. asiaticus* vaccines.

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Table No. XII.

TYPOID + PARATYPHOID A. + PARATYPHOID B. + MALTA FEVER + B. COLUMBENSIS + B. ASIATICUS.

Names of Inoculated Individuals.	Agglutination for	Agglutination limits—Weeks after 1st Inoculation. 1	2	3	4	5	6
Subetheris (Singhalese)	Typhoid	0	1/200	1/200	1/100	1/100	1/200
	Paratyphoid A. ...	0	1/200	1/200	1/200	1/200	1/200
	Paratyphoid B. ...	0	1/200	1/200	1/200	1/200	1/200
	Malta fever	0	1/50	1/50	1/50	1/100	1/100
	B. Columbensis ...	0	1/100	1/100	1/50	1/50	0
	B. Asiaticus ...	0	1/50	1/100	1/100	1/50	1/50
Mr. D. (European)	Typhoid	1/50	1/200	1/200	—	—	1/100
	Paratyphoid A. ...	0	1/100	1/100	—	—	1/200
	Paratyphoid B. ...	0	1/100	1/100	—	—	1/200
	Malta fever	0	0	1/50	—	—	1/50
	B. Columbensis ...	0	1/100	1/50	—	—	0
	B. Asiaticus ...	0	1/200	1/200	—	—	1/50

Table No. XIII.

VACCINATION WITH SIMPLE B. COLUMBENSIS VACCINE (TWO INOCULATIONS).

Inoculated Individuals.	Agglutination limits—Weeks after 1st Injection. 1	2	3	4	5	6
Tamil coolie No. 14	1/50	1/100	1/50	1/50	1/10	1/20
Tamil coolie No. 15	0	1/100	1/100	1/10	1/10	0

Table No. XIV.

VACCINATION WITH SIMPLE B. ASIATICUS VACCINE (TWO INOCULATIONS: 0·6C.C. THE FIRST TIME, 1·2C.C. THE SECOND).

Inoculated Individual.	Agglutination Limits—Weeks after 1st Injection. 1	2	3	4	5	6
Tamil coolie No. 16	1/50	1/200	1/100	1/100	1/50	1/50

Combined "Dysentery-Typhoid-Paratyphoid" Vaccine.

For the preparation of this combined vaccine broth cultures should never be used, as broth cultures of dysentery bacilli give rise to an extremely painful infiltration at the site of the inoculation.

Pepton water cultures should be used, or better, emulsions in salt solution, such as I use at the present time. The combined vaccine I now prepare consists of an emulsion of Shiga-Kruse, Hys Y bacillus, original Flexner bacillus, a Flexner-like bacillus No. 1 isolated in Ceylon, a Flexner-like bacillus No. 2 also isolated in Ceylon, typhoid bacillus, paratyphoid bacillus A, and paratyphoid bacillus B. The individual vaccines are prepared by making emulsions from twenty-four hours agar cultures, in normal salt solution (0·75 per cent.) to which 0·5 per cent. of carbolic acid has been added.

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The individual vaccines are standardized as follows per c.c. :—

Typhoid bacillus	4,000	millions.
Paratyphoid A bacillus	1,000	„
Paratyphoid B bacillus	1,000	„
Shiga-Kruse bacillus	1,000	„
Flexner bacillus	1,000	„
Hys Y bacillus	1,000	„
Flexner-like No. 1	1,000	„
Flexner-like No. 2.	1,000	„

These vaccines are mixed in equal parts so that one c.c. of the mixed vaccine will contain :—

Typhoid	200	millions.
Paratyphoid A	125	„
Paratyphoid B	125	„
Shiga-Kruse	125	„
Flexner	125	„
Hys Y	125	„
Flexner-like No. 1	125	„
Flexner-like No. 2	125	„

Of this vaccine 0·5 to 0·6 is given hypodermically the first time and 1 c.c. to 1·2 c.c. after a week. The reaction is somewhat more severe as a rule than after the typhoid-paratyphoid vaccine. As regards amount of protective substances induced by such vaccine very little can be said, as the agglutination for the germs of the dysentery group was generally slight, the agglutination limit seldom being higher than 1 in 40. It was also very irregular and inconstant, but the same may be said of individuals inoculated with simple Shiga-Kruse, Flexner, &c., vaccines. Typhoid, paratyphoid A and paratyphoid B agglutinins, on the other hand, are produced in fair amount, though, as a rule, distinctly less than in control individuals inoculated with simple typhoid, paratyphoid A and paratyphoid B vaccines. Possibly the amount of bacteria of each species inoculated falls below the necessary minimum.

"*Cholera—Plague—Typhoid—Paratyphoid A—Paratyphoid B—Malta Fever*" *Vaccine.*

This vaccine consists of an emulsion in carbolized (½ per cent.) salt solution (0·75 per cent.) of cholera vibrios, plague bacilli, typhoid, paratyphoid A and B bacilli and micrococcus melitensis. The individual vaccines are prepared as described in previous paragraphs and standardized as follows per c.c. :—

Cholera	4,000	millions.
Plague	1,000	„
Typhoid	1,000	„
Paratyphoid A	1,000	„
Paratyphoid B	1,000	„
Malta fever	4,000	„

These vaccines are mixed together in the following proportions :—

Cholera vaccine, two parts	2 c.c.
Plague „ do.	2 c.c.
Typhoid „ do.	2 c.c.
Paratyphoid A vaccine, one part	1 c.c.
Paratyphoid B „ one „	1 c.c.
Malta fever „ two parts	2 c.c.

Of this mixed vaccine 1 c.c. is inoculated the first time and 2 c.c. the second, a week later. This vaccine is still in the experimental stage having been used only in six individuals The reaction is somewhat severe and similar to that observed after inoculation of a simple plague vaccine or a combined plague-cholera vaccine. From some observations made it would seem that the production of agglutinins is very similar to that observed in individuals inoculated with one disease vaccines, but the investigation is still to be continued.

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RESUMÉ AND CONCLUSIONS.

I. The preparation of combined vaccines is based, I think I may venture to say, on the experimental work I carried out in 1901-1902 in Bonn, in Professor Kruse's Institute (Zeit. für Hygiene, 1902-1903), when I demonstrated that in inoculating an animal with two or three species of bacteria—provided a sufficient minimum quantity was given—agglutinins and immune bodies for all the germs were elaborated, the amount of agglutinins and immune bodies elaborated for each germ being nearly the same as in animals respectively inoculated with only one species.

II. I have prepared and used in man the following vaccines:—

(1) Typhoid—paratyphoid A—paratyphoid B.
(2) Typhoid—Malta fever.
(3) Typhoid—paratyphoid A—paratyphoid B—Malta fever.
(4) Typhoid—paratyphoid A—paratyphoid B—B. asiaticus—B. columbensis.
(5) Typhoid—paratyphoid A—paratyphoid B—B. asiaticus—B. columbensis—Malta fever.
(6) Typhoid—paratyphoid A—paratyphoid B—dysentery Kruse-Shiga—dysentery Flexner—dysentery Hys Y—dysentery Flexner-like No. 1—dysentery Flexner-like No. 2.
(7) Cholera—plague.
(8) Cholera—plague—typhoid—paratyphoid A—paratyphoid B.
(9) Cholera—plague—typhoid—paratyphoid A—paratyphoid B—Malta fever.

III. The inoculation in man of the above combined vaccines is harmless. The reaction is not severe, with the exception of those containing plague germs, such as the "cholera-plague" and "cholera-plague-typhoid-paratyphoid A-paratyphoid B" vaccines, when the reaction is severe, though apparently rather less so than after Haffkine's simple plague vaccine.

IV. The combined vaccines I am now using consist of carbolized emulsions of agar cultures in normal salt solution without heating. These emulsions seem to give a less painful local reaction than broth cultures killed by heat. The presence of 0·5 per cent. carbolic acid is sufficient to kill the germs. The "typhoid-paratyphoid A-paratyphoid B" vaccine is, however, also prepared by heating broth cultures at 53.

V. The individuals inoculated with the above-mentioned combined vaccines generally produce agglutinins for each species of bacteria, and the amount for each species is not much less than control individuals inoculated with simple "one disease" vaccines. The only exception—though only to a certain extent—seems to have been in the case of typhoid-dysentery vaccines.

VI. Combined vaccines, when efficient, are of practical advantage, saving a great deal of time, and rendering possible a contemporaneous vaccination for several different maladies.

THE HYPHOMYCETES FOUND IN SPRUE.

In the present report I do not propose to discuss the etiological rôle played by fungi in sprue, but merely to study the subject from a botanical point of view.

Historical.—Kohlbrugge in 1901 (see *Arch. f. Schiffs u. Tropen-Hygiene*, 1901, *No.* 12) found in cases of sprue a fungus which he identified with the thrush fungus (*Monilia, Oidium, Endomyces, Saccharomyces albicans*). He made a very complete histological study of one of his cases which ended fatally, and emphasized the fact that the fungus in sections of the tongue, &c., had invaded the deep strata of the mucosa, the glands, and portions of the submucosa. He concluded that the thrush fungus, or *Monilia albicans*, was the cause of the disease. Kohlbrugge's findings were confirmed by many observers: Le Dantec suggesting for the disease the term "*Blastomycosis intestinalis.*"

From 1909, being interested in the subject of fungi in general, I have studied the hyphomycetic intestinal flora of a certain number of typical cases of sprue, as well as of other conditions, and normal individuals, and have come to the conclusion

that there are several different species of intestinal monilias (*M. intestinalis, M. fæcalis,* &c.) In my paper on sprue in the *Rivista Critica Clinica Medica,* 1912, I discussed all the various theories, bringing forward what had been found in favour of each by myself and others: I did not express any opinion as regards the etiological rôle of these fungi in sprue, except that they were probably the cause of the frothy diarrhœa. Having noted that this frothy diarrhœa generally improves after strong doses of bicarbonate of soda, I thought that sodium bicarbonate given in large doses, by decreasing the acidity of the intestinal contents might check the growth of fungi, which, as is well known, grow better on acid than on alkaline media.

In 1913 Dr. George Low and myself described a new species of monilia we found in a case of sprue, and called it *Monilia decolorans.* We considered this monilia and similar ones to be probably the cause of some of the important symptoms of the disease, such as frothiness of the stools, &c., but we were not inclined to consider them to be the primary cause of the malady; we quoted in analogy the example of scabies, in which the main part of the symptoms is due to the secondary invasion by staphylococci and not the primary or real cause, the acarus. We quoted also the example of pulmonary tuberculosis, in which a very important symptom, the serotine fever, is not due to the tubercular bacillus, but to the secondary treptococcal infection.

Recently (April, 1914) Dr. P. Bahr has published a report of his investigation of the malady in which he identifies the fungi found in sprue with the thrush fungus (*Monilia albicans*) completely supporting Kolbrugge He seems also to be inclined to agree with Kolbrugge that *Monilia albicans* is the primary cause of the disease.

Presence of fungi in sprue.—In practically every case of sprue it is easy to put in evidence hyphomycetes in the stools, and scrapings from the tongue. The microscopical examination of the frothy motions will often reveal the presence of spore-like bodies and mycelial elements typical of the genus monilia. Even when fungi are not observed microscopically they can generally be put in evidence by cultures, inoculating glucose agar or glucose broth tubes with a particle of the stools. Though generally in much less amount, it is not rare in the tropics to find microscopically identical fungi in stools of patients suffering from other diseases (dysentery, enteric, etc.), and occasionally in normal persons. Microscopically identical fungi may be isolated also from the air, tea dust, copra dust, etc., etc.

Botanical position of the fungi found in sprue. Differentiation of intestinal monilias and monilias in general.—As already stated, all monilias found in sprue as well as in other conditions, such as bronchomycosis, thrush, otomycosis; those found in the air, tea dust, copra dust, etc., have all been considered to be the same species, and identified with the thrush fungus or *Monilia albicans.* Since 1909, in a series of papers I have expressed the opinion based on a certain number of experiments, that the term "thrush fungus" or *Monilia albicans* (*Odium, Saccharomyces, Endomyces albicans*) has been used to cover a large number of different species (possibly even different genera) of fungi, in the same manner that, till some years ago, the term *B. coli* was used to indicate a prodigious number of different bacteria, in the same manner that the term *Trychopython tonsurans* till fairly recently covered numerous different fungi, belonging not only to different species but to different genera, such as the genera epidermophyton, microsporon, endodermophyton. This, in my opinion, erroneous conception of *Monilia albicans* has been due to the classification of such fungi being based hitherto solely on their morphological and microscopical characters and gross appearances of cultures on solid media. Since 1908 I have suggested the classification of such fungi should be based, not only on their morphological appearances, but also, and principally, on (1) their action on litmus milk and gelatine; (2) their action on carbohydrates; (3) on agglutination and immunisation phenomena, whenever possible.

Action of fungi of the genus monilia on litmus milk and gelatine. Some monilias coagulate milk, others do not; some monilias render it acid without coagulating it; some strains decolorize the medium. The greatest number of strains in my experience do not liquefy gelatine, while a few, including the original *Monilia albicans, sensu stricto,* do liquefy this medium.

Appendix VIII.

Reports on work carried out in colonial laboratories.

Action of monilias on carbohydrates. I have always used a very large number of sugars, but for practical purposes the following are sufficient for the identification of most species. glucose, saccharose, lævulose, galactose, maltose, mannite, lactose. I have observed, in analogy to what takes place when dealing with bacteria, that certain well defined species (for instance, *Monilia intestinalis, Monilia tropica*) do not change to any appreciable extent their fermentation properties in the course of time, while with other species the fermentation properties are not constant. I have noted also that strains which do not ferment certain sugars may be trained at times to do so, but this is the case also with many bacteria. It is well known, for instance, that Penfold has been able to change the fermentative properties of germs of the typhoid colon group to a remarkable degree: still no one denies the validity of the usual fermentation tests in differentiating between organisms of this group.

As regards the use of immunization, agglutination, and complement fixation phenomena for the differentiation of monilias, unfortunately these are experiments which take a very great deal of time. I may say, however, that rabbits inoculated subcutaneously with repeated small doses of cultures of monilias, often develop agglutinins in their blood, and these are to a certain extent specific, *viz.*, the inoculated rabbit develops a distinct amount of agglutinins only for the species with which it has been inoculated. It would seem from the experiments made—which however, I consider far from being complete that the classification data obtained in this way are, broadly, in consonance with the results and data obtained by the action of the organisms on milk, gelatine, and sugar broths.

Description of certain species of monilias found in cases of sprue.

In previous reports I have given a description of numerous species of the genus monilia as found in stools, sputum, in tea dust, in copra dust, etc., etc. It is quite possible that future investigation may show that some of the species created cannot stand, but I venture to say that my main point, *viz.*, that there is a plurality of species of the so-called *Monilia albicans*, or thrush-fungus, will be confirmed.

I will limit myself to give here a description of monilias found in stools, and only those species which I consider to be *good*. Some of these species have already been published, but I will repeat here their description for the reader's convenience.

For those who may be interested in the comparative study of these fungi I annex a table containing species derived from cases of bronchomycosis, thrush, tea dust, etc.

Table XV.

Intestinal Monilias.

—	Litmus Milk.	Glucose.	Lævulose.	Maltose.	Galactose.	Saccharose.	Lactose.	Mannite.	Dulcite.	Dextrin.	Raffinose.	Arabinose.	Adonite.	Inulin.	Sorbite.	Broth.	Peptone Water.	Indol.	Gram.	Gelatine.	Serum.	Neutral Red.	Inosite.	Salicin.	Amygdalin.	Isodulcite.	Glycerin.	Erythrite.
Monilia asteroides, Cast., 1914	A C	A	A	A	A	A	A	A	O	A	A	O	O	O	A	T	C	—	+	—	O	—	—	—	—	—	—	—
Monilia fæcalis, Cast., 1911	A / D Ps	A G	A G	A G	A Gs	A Gs	O	O	O	O	O	O	O	O	O	C	C	O	+	O	O B	O	—	—	—	—	—	—
Monilia insolita, Cast., 1911	As / Alk	A G	A G	A G	A G	A G	O	As	O	O	O	O	O	O	O	C	C	O	+	O	O B	O	—	—	—	—	—	—
Monilia intestinalis, Cast., 1911	A Ds	A G	A G	As	A	A	O	O	O	O	O	O	O	O	O	C	C	O	+	O	O	O	—	—	—	—	—	—
Monilia rotundata, Cast., 1911	A C	A	A	A	A	O	A	O	O	O	O	O	O	O	O	C	C	O	+	O	O	O	—	—	—	—	—	—
Monilia decolorans, Cast. and Low, 1913	D F C	A Gs	A G	A Gs	A	A	O	O	O	A	O	O	O	O	O	C	C	O	+	O	O	O	O	O / Alk	O	O	A	O

A—acid; G—gas; C—clot (milk); clear (broth and peptone water); D—decolourized; P—peptonized (milk); $\frac{A}{Alk.}$—acid then alkaline; S—slight; +—positive result; F—fine; O—negative result, viz.: neither acid nor gas in sugar media, non-production of indol, non-liquefaction of serum or gelatine, as the case may be.

Table XVI.

Table showing Monilias so far found in Man, with Names in Alphabetical Order.

—	Litmus Milk.	Glucose.	Lævulose.	Maltose.	Galactose.	Saccharose.	Lactose.	Mannite.	Dulcite.	Dextrin.	Raffinose.	Arabinose.	Adonite.	Inulin.	Sorbite.	Broth.	Peptone Water.	Indol.	Gram.	Gelatine.	Serum.	Neutral Red.	Inosite.	Salicin.	Amygdalin.	Isodulcite.	Glycerin.	Erythrite.
Monilia albicans, Robin.	A C	A G	A Gs	A Gs	A G	Avs	O	O	O	O	O	O	O	O	O	CTP	C	O	+	+	+s	O	—	—	—	—	—	—
Monilia asteroides	A C	A	A	A	A	A	A	A	O	A	A	O	O	O	A	T	C	—	+	—	O	—	—	—	—	—	—	—
Monilia blanchardi, Cast.	Avs / — / Alk	A Gs	A	A	A	A	O	O	O	O	As	O	O	Avs	O	C	C	O	+	O	O	O	—	—	—	—	—	—
Monilia bronchialis, Cast.	O	A G	A G	A G	O	A Gs	O	O	O	A	O	O	O	O	O	C	C	O	+	O	O	O	—	—	—	—	—	—
Monilia burgessi, Cast.	O / — / Alk	A Gs	A	A Gs	A	A Gs	O	O	O	O	O	O	O	O	O	C	C	O	+	O	O B	O	—	—	—	—	—	—
Monilia chalmersi, Cast.	As / — / Alk	A G	A G	As	A Gs	A G	O	O	O	O	As	O	O	A Gs	O	C	C	O	+	O	O	O	—	—	—	—	—	—
Monilia decolorans, Cast. and Low ...	D F C	A Gs	A G	A Gs	A	A	O	O	O	A	O	O	O	O	O	C	C	O	+	O	O	O.	O	O / — / Alk	O	O	A	O
Monilia enterica, Cast....	O / — / . lk	A G	A G	A G	A G	A G	O	As	O	As	O	O	O	O	O	C	C	O	+	O	O	O	—	—	—	—	—	—
Monilia fæcalis, Cast.	A / — / D Ps	A G	A G	A G	A Gs	A Gs	O	O	O	O	O	O	O	O	O	C	C	O	+	O	O B	O	—	—	—	—	—	—
Monilia guillermondi, Cast.	O / — / Alk	A G	A G	As	A	A G	O	O	O	O	A Gs	O	O	O	O	CTP	C	O	+	O	O	O	—	—	—	—	—	—
Monilia insolita, Cast.	As / — / Alk	A G	A G	A G	A G	A G	O	As	O	O	O	O	O	O	O	C	C	O	+	O	O B	O	—	—	—	—	—	—
Monilia intestinalis, Cast.	A Ds	A G	A G	As	A	A	O	O	O	O	O	O	O	O	O	C	C	O	+	O	O	O	—	—	—	—	—	—
Monilia krusei, Cast.	O	A G	A G	O	O	O	O	O	O	O	O	O	O	O	O	C	C	O	+	O	O	O	—	—	—	—	—	—
Monilia lustigi, Cast.	As / — / D	A	A Gs	Avs	A	A Gs	O	O	O	A	A Gs	O	O	O	O	C	C	O	+	O	O B	O	—	—	—	—	—	—

—	Litmus Milk.	Glucose.	Lævulose.	Maltose.	Galactose.	Saccharose.	Lactose.	Mannite.	Dulcite.	Dextrin	Raffinose.	Arabinose.	Adonite.	Inulin.	Sorbite.	Broth.	Peptone Water.	Indol.	Gram.	Gelatine.	Serum.	Neutral Red	Inosite	Salvin.	Amygdalin.	Isodulcite.	Glycerin	Erythrite.
Monilia negrii, Cast.	Avs / Alk	A G	A G	As	A Gs	A G	O	O	O	O	A Gs	O	O	O	O	C	C	O	+	O	O	O	—	—	—	—	—	—
Monilia nivea, Cast.	O / Alk	A G	A G	A G	A G	A Gs	O	O	O	O	A G	O	O	O	O	C	C	O	+	O	O	O	—	—	—	—	—	—
Monilia nitioa, Cast.	A / D C	A G	A G	A	A	A	A	A	O	Avs	As or O	O	O	O	O	CTP	C	O	+	O	O	O	—	—	—	—	—	—
Monilia paratropicalis, Cast.	As / Alk	A G	A G	A G	A G	A. G	O	O	O	Avs	O	O	O	O	O	CTP	C	O	+	O	O	O	—	—	—	—	—	—
Monilia perryi, Cast.	As / D Alk	A	A Gs	A	A	A Gs	O	O	O	O	As	O	O	Avs	O	C	C	O	+	O	O	O	—	—	—	—	—	—
Monilia pinoyi, Cast	O	A G	A G	A G	O	O	O	O	O	O	O	O	O	O	O	C	C	O	+	O	O	O	—	—	—	—	—	—
Monilia pseudo tropicalis, Cast. ...	A Cs	A G	A G	O	A Gs	A G	A G	O	O	O	O	O	O	O	O	C	C	O	+	O	O	O	—	—	—	—	—	—
Monilie pulmonalis, Cast.	O / Alk D	A G	A G	A G	A Gs	A G	O	Avs	O	O	A	A Gs	O	O	O	CTP	C	O	+	O	O B	O	—	—	—	—	—	—
Monilia rhoi, Cast.	As / Alk	A G	A G	Avs	A Gs	A G	O	O	O	O	O	O	O	O	O	C	C	O	+	O	O	O	—	—	—	—	—	—
Monilia rotundata, Cast.	A C	A	A	A	A	O	A	O	O	O	O	O	O	O	O	C	C	O	+	O	O	O	—	—	—	—	—	—
Monilia rugosa, Cast.	A / Ps Cs	As	As	As	As	As	O	O	O	O	O	O	O	O	O	C	C	O	+	O	O	O	—	—	—	—	—	—
Monilia tropicalis, Cast.	A or O	A G	A G	A G	A Gs	A Gs	O	O	O	O	O	O	O	O	O	C	C	O	+	O	O B	O	—	—	—	—	—	—
Monilia zeylanica, Cast.	A C S	A	A	A	A	A	As	O	O	A	Avs / Gvs	O	O	Avs	O	C	C	O	+	O	O	O	—	—	—	—	—	—

ABBREVIATIONS USED IN THE TABLES:—

A—acid; G—gas; C—clot (milk) clear (broth and peptone water); C.T.P. clear at first then thin, pellicle present; D—decolourized; P—peptonized (milk); Pellicle (broth) Alk—alkaline; $\frac{A}{Alk.}$—acid, then alkaline; S—slight; VS—very slight; *T*—brown pigmentation of the medium; O—negative result, *viz.*, neither acid nor clot in milk; neither acid nor gas in sugar media, non-production of indol; non-liquefaction of gelatine or serum as the case may be; +—positive result, liquefaction of medium; F—fine.

Appendix VIII.

REPORTS ON WORK CARRIED OUT IN COLONIAL LABORATORIES.

Monilia intestinalis, Cast., 1911.—Microscopically has all the characters of the genus monilia; grows abundantly on slightly acid sugar media, giving rise to large white colonies, which soon coalesce into a cream-like abundant growth. The growth is composed practically of only globular yeast-like cells, while in the water of condensation globular cells and mycelium may be found together.

A little mycelium may be found however, also in the growth on the slope. Asous formations are absent, gelatine and serum are not liquefied, litmus milk is slowly decolourized, the decolourization starting at the bottom of the tube. No clotting. This monilia produces acid and gas in glucose and lævulose, acid in maltose, galactose, saccharose; does not ferment lactose, mannite, dulcite, dextrin, raffinose, arabinose, adonite, inulin, sorbite.

Origin.—Isolated by me in three cases of sprue.

Monilia fœcalis, Cast., 1911.—Grows abundantly on sugar media, giving rise to white colonies, which soon coalesce. Milk is rendered first slightly acid, then alkaline, gelatine not liquefied. Serum is not liquefied: a dark pigmentation often develops on the surface of the medium round the growth—this pigmentation may be lost in sub-cultures.

Origin.—Isolated from two cases of sprue, one of enteritis, one of ptomaine poisoning; also from a sputum which has been collected in a dirty receptacle.

Monilia insolita, Cast., 1911.—Colonies on sugar media, white. Milk is first very slightly acid, then alkaline, and becomes slowly decolourized. Gelatine is not liquefied. The growth on serum does not become surrounded by a zone of dark pigmentation; the medium is not liquefied. The fungus produces acid and gas in glucose, lævulose, maltose, galactose, saccharose, produces often slight acidity in mannite, and does not ferment lactose, dulcite, dextrin, raffinose, arabinose, adonite, inulin, sorbite.

Origin.—This monilia was isolated from the stools, saliva, and scrapings of tongue from a case of sprue; stools of two cases of enteric, and a normal individual; also from sputum.

Remarks.—It is probable that this monilia is in reality merely a variety of *M. fœcalis*.

Monilia tropicalis, Cast., 1900.—On glucose agar large white colonies appear which later on coalesce. Gelatine and serum not liquefied; there is no brownish or black discolouration of the serum. Litmus milk is not changed, or is rendered slightly acid: it is never clotted. This monilia produces acid and gas in glucose, lævulose, maltose, galactose, and saccharose; does not ferment lactose, mannite, dulcite, dextrin, raffinose, arabinose, adonite, inulin, sorbite.

Origin and remarks.—Found once in the stools of a case of sprue. This species is the most frequently met with in Ceylon, in cases of broncho-mycosis.

Monilia (?) *rotundata*, Cast., 1911.—Growth on glucose agar has a somewhat crinkled appearance. The colour is yellowish. Milk is rendered strongly acid and clotted. Serum and gelatine are not liquefied. This fungus does not produce gas in any sugar (glucose, lævulose, galactose, saccharose, lactose, mannite, dulcite, dextrin, raffinose, arabinose, adonite, inulin, sorbite); it produces acidity in glucose, lævulose, maltose, galactose, lactose.

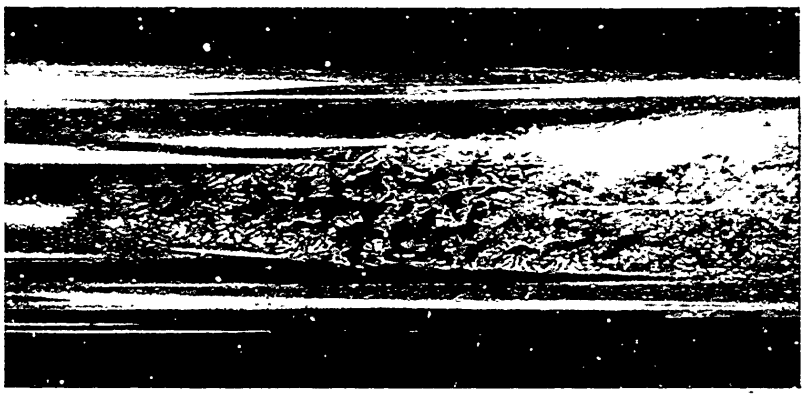
Origin.—Isolated by me from stools of a case of sprue, a case of enteric, and a case of simple enteritis.

Monilia decolorans, Cast. and Low, 1913.—Has all the characters of *Monilia intestinalis*, Cast., apart from the fact that after a time it coagulates milk.

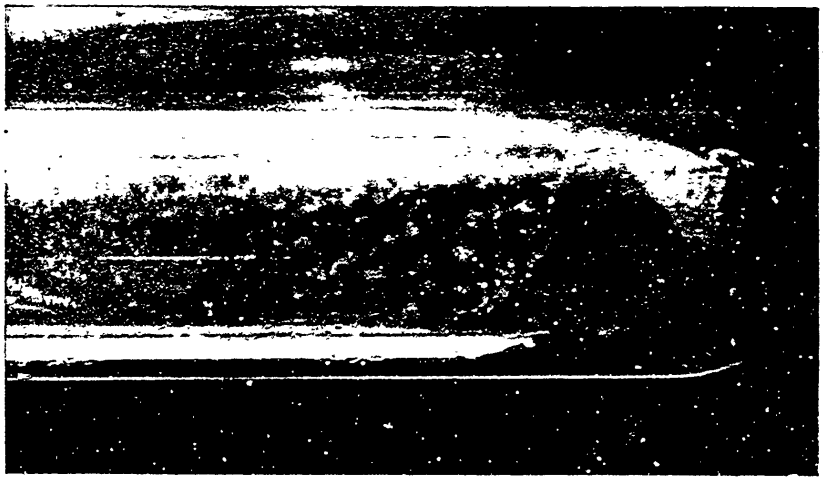
Monilia asteroides, Cast., 1914.—The colonies on glucose agar have a characteristic, radiating appearance (see photograph), hence its name. This fungus does not clot milk, grows very badly or not at all on serum, which is never liquefied. Does not produce gas in any of the sugars used, but produces acidity in lævulose, saccharose, glucose, maltose, mannite, galactose, lactose, raffinose, dextrin, sorbite.

Origin.—This fungus has been isolated from the stools of a case of sprue, also from one of those peculiar cases of pseudo-sprue I have described, which seem to be in reality chronic infections due to a Flexner-like bacillus.

Monilia intestinalis



Monilia asteroides.



Monilia rotundata.

APPENDIX VIII.

REPORTS ON WORK CARRIED OUT IN COLONIAL LABORATORIES.

Remarks.—It is doubtful whether it is botanically correct to place this species and *Monilia rotundata* in the genus monilia. They possibly belong to different genera, but further researches are necessary on this point.

Conclusions.

I.—In practically every case of sprue it is possible to put in evidence fungi: microscopically or culturally.

II.—These fungi do not all belong to the same species—the so-called "thrush fungus" or *Monilia albicans*, as stated by Kohlbrugge and all other observers who have confirmed his findings.

III.—As I have stated since several years, there is a plurality of species of such fungi, and the term *Monilia albicans* has been used in the past to cover a large number of different species and possibly different genera, in the same manner as in the past the term *B. coli* was used to cover a great number of different bacteria.

As a matter of fact, *Monilia albicans sensu stricto* (*M. albicans*, Robin, 1853, em. Cast, 1909, has never been observed by me in sprue cases, as none of the monilias isolated by me in sprue liquefies gelatine.

IV.—The following, probably good species, have been isolated from the stools or scrapings of tongue and saliva of sprue patients: *Monilia intestinalis*, Cast., 1911, *Monilia decolorans*, Cast. and Low, 1913, *Monilia fœcalis*, Cast., 1911, *Monilia tropicalis*, Cast., 1911, *Monilia asteroides*, Cast., 1914. The same patient may occasionally harbour two or more different species.

Monilia intestinalis and *Monilia decolorans* have so far been found only in sprue cases; the other species have been found in several other conditions besides sprue.

ALDO CASTELLANI.

No. 6.

JAMAICA.

THE GOVERNOR to THE SECRETARY OF STATE.

(Received 9th May, 1914.)

SIR, King's House, Jamaica, 20th April, 1914.

IN continuation of my despatch of the 16th October last,* I have the honour to transmit, for the information of the Committee of the Tropical Diseases Research Fund, the report of the Government Bacteriologist of this Colony on the work carried out by him and his assistant for the half-year, from 1st October, 1913, to the 31st March, 1914.

I have, &c.,
W. H. MANNING,
Governor.

Enclosure in No. 6.

SIX-MONTHLY REPORT ON THE WORK DONE AT THE PATHOLOGICAL LABORATORY, SEPTEMBER, 1913—MARCH, 1914.

Pathological Laboratory, Public Hospital, Kingston, Jamaica,
SIR, 31st March, 1914.

I HAVE the honour to forward my report, for the information of the Right Honourable the Secretary of State for the Colonies and of the Tropical Research Committee, upon the work done at the Pathological Laboratory during the period September, 1913—March, 1914.

In November last Dr. Catto, M.B., B.S. (London), who had been selected for the post of Assistant Bacteriologist, arrived in Jamaica, and I feel sure that with his help good work will be able to be carried out in the domain of research into various diseases prevalent in this island.

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* Page 189 of [Cd. 7261].

Appendix VIII.

Reports on work carried out in Colonial Laboratories.

As will be seen from the table (Table V.) appended, the previous large number of specimens received for examination is being maintained, namely, 3,271 for the six months, making a total for the year of 6,521.

For the purposes of description I propose to tabulate these into the two main groups. 1, Routine work, 2, Special matters, including research, and to sub-divide these as follows:—

I. Routine Work:—
1. Enteric fever.
2. Blood examinations for malaria, babesia, filaria, etc.
3. Fæcal examinations.
   (*a*) For helminthiasis.
   (*b*) For amœba, *B. typhosus*, etc.
4. Urine examinations.
5. Pus specimens.
6. Sputa.
7. Tissues sectioned for diagnosis, etc.
8. Waters subjected to bacterial analysis.
9. Miscellaneous; including effusions, gastric contents, vaccines, etc.

II. Special matters:—
1. Pellagra.
2. Streptothrix.
3. Vomiting sickness.

To dispose of the routine work first:

1. *Enteric fever.* During the six months under review 474 specimens of blood have been examined by Widal's agglutination reaction. This number is less than that of the previous six months, but still bears out the point on which I have more than once laid stress already, namely, that a large proportion of positive reactions (considerably larger than appears to be the case in other countries) occur with *B. paratyphosus A.* Many instances of the "eight-ten day fever" in Jamaica are, I am convinced, due to organisms of the coli-typhoid group, and, though not due definitely to *Paratyphosus A* in every case, some instances are to be so ascribed, as evidenced by the high degrees of dilution of the serum in which a positive reaction occurs. In other cases agglutination occurs in low dilutions, such as 1:30, fairly frequently, and with 1:50 not uncommonly. Since a similar result is obtained also with *B. typhosus* in the former dilution, the organism, one would infer, is a member of this group, and, consequently, gives rise to a "group agglutination" reaction in the serum of the patient affected. I think that one might even venture a stage further and say that, since the agglutinins for *B. paratyphosus* are marked in higher dilutions than those for *B. typhosus*, the organism is probably more nearly related to the former than the latter in these shorter fevers.

The fact that the ratio of positive paratyphosus reactions is this time in excess of that given in my last report must not be taken as implying that this disease is on the increase; the explanation is that many more specimens are sent up from doubtful cases now than was formerly the case. For example, a patient has a moderately severe attack of fever which does not yield to quinine, but the constitutional symptoms do not appear to the medical attendant to be so marked as in a true case of typhoid. Formerly "expectant treatment" would have been persisted in, and when the fever disappeared at the tenth day or so the happy result would be attributed to the line of treatment adopted, and the doctor would congratulate himself on having had the courage of his convictions, and in having persisted in the administration of quinine, or antipyretics, and the patient would go away with the idea that his form of malaria was a very obstinate one, and that quinine would not act in his case for ten days. Or he would take up the position that "quinine was unsuitable for his form of malaria," but that it yielded at last to Tinct. Iodi in small doses, or Sodii Bicarb., or whatever placebo may have been given to him, or to panopepton, sanatogen, or any other nostrum which his fancy may have led him to make trial of. The evil effects of such a point of view, however, would be more widespread than this; for, in the event of the patient later suffering from a true attack of malaria, valuable time would be lost owing to the attitude of the patient or his friends that he "could not take quinine," or that "it did not suit his particular form of malaria."

Appendix VIII.

REPORTS ON WORK CARRIED OUT IN COLONIAL LABORATORIES.

On the other hand, in many cases of severe or typical average cases of typhoid fever (except in hospital) no specimen is sent up, the case being reported as enteric fever without any bacterial examination being made.

Now, however, matters are different, for knowledge of the uses of a clinical laboratory is not confined to medical men, and the patients themselves urge the attendant to send up to "make sure" that what the latter regards as malaria is really such and not typhoid in anomalous form.

Hence I believe the increase of positive paratyphosus reactions is to be ascribed not to the greater prevalence of this disease, but to the larger number of specimens sent up from patients exhibiting an ill-defined course of temperature lasting for over a week. Repeatedly I have had letters from practitioners here within a day or two of my reporting to them a positive agglutination of *B. paratyphosus*, saying that the blood had been taken on the seventh or eighth day, and that within forty-eight hours the temperature had fallen to normal.

I need not dilate upon this question, for I spoke of it in detail in a former report upon 1,500 consecutive Widal reactions, and my remarks there were afterwards extended and amplified into a paper which was printed in the *Practitioner* medical journal, of October, 1913, where all these various points were dealt with.

Of the 474 specimens examined, 111, or 23·4 per cent., gave a positive reaction with *B. typhosus* only, 94, or 17·72 per cent., with *B. paratyphosus* only, while 35, or 7·38 per cent., were cases of mixed infection.

Also, of the 240 cases which gave a positive reaction, 111, as above, or 46·25 per cent., did so with *B. typhosus* only, 94, or 39·16 per cent. with *B. paratyphosus* only, and 35, or 14·58 per cent., were of double infection.

Tables I. and II., appended, show the results of these examinations month by month, and the various districts from which specimens have been sent.

2. *Blood Examinations.*—There is very little to say on this point. They have almost entirely consisted of smears sent up for diagnosis of malaria, or for differential leucocyte enumerations.

Of the malaria smears, by far the majority of those showing parasites contain *Plasmodium præcox*. Quartan parasites and benign tertian were both rare, amounting to about 10 per cent. only in each case, the remaining 80 per cent. being subtertian. In two instances all three were present, and in three others the *P. malariæ* and *falciparum* were combined.

A few smears were sent up for examination for the *Piroplasma bigeminum*, and this protozoon was found in about half the slides. Trypan blue was used with successful results in nearly all cases, but in some of them parasites persisted, possibly because too small a dose had been given at first. When this is the case it is often found that the organism appears to have become to some extent "trypan fast," and large subsequent doses are ineffectual in ridding the animal of the infection; in a few, again, the preliminary dose apparently brings about the condition of hypersensitiveness, and the second dose results in the production of anaphylactic symptoms, which have in some terminated fatally.

The blood has also been examined from several pellagra patients, but this question is dealt with later (p. 4).

From one case blood smears were sent up which showed *Filaria diurna* on examination. As I have not yet found any cases of this affection in a Jamaican (unless he had been abroad to other West Indian islands), I made inquiries, and discovered that the patient was a student at the training college for teachers here, and had been sent over from British Guiana. The record, therefore, still remains unbroken, and I do not think that the condition exists, at least to any extent, in Jamaicans who have always resided here.

3. *Examination of Fæces for Helminthiasis.*—During the last six months 1,338 specimens have been examined for the presence of ova of ankylostome and other parasites, as compared with 1,162 during the preceding period.

Taking account of the results over the whole island, there is not as yet indication of much improvement. One could hardly expect any after only six months' treatment of a condition so very widespread. At the same time it must be noted that the difference, though slight, is on the right side; in other words, although more specimens have been sent up to the laboratory, the percentage number found

infected is about 8·5 per cent. less as regards total helminthiasis, of which a little over half is due to reduction of ankylostomiasis alone and in combination.

The reduction in the percentage of those containing ankylostome alone amounts to but 1·5, showing that, though other parasitic worms may be got rid of with comparative ease, the hookworm eradication is a more difficult matter.

The results of treatment show considerable variation when one analyses the findings in specimens sent from various districts. To take one example: The District Medical Officer at Lionel Town has evidently been going in very thoroughly for adequate treatment of those under his charge, for of the specimens sent up during the six months, March to September, 1913, which amounted to 140 in all, over 87 per cent. showed helminthiasis in some form or another, and 66 per cent. of these (58·5 per cent. of the whole) contained hookworm ova. During this last six months, however, more than double the number of specimens have come from that district (309), but positive results were found only in 63·75 per cent., and 40·4 per cent. contained ankylostome ova.

Comparison between the results set forth in my last report and those of the present cannot be carried much further than has just been indicated without tending to lead to erroneous conclusions; for the specimens sent up last year were almost entirely taken haphazard from persons who had not been under treatment for this condition, and so formed a fair estimate of the prevalence of helminthiasis in Jamaica.

During the last six months, however, specimens have been sent up repeatedly from the same patients, in order to see whether they were still harbouring the parasites, or in other words to test the effects of the treatment.

One conclusion may safely be drawn from these figures, and that is that the eradication of the pest is not proving the comparatively simple undertaking which many imagine it to be. To find the ova in the fæces, and, in consequence, to order the dispenser to prepare a dose of thymol, is nothing less than playing with a disease which causes untold misery and inestimable incapacitation among labourers on the various plantations.

The results given also tend still more to drive home the lesson that, however adequately the individual members are dosed with thymol, recurrence must take place so long as the soil remains infected, and that, even if the soil were once rendered free from the larvæ, infection of it must inevitably occur so long as untreated coolies are brought to this country and sent up to the districts to spread the condition broadcast.

Ankylostomiasis will never be stamped out on the coolie estates unless:

1. Immigrating coolies are treated on the voyage, so that they land here free from infection; or, if this for some reason or other is not found practicable,
2. They are kept at a base depôt until repeated examination shows them to be free from the parasite before they are sent up country:
3. Adequate latrine accommodation is provided on the estates:
4. Care be taken that such latrines are used.

Lastly, my examinations show again that thymol is not an efficient anthelminthic for trichuris. Fæces which had shown trichuris as well as ankylostome to be present, and which had been sent up repeatedly from the same patient in order that it might be known whether the latter had been expelled as a result of thymol, proved abundantly the fact that, while the latter became less and less, even to complete disappearance, the former showed very little diminution. Clinically, therefore, one is led to expect what the figures themselves show that, whereas in my last report 8·48 per cent. of positive results contained trichocephalus only, and this time 8·07 per cent. come under the same heading; if we include those containing trichocephalus in combination, 49·46 per cent. did so in my previous report, as compared with 48·61 per cent. in the present one; thus, there is seen to be no appreciable difference.

Ascaris infection also is very common here. Not infrequently one sees 20, 30, and even 50 ova in a single field. This apparently is not regarded as of any importance, in spite of the fact that a large proportion of deaths (in vomiting sickness, for example) is ascribed to it.

Appendix VIII.

Reports on work carried out in Colonial Laboratories.

Taking the figures in my September report, in 4·76 per cent. of cases of helminthiasis ascarides were present alone, and in 36·77 per cent. counting those which showed them to be present in combination with others, while in this review, although ankylostome shows, as already stated, slight reduction owing to its treatment being assiduously undertaken, ascariasis has increased; for this parasite was found in 42·37 per cent. of cases.

Other worms which have been found, but rarely, were *Strongyloides intestinalis*, *Oxyuris vermicularis*, and on two occasions ova of *Tænia diminuta* (both from Lionel Town).

Apart from fæces sent up as above, 91 specimens have been examined for *Amœba dysenteriæ*, *B. typhosus*, *B. dysenteria*, etc. The former have been found on twenty-four occasions.

4. *Other Routine Examinations.*—Specimens of urine, pus, sputa, water for bacterial analysis, and other routine matters do not call for special mention; the appended table shows how many of them have been dealt with.

II.—Special Matters.

1. Pellagra.
2. Streptothrix Infection.
3. Vomiting Sickness.

1. *Pellagra.*—Dr. Catto and myself are undertaking an investigation into the morbid anatomy of pellagra. There are a considerable number of these cases at the asylum in Kingston, but I regret to say that it is a very difficult matter to obtain reliable histories of such patients. In many of them it is impossible to say, for example, whether their mental condition is an outcome of the pellagra, or whether one is dealing with pellagra supervening in an insane subject. The investigation is only in its inception. We have commenced by taking specimens of blood at various stages of the disease, and from extensive differential leucocyte enumerations fail to find any alteration common to them. 500 leucocytes are counted in each case. No useful purpose would be served by giving the details of each one, but the minimum, the maximum, and the average of each variety of cell will be stated, thus showing the variations which may occur.

—	Polymorph.		Large Mono-nuclear.	Transitional.	Lymphocytes.			Eosinophile.	Basophiles.	Myelocyles.
	Normal.	Stab-Kernige.			Large.	Small.	Türks.			
Average ...	49·8	2·6	3·5	1·7	7	24·1	1·2	9·5	0·5	0·1
	52·4		5·2		32·3			9·5	0·5	0·1
Maximum ...	73	3·8	7·4	2·6	12	31·8	3	19·6	1·2	1·0
	76·8		10·0		46·8			19·6	1·2	1·0
Minimum ...	31·4	1·0	1·9	1·0	1·8	8·6	0	0·6	0	0
	32·4		2·9		10·4			0·6	0	0

It is thus seen that the variations may be very wide, but the average agrees, except in one particular, fairly closely with what has been found elsewhere, as, for instance, by the Illinois Pellagra Commission, which gives as an average: polymorphonuclears 57·22, large mononuclears and transitionals 3·42, lymphocytes 34·22, eosinophiles 4·5, basophiles 0·67 per cent., as compared with our figures of 52·4 5·2, 32·3, 9·5, and 0·5 respectively.

The striking difference occurs in the high degree of eosinophilia in our cases, and that is explained by the enormous prevalence of helminthiasis in this island, a matter of which I have already treated in this report. It is of importance to bear in mind the fact that in the insane there are possibilities of so many conditions which will tend to upset the normal proportions of the different leucocytes to one another; as, for instance, the presence of intestinal parasites, small wounds, intercurrent diseases and so forth. But, when comparing the counts from subjects in about the same stages of the disease and of a similar degree of severity,

we have been driven to the conclusion that there are no characteristic variations of sufficient constancy to warrant any serviceable inferences.

The classification adopted as the one least liable to error from the personal equation has been that of von Schilling Torgau; namely:—

1. Neutrophile (finely granular oxyphile) with the usual polymorph nucleus.
2. The "Stabkernige" form of the above with nucleus T., U., or V-shaped, not properly polymorphonuclear.
3. Lymphocytes, divided into small and large. It is here that the personal element might come in, but as far as possible by "large" we imply mononuclear cells about 12μ in diameter, with a round or oval nucleus more or less centrally situated.
4. Türk's "Reiz ungsformen" lymphocytes.
5. Large mononuclear cells of about 14-20μ with eccentrically situated nucleus, staining more faintly than that of the large lymphocyte and with abundant pale blue staining protoplasm.
6. Transitionals; somewhat similar cells, but with a nucleus tending to become folded and polymorph.
7. Eosinophile.
8. Basophile or mast cells.

No mention has been made of the erythrocytes because, though carefully examined, no changes were as a rule found in them. Occasionally we came across a nucleated one, and in some few instances there was a little polychromatism and anisocytosis, but not sufficient or frequent enough to call for special remark.

2. *Streptothrix.* In two cases exhibiting the symptoms of tuberculosis of the lung from whom a specimen of the sputum was sent up for examination for the *Bacillus tuberculosis*, I was unable to detect any of these organisms, but saw under the microscope some filaments of a streptothrix.

The patients showed local physical signs in the upper lobe of the left lung in one case, in the middle lobe of the right in the other, and clinical symptoms of cough with evening rise of temperature. Repeated examinations failed to reveal any tubercle bacilli, but each time pieces or small masses of thin, branching mycelium were seen. These, on staining by Gram's method, stained a little irregularly, giving somewhat of a granular appearance, the threads were not acid-fast, though here and there in the length of a thread appeared a small fragment which retained the stain.

I obtained a growth in liquid medium—peptone broth—but growth was slow. In this it appeared as small dots at the sides of the culture tubes, while a deposit consisting partly of similar mycelium was seen at the bottom.

Growth in the broth was obscured by the more rapid development of bacteria. I tried plating on various solid media in order to isolate the organism, but did not succeed. I was able, however, to carry it on through three broth cultures in one case and four in the other, but no further.

In default of isolation animal experiments were not carried out.

I notice that in the Milroy Lectures for 1910 Mr. Foulerton says:—"Of all the ordinary culture media peptone broth seems the best suited for the growth of these parasites, growth appears between the third and seventh days of incubation at a temperature of 37°C., and is represented either by a filmy-looking mass of very small white colonies at the bottom of the broth or by small isolated colonies which adhere to the side of the tube. . . . . In some cases growth is not to be obtained on any other artificial medium. Growth on nutrient agar, when it occurs, is very slow."

In the cases mentioned above I could not make out any growth on this medium (agar), being unable to isolate it, if it did develop at all, it was obscured by the more abundant growth of accompanying bacterial organisms. Both as regards its source of origin and its appearance in peptone broth it most nearly resembled Foulerton's *Streptothrix hominis I.* Of this, he states: "This species has a low degree of pathogenicity for ordinary laboratory animals, inoculation tests, either with the original pus or with pure cultures, usually failing," and later "From one other case of pulmonary streptotrichosis. . . . . small whitish colonies of a fine streptothrix

organism, so far resembling the Species I. . . . . were obtained in both cultures, but attempts to obtain cultures on solid media failed . . . . . .and animal inoculations, when carried out, gave negative results. In another case, one of pulmonary streptotrichosis, attempts at culture of the parasite failed, but inoculation of the sputum from the case produced, on intraperitoneal inoculation of rabbits, a fatal tuberculous kind of peritonitis, in the lesions of which the streptothrix was present in large quantities."

I regret that I could not make trial of this method in my cases.

Mr. Foulerton's fuller description of his *St. hominis I.* is: "Found and isolated in two cases of pulmonary streptotrichosis and in four cases of oral infection." Mine were both pulmonary.

"Cultural characteristics: Growth on artificial media under any conditions is uncertain, and usually scanty." In three out of his six cases growth could not be obtained beyond the third or fourth subculture on artificial media. In mine, I could not find it after the third. "On potato no growth was obtained, and on most media (except the peptone-beef-broth) growth was scanty and uncertain."

I have made special mention of these cases, because it is more than probable that a certain proportion of those giving physical signs of tuberculous infection, but without any family history of this disease and without corroboration by the finding of the *bacillus tuberculosis* in the sputum, are cases of streptothrix infection.

3. *Vomiting Sickness.*—During the last six months Dr. Seidelin's report upon his investigations into this disease has been published, and before going on to describe the cases which I have met with this year I would like to make a few remarks on the bearings which my own investigations have had in leading me to agree with or differ from his conclusions.

He states (page 14): "Either some observers have overlooked mild forms of the disease, or . . . others have included cases of a different nature . . . the latter seems the more probable." This statement I certainly agree with, because it has been my experience to find that any case of a child who vomits, whether at the onset or during the course of an illness, is put down by the laity, and sometimes also by the medical attendant, as one of vomiting sickness, if it occurs at the season when this disease is prevalent (December—March).

Also, some cases are reported as "vomiting sickness without vomiting," and others are definitely recorded as "vomiting sickness," when none of the usual symptoms of the disease are present. One case in point I may mention, and I have no reason for regarding it as unique. I was summoned to carry out the post-mortem examination of a child who had been reported at the local police station as suffering from vomiting sickness, a record of cases occurring in that part of the district being kept there. The case was that of a marasmic infant. The autopsy revealed none of the usual signs of vomiting sickness. On questioning the mother afterwards as to the history and symptoms, it turned out that the child had been wasting for over three months, had never had any vomiting or convulsions, but had "simply faded away." When I asked the reason for its being reported as vomiting sickness, the parents informed me that medicine could be obtained free at the police station for vomiting sickness patients, and, since to the uneducated medicine regardless of diagnosis is the main use of the physician, the case had been reported as one of vomiting sickness by the parents in order to obtain free medicine.

As regards the other alternative in the statement above referring to "mild forms" of the disease, these are exceedingly rare in all the districts in which I have met with it; certainly not so numerous as to reduce the case mortality from 75 per cent. (Seidelin's figures) to 2 per cent. (Tillman's estimate). My own figures up to the end of March, 1913, work out a case mortality of 81 per cent., and I may add that this year out of twenty cases reported to me only two have recovered, giving a mortality of 90 per cent., or deducting those for which other cause of death may be given or where the symptoms were not those usually characteristic of vomiting sickness, there were two recoveries out of sixteen cases, or a mortality of 87·5 per cent. Also, of those seen by me, or reported to me, less than half a dozen could be justly spoken of as "mild"—clinically speaking—unless by the term "mild" is meant "rapidly recovering," because, as the histories previously reported by me of

184 cases have abundantly shown, those appearing but little indisposed at the beginning of the illness may suddenly be attacked by convulsions, become comatose, and die in a few hours. Of all the cases seen by Dr. Seidelin five, or possibly six, might be described as mild, and this experience coincides with my own. The inference is, therefore, that the weight of evidence is strongly in favour of Dr. Seidelin's second alternative, that those who report such a low mortality have included cases of a different nature (different, that is, from true vomiting sickness).

As regards the term "black vomit" as one of the synonyms of the disease, I think that this is an error, and should no longer be maintained; of over 200 cases reported to me in detail, only two had any vomiting so described, and amongst those seen by me personally I have never met with a case in which the vomit was black, and if employed as a synonym at all, it is, I feel sure, the one used least frequently. The vomitus in all that I have seen had been in the main mucoid, watery, or frothy, while very occasionally, if there has been much straining or retching, it may be pinkish from admixed blood.

Dr. Seidelin's remarks on page 21 of his report, on the question of "emaciated subjects," agree with my own experience. Nearly all the cases which I have seen have been fine, well-nourished children.

On page 23 he refers to the organisms present in some of the cases. It was owing to the varied sugar reactions of the Gram-negative diplococci isolated in different cases that in my report of March, 1913, I expressly gave as the title of Table II. of the appendix, "Cases in which a Gram-negative diplococcus was isolated from the cerebro-spinal fluid," and purposely avoided calling the organism the meningococcus, except in the first series—the Peart cases—in which the typical meningococcus reactions were given.

The points put forward on pages 86 and 87 of Dr. Seidelin's report appear to give the quietus to the yellow fever theory; namely.—

i. The class of persons attacked—the native population only, never foreigners;

ii. The age of persons attacked—yellow fever in children usually a benign disease, whereas in vomiting sickness in my series of cases 65·57 per cent. occurred below the age of six years, with a percentage mortality of 80;

iii. The seasonal prevalence—becoming rare or dying out during the hot and rainy seasons, and becoming epidemic during the cool and dry winter months;

iv. Duration of the disease. In the cases of yellow fever mentioned in his Yucatan report, death in the majority of severe cases occurred on the fifth, or occasionally on the fourth, day of disease, whereas in my series of 184 cases the average duration of vomiting sickness cases worked out at 14½ hours (see March, 1913, report, Table IV. in appendix);

v. "The classical clinical symptoms of fatal yellow fever—fever, black vomit, jaundice, and anuria—are almost constantly absent" (page 86).

In my own defence I would like to state a few facts with reference to Dr. Seidelin's remarks on page 88: "The evidence is that meningococci have been found by Scott in the cerebro-spinal fluid in a considerable number of cases of vomiting sickness. Scott himself, however, in his latest paper is less positive," etc. This arose from the fact that the first cases actually seen by myself were the "Peart" series in September, 1912, which were definitely instances of cerebro-spinal meningitis. Later on, as I became better acquainted with vomiting sickness, it was obvious that cerebro-spinal fever and vomiting sickness were two distinct affections, though with certain more or less closely resembling symptoms, or perhaps it is better stated by saying that under the term "vomiting sickness" had been grouped cases of cerebro-spinal meningitis (which occur in small numbers) and in far greater numbers cases of vomiting sickness proper.

Finally, before passing on to speak of my investigations this year, I would like to add that I consider Dr. Seidelin's report an excellent one, and the fact that the problem of causation has not been solved does not detract from its usefulness, though, of course, the solving of it would have enhanced its value. It is an

exceedingly fair and impartial statement of our knowledge of the disease to the present time, showing no hasty jumping to conclusions, no bolstering up of preconceived ideas, but a calm, judicial summary.

This year the disease has been exceptionally limited, for whereas by the end of March, 1913, I had 185 cases reported to me and specimens had been sent up from most of them, this year I have had reports of only 20. Several of these occurred within a few miles of Kingston, so that I had the good fortune to be able to investigate them at first hand.

A few details of each of them will be given. Dr. Lofthouse, District Medical Officer of Balaclava, has reported three cases:—

1. E. C., female, aged six years. Apparently quite well till 11 a.m., 8th January, when she suddenly felt ill and lay down. Shortly afterwards she began to vomit; she vomited twice, then passed into a comatose state and died without recovering consciousness at 6 p.m. She had no convulsions. Duration of illness seven hours.

   No statement was given as to the previous meal, character of vomit, etc.

   Blood smears were sent from this patient and showed a remarkable condition. There are a few nucleated red corpuscles and there was a great increase in the number of leucocytes. A differential enumeration of these yielded the following results: polymorphonuclears 42 per cent., large mononuclear 1 per cent., large lymphocytes 6 per cent., small lymphocytes 41 per cent., eosinophiles 0·5 per cent., transitionals 0·5 per cent., myelocytes 9 per cent. At the autopsy the small intestine "contained several round worms," but everything else was reported to be normal. No tissues were sent, and as the spleen and lymphatic glands were both stated to be normal I cannot conjecture the cause of death in this case.

   Dr. Lofthouse states, "No obvious cause of death revealed at autopsy."

2. E. L., male, aged six years, black. "Sudden onset of illness with vomiting, which was repeated; the patient then passed into a comatose state." Death occurred two hours after the first onset.

   At the post-mortem examination some round worms were found, but the only point worthy of note apparently was that the "spleen was very large." "No cause of death revealed at autopsy." Again from this case blood-smears were sent, but no tissues. No enlargement of the lymphatic glands noted.

   Here also the smears showed a great increase in the leucocyte numbers, particularly the mononuclear variety, and a differential count gave: polymorphonuclears 26 per cent., large mononuclear 1 per cent., transitional 1 per cent., large lymphocytes 9 per cent., small lymphocytes 50 per cent., eosinophile 1 per cent., myelocytes 12 per cent.

   No smears from cases either before or since which have been examined by me, revealed these peculiar features.

3. K. L. W., female, aged two years, black. Apparently well till 6 p.m., 21st March, when she cried out and had a fit, lost consciousness and died at 9 p.m. Duration three hours. There was no vomiting at all. At the autopsy, 15½ hours later, the only abnormality recorded was that there were "dozens of round worms (ascarides) in the intestine"; the vessels of the cerebral cortex were said to be engorged.

   This case ought not, I think, to be included. The diagnosis at any other time of the year would have been "infantile convulsions associated with intestinal worms," but because death occurred in three hours and during the cooler months it is reported as "vomiting sickness without vomiting." (See above, page [illegible].)

4. One case has been reported by the District Medical Officer at Gayle.

   J. W., male, aged two and a half years. Suddenly seized with vomiting and convulsions at 6 p.m., 19th March; became comatose and died at 9 p.m. Duration three hours.

Autopsy carried out 36 hours or more afterwards, and report states that "except for 20 round worms in the intestines and slight congestion of meninges, nothing abnormal found."

Spinal fluid was sent, but only a *B. coli* growth resulted.

From Falmouth eight cases have been reported to me, but in most the reports are very meagre, the history incomplete, the post-mortem conditions cursorily described, and the tissues sent very decomposed.

The difficulty in obtaining a good history is very great; the patients are in many cases not seen by a doctor during life, and the replies of the parents will usually vary with the form of the questions.

Details of each need not be given unless there are reasons to suppose them reliable.

5. A. L., female, aged six years. Duration of illness eight hours; not seen during life.
6. H. C., female, aged 27 years; mother of the last. Started to vomit on morning of 5th February, and this symptom persisted till she came to hospital on the afternoon of the following day. The only note on the symptoms is: "Cold sweat over face and hands, pulse small and weak, no pain or tenderness."

   Vomiting ceased next day and patient made good progress. Duration about 48 hours.
7. B. C., female, aged 15 months; lived about 200 yards from last. Started to vomit at 11 p.m., 6th February, and was brought to the doctor two hours later; the vomiting ceased after the first dose of a mixture containing Sp. Ammon. Aromat. and Acid Hydrocyan. dil., and the child returned home the same morning quite well.

   There is very little reason for calling this a definite case of vomiting sickness. It is true there was vomiting, but no other of the usual symptoms, convulsions, loss of consciousness, etc.; and children of the age of this patient (15 months) may readily vomit from a variety of causes. Probably nothing would have been heard of this had not the previous two cases occurred close by.
8. P. W., male, aged six years, black. Said to have vomited *once* only, and shortly afterwards lost consciousness and died in two hours. No other details given. I do not think this patient was seen by a medical man.
9. C. N., male, aged four years, black. "Vomiting, convulsions, and death" in 4-6 hours. Not seen during life by a doctor; but at the post-mortem, "Intestines packed with round worms, forming almost impassable masses in parts of lower ileum." Nothing else abnormal noted.
10. D. C., male, aged eleven years, black. The history in this case is unusual, both as regards length of disease and sequence of events. Complained of "bad feelings in the stomach" early on 25th February, refused food during that day, and went to bed still complaining. During the succeeding night he vomited once, then lost consciousness and died about 20 hours after the first sensations of illness. At the autopsy it was stated that the "liver appears fatty," "Mesenteric glands enlarged," "Pancreas very fatty." Nothing else abnormal. Microscopically, the pancreas showed hæmorrhage and a certain fibrosis in excess of the normal.
11. L. W., female, aged six years, black. This patient also did not give a typical history. She "began to have fits" during the morning of 27th February, and lost consciousness; then vomited twice and remained unconscious till death. Duration four hours.

    At the autopsy the following abnormalities were noted by the District Medical Officer:—

    Pericardium filled with dark stained fluid.
    Intestines contained about a dozen round worms.
    Pancreas appeared hæmorrhagic.
    Mesenteric glands enlarged.
    Cerebral meninges covered with petechiæ.

Appendix VIII.

Reports on work carried out in Colonial Laboratories.

Tissues were sent up to the laboratory, but insufficient preservative had been added and the whole were badly decomposed.

12. W. S., male, aged seven years, black. Suddenly taken ill with vomiting at 2 a.m., on 28th February, and this symptom continued till death three hours later, no statement as to presence of convulsions, coma, or as to the physical conditions. Probably not seen by a doctor during life.

We now come to the last series of eight cases; of these I am able to give fuller notes, because they all occurred within a short distance of Kingston, and I was able to perform the post-mortem examinations in each case myself.

1. J. E. B., male, age three and a half years, black. Apparently well on Thursday, 12th February, when he vomited three times, without effort, after taking food—vegetable soup, of which he only had the liquid. He did not seem ill and kept trying to take the soup, but each time brought it up again.

Later he had some tea and retained it; "quite himself next morning." No other symptom (appeared quite well and took food as usual) till 7.30 a.m., 14th February. Then complained of not being well, but had no pain. He got up and lay down on the ground. Between 8 and 8.30 a.m. his mother went to take him up and found him "in a fit"—arms stiff, hands clenched and shaking. He had no more vomiting, but these "spasms" recurred frequently and the child never regained consciousness. Pulse soft and regular; respiration natural. No Kernig's sign, no rigidity of neck muscles. Sores on lips and at left angle of mouth and below nostrils.

Was brought to Dr. Edwards at 2 p.m., and died at 3.30 p.m. Duration . i. From first vomiting, about 44 hours.

ii. Intermission of 36 hours, during which he seemed quite well.

iii. Final attack eight hours.

No others in the family attacked.

Autopsy: Abrasions by mouth and nose. No jaundice or discolouration of conjunctiva. Respiratory system: Trachea injected, contained frothy mucus. Lungs crepitant all over. Small patches of emphysema. No petechiæ on pleura; glands very slightly enlarged. Circulatory system; ½ oz. pinkish fluid in pericardium; few small petechiæ over upper and posterior surface of right ventricle. Valves normal; muscle slightly pale.

Abdomen: liver 420 grms., nutmeg-like and congested, dark. Spleen 37½ grms., two accessory spleens present. Patches of greyish-pink mottling on surface and in interior. Kidneys showed slight congestion of secretory portion, more in left than right; otherwise apparently normal. Stomach contained ½ oz. of pinkish, grumous material. Mucous membrane injected all over fundus and at lower part a more congested area, 2 by 1cm., almost ecchymotic and showing possible superficial abrasion. Small intestine showed Peyer's patches swollen and slightly hyperæmic. No worms of any kind. Large intestine: Solitary follicles enlarged and stained brownish at lower part. Appendix 12·5cm. in length, contained fæcal matter. Pancreas normal. Mesenteric glands enlarged and hyperæmic.

Head: Meninges of surface of brain showed engorged vessels, but no opacity or effusion. No excess of fluid in ventricles. No spinal meningitis, but vessels of cord injected.

With reference to this case I received a telegram at 2.30 p.m., and immediately went to the case with Dr. Edwards, arriving just at the moment of death, and was thus able to take specimens of the blood from a vein in large quantities of broth for culture, and also to make cultures of the cerebro-spinal fluid taken by lumbar puncture.

I returned immediately to the laboratory and placed all the cultures in the incubator, half of them aërobically and half anaërobically.

Appendix VIII.

Reports on work carried out in Colonial Laboratories.

The next morning early I carried out a complete post-mortem examination, and took specimens of the following tissues:—

In Flemming's solution: Mesenteric lymph nodule, pancreas, heart muscle, liver, spleen, kidney, suprarenal.

In Schaudinn: Lung, spleen, kidney, suprarenal.

In formalin: Hypophysis cerebri, spinal cord dorsal and lumbar regions, cerebral cortex, basal ganglia, cerebellum. Smears of blood (also before death), spleen smears, brain smears, and urine.

Briefly the tissues all showed in various degrees the changes so ably described in Seidelin's report, so there is no need for me to give them in detail.

Blood cultures I had never before had the opportunity of making under conditions in which one could be certain of ensuring against accidental contamination; nor had Dr. Seidelin any opportunity of making cultures of the blood and spinal fluid and incubating both aërobically and anaërobically. The cultures were all kept for over a week, and two of them for three weeks, but no growth whatever occurred in any of the tubes.

2. D. G., male, aged three years, black. Apparently quite well till 3 p.m., 15th February, when he vomited; then recovered and played about till going to bed at 7 p.m., woke up at 10 p.m. and called for water; vomited and again went to sleep. Shortly afterwards he was heard to groan, and at 11.55 p.m. was seized with convulsions and died an hour later. Total duration ten hours, with interval of seven hours' calm period.

   Autopsy: Body well nourished; sclerotics slightly yellow. Thorax: No affection of lungs or pleura; trachea faintly injected in lower part. Bronchial glands not enlarged. Heart muscle a little pale, but otherwise normal, valves competent. Thymus 5 × 4 × 1·5cm.

   Abdomen: Liver shows yellowish patches on surface, spleen 7 × 5 × 2·5cm.; Malpighian corpuscles prominent. Stomach contained pale, grumous matter; fundus towards pyloric end markedly injected. Mesenteric glands enlarged, not hyperæmic. Intestine (small) showed congested patches in jejunum all along and petechiæ scattered; congestion very marked. Large bowel loaded. Appendix 6·5cm., slight constriction 2cm. from tip. Kidneys normal, pancreas normal.

   Brain: Vessels of surface engorged; membranes transparent; substance apparently normal.

   Death might equally be due to infantile convulsions with gastro-enteritis.

I did not see this case till the autopsy, 13½ hours after death. The cerebro-spinal fluid was clear, flowed drop by drop, and on culture on Nasgar yielded a gram-negative diplococcus which gave rise to acid in glucose, maltose, and galactose, and after four days a faintly acid reaction also in mannite.

3. C. L., female, aged one year, black. "Attack of vomiting just before 6 p.m., 3rd March, followed by convulsions, died in fifteen minutes." Said to have always been subject to vomiting; had teething trouble. Duration 15 minutes. At the autopsy: Sore at each angle of mouth; body well nourished. No jaundice of scleræ. Thorax: Trachea injected throughout length, lungs congested at bases, possibly a post-mortem change. Slight adhesions at apices of both pleuræ. Heart normal; about 30cc. of straw-coloured fluid in pericardium. Thymus normal. Abdomen: Liver fatty, not enlarged, spleen normal; intestines showed congestion in patches, mostly at upper part and in duodenum. Pancreas congested, but showed no hæmorrhages. No worms present. Stomach showed marked congestion and petechiæ at cardiac end. Kidneys slight congestion, capsules not adherent. Mesenteric glands enlarged and hyperæmic. Peyers' patches prominent and congested. Brain: Vessels of cortex engorged, petechiæ in brain substance; no excess of fluid in ventricles or at base. No fluid obtained by lumbar puncture.

No history could be obtained as regards diet, but this case, from the extreme rapidity and from the history of vomiting and gastric trouble since birth, was

probably an ordinary attack of infantile convulsions, very likely arising from dietetic irregularities, rather than a case of true vomiting sickness.

4. L. R., female, aged two years, brown. All the history obtainable of this patient was that she was taken ill at 4 a.m., 4th March, with vomiting. Fits supervened at 5 a.m., lasted till death, which took place shortly before 6 a.m. Duration two hours.

   Autopsy: No jaundice. Trachea slightly injected, both lungs congested; retropharyngeal glands enlarged and hyperæmic. Pericardium contained half an ounce of clear fluid. Heart showed small epicardial hæmorrhages and a small subendocardial hæmorrhage at the base of the left posterior flap of the mitral valve. Liver showed pale patches on the surface; grey-brown on section with paler patches. Spleen was slightly congested, Malpighian bodies prominent. Stomach was markedly congested, especially at the orifices. Intestines: Mucous membrane somewhat congested throughout, Peyers' patches enlarged; 15 ascarides present. Pancreas hyperæmic, not enlarged. Mesenteric glands enlarged and hyperæmic. Kidneys hyperæmic, but otherwise normal macroscopically. Brain showed engorgement of the cortical vessels; ventricles contained excess of clear fluid. Serous meningitis, gelatinous looking.

   The ventricular fluid showed many cocci, diploid, mostly extracellular (not all); Gram-negative, but not easily decolorized (? staphylococci); also a Gram-negative bacillus (*coli*), possibly a post-mortem contamination.

5. O. F., female, aged 25 years, black. Was taken ill at 5 a.m., 9th March, with "vomiting and fits"; was given warm milk and appeared to be quite well during the remainder of that day, but vomited again during the evening of 9th, fits recurred, followed by coma, and death at 9.30 a.m., 10th March. Her child, aged four years, said to have died with similar symptoms after an illness of one hour on the previous day (9th).

   Autopsy: No jaundice; scars of old yaws present. Sores on lips; poorly nourished (was confined three months previously). Thorax: Adhesions, not very firm, at side and posteriorly, of right pleura. Interlobar adhesions in left lung. Trachea injected, petechial. Lungs congested in patches, especially upper lobe of right lung. Bronchial glands enlarged. Heart: pericardium thickened in patches, with myocarditis beneath. Valves normal.

   Abdomen: Liver friable, weight 51 ounces. Spleen small, much lobulated, dark, pulpy. Stomach: petechial patches present, also in small intestine; Peyers' patches in one or two instances picked out in petechiæ. No worms found. Pancreas fibrous and tough. Polypoid excrescence, 5mm. in length, in jejunum. Retroperitoneal glands enlarged and hyperæmic. Inguinal glands showed similar condition. Kidneys congested, especially in secretory part.

   The brain showed milkiness at base, especially over the cerebellum. Cerebro-spinal fluid smears and cultures taken. From these latter Gram-negative diplococci developed, which were inclined to grow in chains. This organism produced acid, but no gas, in dextrose, maltose, and galactose in 48 hours, and after six days slightly also in mannite and raffinose.

6. The history of this case is a little unusual, in that convulsions preceded the vomiting by some three hours. This is the only case, too, where any details as regards the nature of the preceding meal have been obtainable. On one's attempting to elicit this information the native immediately puts himself on his guard, I presume because he thinks that he may get into trouble if there is any suspicion of poisoning, and the almost invariable reply is "usual food," or "milk," or "pap," or "the same as ourselves." This is in many cases, I am sure, erroneous.

   M. Coolie, female, aged three years. Went to bed well on the evening of 10th March. Meals that day: fresh pork (but one of the parents

said "salt pork") for breakfast, rice and peas in the evening. Woke at 3 a.m., 11th March, cried out (not complaining of any pain) and had a fit. These succeeded one another rapidly till 6 a.m., when the child vomited yellow "bilious" matter, then became comatose and remained so till death. Duration six and a half hours.

Autopsy: Body well nourished; slight sore fissures at angles of mouth, no jaundice. Thorax: Lungs crepitant all over, lower lobes congested in both (post-mortem 24 hours after death). About 6cc. of clear fluid in the pericardium. Heart muscle a little pale. Thymus 6 × 4 × 1·5cm. Abdomen: Liver dark, with pale patches on surface, dark on section, uniformly friable. Spleen showed patchy congestion with prominent Malpighian bodies. Stomach contained light brown grumous material, mucous membrane congested; small petechiæ, especially at cardiac end. Intestines contained four ascarides, no congestion; Peyers' patches prominent, but neither congested nor swollen. Kidneys both deeply congested. Bladder fairly full of pale urine. It contained no albumen, nor casts.

Head: Cortical veins congested, brain substance pale; the ventricles contained an excess of turbid, slightly blood-tinged fluid. Coliform organisms only developed on culture.

7. This case should not, in my opinion, be reported as a case of vomiting sickness at all. It was probably a case of epilepsy of long standing, terminating in status epilepticus and exhaustion.

L. W., female, aged 21 years, black. History of having been subject to fits. Last evening, 16th March, at 6.30 p.m., she had a succession of these fits, from which she never recovered, remaining unconscious throughout, until death at 8.30 p.m. *There was at no time any vomiting.*

Autopsy: Thorax: Trachea shows several small petechial patches, and one larger submucous ecchymosis just below the left vocal cord. Lungs showed scattered tuberculous areas, and larger deposits at left apex. Bronchial glands enlarged, not caseous. Heart normal. Abdomen: Liver weighed 1,950 grms., showed perihepatitis, tissue mottled, dark brick-red on section. Spleen 1,050 grms., perisplenitis present, tarry on section, but firm (cut like damson cheese). Stomach much congested and showed petechiæ. Intestines normal in appearance, but contained a mass of ascarides. Kidneys very pale, cortex and medulla distinction poorly marked; pyramids hazy, porcelain-like.

Brain very pale, membranes adherent, especially in parts, no tumour of brain discovered. Diagnosis: Status epilepticus, or possibly uræmic convulsions. No urine was obtainable for examination.

8. This patient was not seen during life by any doctor. No details of the history were obtainable; the post-mortem examination was not made till 40 hours after death, when decomposition had set in. The only reason for including it in the list is that it was reported as a case of vomiting sickness, though, on further inquiry, I found that the authorities for this were only the parents and the constable at the local police station.

S. N., male, aged two and a half years, black. Said to have been taken ill at 4 a.m., 15th March, with vomiting and diarrhœa, and died at 6.30 p.m. the next day. Duration 38½ hours. No history of any convulsions, etc.

The stomach was found congested (petechial) more towards the pylorus, and the upper part of the small intestines showed similar changes; and the case was very likely one of acute gastro-enteritis.

As regards age and sex the cases this year agree almost exactly with those of last. Thus, no cases occurred under the age of one year; only three between the ages of one and two; five were three years old, two were four years, and five between the ages of five and six. Over this age one each occurred at 7, 11, 21, 25, and 27, respectively, so that 75 per cent. were six years old or under.

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With regard to sex the cases were exactly divided, ten being male and ten female.

Only in one instance, that of D. G. (page 11) was a diplococcus obtained from the cerebro-spinal fluid, giving the morphological and cultural characteristics of the meningococcus; and this was not quite typical in its sugar reactions, producing faint acidity in mannite after four days.

In another case, that of O. F. (page 12), diplococci negative to Gram's staining method, but atypical in tending to grow in chains, and in producing acid in mannite and raffinose, were present.

I wish to state that in dealing with the morbid anatomy Dr. Catto has been of great assistance in this part of the investigation, for it would have been impossible to carry out both the bacteriological and anatomical researches unaided. To him, therefore, was relegated the work of cutting and staining the sections of the various tissues and organs, and I am greatly indebted to him for the ability with which he has performed this part of the work.

Although the cases this year have been few in number, only about one-tenth of those reported to me last year, nevertheless, they occurred in such close proximity to the laboratory that we have been able to carry out certain investigations which could not be done last year, and, in fact, some experiments we performed had never been tried previously. These were:—

i. Anaërobic cultivation of blood taken direct from the circulation, as well as aërobic.
ii. Anaërobic cultivation of the cerebro-spinal fluid.
iii. Animal experiments (in addition to those carried out last year when Dr. Seidelin was here).

Briefly, the results of all these may be summed up in the word "negative," but this does not mean that no inferences can be drawn from them.

1. I had always been hoping for an opportunity of obtaining a good blood culture at the point of death, for if the condition be due to a bacteriæmia it was probable that the organism would be best obtained then; I therefore kept materials ready for an emergency call, and an excellent opportunity arose in the case of J. E. B. (page 10). This was a typical case in practically every respect; the age, the history, the length of disease, the period of intermission, the more fulminating termination, all were typical. The pathological findings at the autopsy were those generally found, and there were no worms present to complicate matters.

   All the blood cultures, aërobic and anaërobic, remained sterile; I made eight of these and incubated four in each way.

   There will probably be no further opportunity of confirming these findings (or rather absence of findings) this year, but there may be next. However, every care was taken to make the examination complete in the above case, and, by putting up several cultures, to check my own results, so that if these be taken as correct, the *natural inference is that the condition is not a septicæmia.*

2. In this case also the spinal fluid showed no organisms either in smears, or culture in broth, on nasgar, or on blood-agar.

   This tends to show that (apart from true meningitis cases, such as the "Peart series," reported last year) the cocci found in some of the cases are either accidental concomitants or else merely part causes, and only in a few of the cases.

   The fact of this variability tends to support this view; variability, that is, as regards form—sometimes in groups, occasionally in chains; as regards staining reactions—sometimes decolorize much more readily by Gram's method than at others: and as regards sugar reactions—galactose is sometimes unaltered, mannite is less often rendered acid, and in the latter the reaction is usually delayed, and in one case, above quoted, raffinose altered at the end of five days. This coincides largely with Dr. Seidelin's view of these organisms.

3. Animal feeding with gastric contents in two cases produced no results; intraperitoneal inoculation killed rapidly, but with signs of general peritonitis, not those of vomiting sickness.

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Our work on vomiting sickness this year, in spite of the paucity of cases, has not, I venture to think, been barren of results; and, following up my summary in the 1913 report, I would add:—

1. That the weight of evidence is against the disease being due to a bacteriæmia.
2. That the rapidity of progress of symptoms with early fatal termination (or, in rarer instances, rapid and complete recovery) rather indicate the action of a poison.
3. That, in view of the early symptoms being gastric, and the cerebral succeeding soon after, this poison is produced in and absorbed from the stomach; (the gastric and duodenal congestion present tend to support this).
4. That, since feeding experiments have proved negative, and chemical tests (which in former years have been repeatedly tried by the Island chemist) have revealed none of the usual poisons, and no signs of alkaloids, the poison (if such it be) is one which rapidly leaves the stomach or is rapidly decomposed; for example, it may be of the nature of a glucoside.
5. That it rapidly spreads over the whole body, as is evidenced by the hæmorrhages and other changes present in almost every organ and tissue.
6. That it produces its effects (apart from the clinical symptoms arising from cerebral causes) in the main upon the liver, as evidenced by the extensive fatty changes set up in that organ.
7. That, seeing the enormous mortality (90 per cent. of the cases reported to me this year), the first indication for treatment which can be deduced from the above theory—for it is little more than theory and conjecture, though based on observed facts, until the poison be isolated and its antidote found—is to wash out the stomach at the very earliest opportunity.

The only suggestion I can offer as to the source of this hypothetical poison is that, since one can never obtain any history to implicate any particular article of food, it is due to something which is apparently dangerous only at certain times of the year, some fruit, perhaps, or vegetable, or what, in my opinion, is more probable, some growth (fungus, yeast, mould, etc.) on or in this food, rendering it toxic.

The disease rarely attacks adults, as it would if it were due to ordinary food poisoning; it almost never attacks the infant in arms, but it attacks mainly those at the toddling age (75 per cent. this year); amongst the poorer natives the children get the minimum of attention, and there is every opportunity for them to pick up unripe, or otherwise unsuitable, food from the ground and eat it, without their parents even being aware that they have done so.

Appended hereto are various tables setting forth details of the work done during the last six months.

I have, &c.,
H. Harold Scott,
M.D. (London), D.P.H.,
Government Pathologist.

The Honourable
The Superintending Medical Officer.

Table I.

Showing the number of specimens sent up for Widal's reaction, month by month, and the results:—

Enteric Fever.

Month.	Typhosus.	Paratyphosus.	Negative.	Doubtful.	Double.	Totals.
September 20th-30th	7	2	10	5	—	24
October	19	32	51	12	10	124
November	17	14	37	6	8	82
December	17	6	37	—	2	62
January	21	10	22	6	4	63
February	11	21	21	4	6	63
March 20th	19	9	16	7	5	56
Totals	111	94	194	40	35	474

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Table II.

Showing the various districts from which specimens of blood have been sent up for Widal's reaction, with the results :—

District.	Typhosus.	Paratyphosus.	Negative.	Doubtful.	Double.	Totals.
Alexandria	4	—	—	—	—	4
Annotto Bay	8	4	16	2	8	38
Black River	—	1	1	—	—	2
Brown's Town	—	—	—	—	1	1
Buff Bay	2	1	2	4	1	10
Chapelton	1	1	3	—	1	6
Clark's Town	—	—	1	—	—	1
Gayle	—	—	4	—	—	4
Hospital, including Kingston ...	46	35	76	11	8	176
Linstead	2	3	4	1	2	12
Lionel Town	1	—	3	—	—	4
Mandeville	6	4	7	—	1	18
May Pen	—	2	—	—	—	2
Montego Bay	11	12	9	2	3	37
Morant Bay	—	1	3	2	1	7
Plantain Garden River	3	3	13	1	1	21
Port Antonio	10	10	19	6	2	47
Port Maria	6	6	6	1	1	20
Richmond	2	—	4	4	—	10
Sav-la-Mar	—	—	1	—	—	1
Spanish Town	5	4	3	1	2	15
St. Andrew	2	5	9	5	2	23
St. Ann's Bay	2	2	9	—	—	13
Others (2)	—	—	1	—	1	2
Totals	111	94	194	40	35	474

Table III.

Details of helminthiasis in various districts :—

District.	No. Sent.	Negative.	Ankylostomiasis Alone.	Ascariasis Alone.	Trichocephalus Alone.	All Three.	Ankylostomiasis & Ascariasis.	Ankylostomiasis & Trichocephalus.	Ascariasis & Trichocephalus.
Alexandria	14	2	3	1	2	4	1	1	0
Annotto Bay	16	3	9	0	0	1	0	3	0
Black River...	74	18	17	9	2	5	10	11	2
Buff Bay	160	13	102	2	1	8	16	12	6
Chapelton	61	11	7	1	7	17	2	10	6
Falmouth	79	2	8	4	8	29	4	15	9
Kingston (and Hospital)	43	9	11	2	1	9	2	5	4
Linstead	131	10	16	4	6	39	18	26	12
Lionel Town	309	112	73	23	36	19	15	18	13
Lucea	16	1	8	0	0	1	3	3	0
Mandeville	54	7	5	7	3	15	9	5	3
May Pen Poor House	13	1	0	1	0	7	3	1	0
Montego Bay	119	28	31	8	10	19	3	13	7
Plantain Garded River	42	13	17	1	0	0	6	5	0
Port Maria	83	5	58	1	1	3	9	6	0
Spanish Town	11	2	0	3	1	2	0	3	0
St. Ann's Bay	79	6	6	2	8	28	8	13	8
St. Mary's Poor House	28	5	8	0	2	2	2	9	0
Others	6	0	0	0	0	2	1	2	1
Total	1,338	248	379	69	88	210	112	161	71
Percentage on Positive Results ...	No. positive 1,090	—	34·77	6·33	8·07	19·26	10·27	14·77	6·51

APPENDIX VIII.

REPORTS ON WORK CARRIED OUT IN COLONIAL LABORATORIES.

TABLE IV.

Showing the percentage of helminthiasis in general and of ankylostomiasis in particular in certain districts, from which over 100 specimens have been sent:-

District.	Helminthiasis.	Ankylostome Alone.	Ankylostome Alone and in Combination.
Buff Bay	91·87	69·38	93·87
Linstead	92·36	13·22	81·81
Lionel Town	63·75	37·05	63·45
Montego Bay	76·47	34·06	72·52
Whole Island	81·46	34·77	79·08
Whole Island exclusive of Lionel Town ...	86·78	34·26	82·53

TABLE V.

Showing the specimens examined month by month at the laboratory:—

Subject.	September.	October.	November.	December.	January.	February.	March.	Total.
Enteric fever	24	124	82	62	63	63	56	474
Smears	22	94	87	43	84	69	65	354
Fæces for ankyl.	98	261	226	253	200	190	110	1,338
Fæces for amœbæ ...	7	12	14	17	16	19	6	91
Urines	8	9	10	11	31	31	20	120
Pus	12	4	10	6	11	14	9	66
Sputum	11	14	17	24	15	36	24	141
Tissues	7	3	4	6	26	74	129	249
Waters	2	14	15	3	19	10	—	63
Miscellaneous	30	32	28	43	67	95	80	375
Totals	221	507	443	468	532	601	499	3,271

No. 7.

JAMAICA.

THE GOVERNOR to THE SECRETARY OF STATE.

(Received 3rd November, 1914.)

SIR, King's House, Jamaica, 16th October, 1914.

IN continuation of my despatch, dated the 20th April, 1914,* I have the honour to transmit, for the information of the Committee of the Tropical Diseases Research Fund, the report of the Government Bacteriologist on the work done at the Pathological Laboratory during the period from 1st April to 30th September, 1914.

I have, &c.,
W. H. MANNING,
Governor.

Enclosure in No. 7.

SIX-MONTHLY REPORT ON THE WORK DONE AT THE PATHOLOGICAL LABORATORY, MARCH-SEPTEMBER, 1914.

The Pathological Laboratory, The Public Hospital,
SIR, Kingston, Jamaica, 3rd October, 1914.

I HAVE the honour to forward herewith, in accordance with the instructions of the Right Honourable the Secretary of State for the Colonies, for the information of the Tropical Research Committee, my seventh half-yearly report on the

* No. 6.

Appendix VIII.

Reports on work carried out in Colonial Laboratories.

work carried out at the Pathological Laboratory, for the six months ending September, 1914.

The staff of the institution consists, as before, of myself as Government Bacteriologist, Dr. Catto, Assistant Bacteriologist, one trained laboratory attendant, a stenographer, and a boy as cleaner.

Since the outbreak of the war at the beginning of August, I have spent part of the day in assisting the officers of the Royal Army Medical Corps at the military hospital here, as three of their staff are on duty at various outstations, as arranged for by the local mobilization scheme in case of emergencies. During this time more of the routine work of the laboratory has in consequence fallen to the Assistant Bacteriologist, who, I am glad to report, has responded well to the increased demand upon his services.

A perusal of the appended Table I. will show that during the period under review a very large number of specimens has been dealt with, in fact, more than double that of the preceding six months, namely, 6,612, as compared with 3,271 during the period October, 1913, to March, 1914.

In attempting to describe the multifarious nature of the specimens sent up for examination, and in order that matters of interest may not be overlooked, I will group the work done under the two main headings of: I.—Routine, II.—Special, including research.

These will be further sub-divided as follows:—

Under I.—Routine Work:—

1. Widal examinations for diagnosis of enteric fever.
2. Other blood examinations for malarial parasites, filaria, etc.
3. Fæcal examinations for helminthiasis and dysentery.
4. Examination of rats for plague.
5. Bacterial analyses of water samples.
6. Autopsies of special cases.
7. Routine examinations of pus, urines, sputa.
8. Miscellaneous, including examinations of gastric contents, effusions and exudations, preparation of vaccines, Wasserman reactions, and so forth.

Under II.—Special Work, some details will be given of:—

1. Veterinary work—investigations into cases of contagious abortion at the Government farm.
2. Special researches into the causes of the spread and prevalence of enteric fever in Kingston.

As regards the question of research into the pathological anatomy of pellagra, this is still being carried on by Dr. Catto, but there is nothing definite at present to report, as only two fatal cases have come to our notice, and both were patients in the asylum with other diseases complicating the pellagrous condition.

I.—Routine Work.

1. *Widal Reactions for Enteric Fever.*—The number of specimens of blood sent up for this examination to be made far exceeds that of any previous six-monthly period since my arrival in the island, or since the laboratory was instituted. The largest hitherto was 561, in the corresponding period of 1913, while in the subsequent six months 474 bloods were sent up. This year 767 sera were tested by this reaction during the period under review in this report, and of these, 306, or 39·89 per cent., gave a positive result, as compared with 280 in my last report. Table IV., appended, shows that the increase arises very largely from specimens sent from Kingston (including both town and hospital) and the adjoining parish of St. Andrew.

Noticing this to be the case, I compiled from the laboratory records the figures in Table III., which are instructive in showing that, whereas in the months of April, July, and August the number of specimens sent from Kingston varied between 62 and 68, in May and June the number was nearly doubled. This, even if the percentage of positive reactions remained the same as in the other months, would mean nearly twice the actual number of cases of enteric fever, but the table shows that in June the percentage of positive cases rose to 54·12 per cent., and the actual cases (that is, blood specimens yielding a positive result) rose from 21 in

April to 40 in May and 59 in June. A somewhat similar but less marked condition of things having occurred in 1913, I started in March of this year a series of investigations into the matter, which already reveal findings of much interest and considerable importance. These are treated of in detail under Special Work, pages 7-11.

Briefly to sum up this section of the routine work, it is seen that, of 767 sera examined, 306 reacted positively, and of those 306 agglutinating sera, 196, or over 64 per cent., came from Kingston and St. Andrew, and 181, or 59 per cent., were from Kingston itself, a city exposed to bright sunshine all day long nearly every day of the year, and situated with a gentle slope from the upper part right down to the sea, and therefore with an ideal natural drainage. It was in the endeavour to discover the reason for such extensive prevalence of enteric fever in a town so favourably situated that the investigation referred to was undertaken.

Owing to three cases occurring amongst the police constables in April, an investigation was carried out for the purpose of ascertaining whether any "carriers" existed in the barrack-room occupied by these men. Thirty-two specimens of blood were taken and four of them gave a positive reaction. Two of these gave a definite history of a previous attack of typhoid fever, while another constable, who stated that he had been ill with the disease in September, 1912, gave negative results, and the serum from a fourth agglutinated *B. paratyphosus.*

The excreta from all of them have been examined at intervals, but with negative results as regards isolation of the *B. typhosus* or *paratyphosus;* with such serological findings it is possible, if not probable, that one or more carriers exist, but if so they are intermittent, and at considerable intervals.

Further attempts will be made to set this question at rest.

2. *Blood Examinations for Parasites, Counts, etc.*—Six hundred and eighty-nine of these have been sent up, of which 400 were examined for malaria. In 30 of these the parasite of malarial fever was found, namely, *Pl. vivax* 7 times, *Pl. malariæ* 4, and *Pl. falciparum* 21 times; in two instances there was a combined infection of quartan and subtertian, and in one instance the parasite was different from any of the usual forms, and very closely resembled that described by Professor Stephens under the name of *Pl. tenue,* that is, the protoplasm was slender and scanty, the chromatin relatively abundant, and tending to assume bizarre forms in preference to the usual dot.

In a former report I stated that after making several blood examinations I had never yet met with a case of filariasis in a Jamaican who had not also lived elsewhere than in this island. I have only come across four cases during the last four years, and in every instance the patient had lived part of his life abroad.

Doubt has been thrown upon this remark of mine, one authority stating that, seeing that the disease occurs in neighbouring West Indian islands, careful examination would probably result in its being found more commonly than I had supposed. Accordingly, with the co-operation of the Medical Officers in charge of patients in the general hospital, I examined the blood of the in-patients at different times, both during the day and night, taking them 25 at a time, but in no instance could I discover any filaria embryos. Any patient who showed glandular enlargement, and all who showed symptoms and signs of elephantiasis, were examined but, except for one patient who had lived for many years in British Guiana, I found no filariasis.

Lastly, in five specimens of blood sent up from cattle at the Government farm I have found the *Pirosoma bigeminum.*

3. *Examination of Fæces for Helminthiasis, etc.*—During this half-year 1,422 specimens have been examined for ova of worms, as compared with 1,338 during the preceding period, and of these 1,210 contained ova of some kind, and usually a combination of several varieties. This is a higher percentage of infection than was revealed by the figures in my last report, namely, 85·09 per cent. for the whole island, whereas, in the period September, 1913-March, 1914, it was 81·46 per cent.

Table VI. has been drawn up in order to show at a glance facts which it would take pages of writing to describe. Briefly, 38·59 per cent of the total positive findings contained ankylostome ova only, while an additional 42·73 per cent. contained them in conjunction with ascaris and trichocephalus.

These latter two were found singly in only 5·62 per cent. and 7·19 per cent. respectively, but in combination with others in some 45 per cent. in each case.

It is remarkable that in certain districts, notably in Buff Bay, these last two are uncommon, the ankylostome markedly preponderating. Thus, in only 13 per cent. was ankylostome combined with ascaris and trichocephalus, whereas, in others, for example, Chapelton, under 20 per cent. of the cases were infected with hookworm only, while in close upon 50 per cent. the latter was complicated with both the former. In Buff Bay, again, though helminthiasis as a whole is 2·5 per cent. less than was stated in my last report, the proportion containing ankylostome alone was 14 per cent. greater.

Sixty-five specimens have been sent up from patients exhibiting dysenteric symptoms. Of these 27 contained the amœba of this disease, and in one was found *Trichomonas intestinalis*.

4. *Examination of Rats for Plague.*—Owing to the presence of plague in Cuba and in New Orleans, a vigorous rat campaign was started in Jamaica early in the year. During the six months with which we are dealing, 2,300 rats have been examined at the laboratory. Cultivations, smears, and inoculation experiments were carried out in the cases of any rats which afforded suspicion of plague, and (in view of Castellani's statement that the bacilli may be present without any gross naked-eye lesions in the animal) of several apparently normal rats also, but with uniformly negative results.

5. *Bacterial Analyses of Water Supplies.*—Sixty-three samples have been subjected to analysis. The sources of supply to Kingston are all examined and reported upon regularly every month. In June and July of this year, owing to the comparatively large number of cases of enteric fever occurring in Kingston, the Medical Officer of Health for the city wrote condemning strongly the water supply, and particularly incriminating a subsidiary source which is only used when the output from the two regular sources is insufficient.

His statements and the widespread publication of them gave rise to a scare which, though quite unfounded, served the useful purpose of causing more analyses to be undertaken, not only of the main sources of supply, but also of individual filter-beds. These were quite up to the usual tropical standards, and the Medical Officer of Health had made the mistake of overlooking the fact that the water especially attacked by him had not been supplying the city during the period dealt with owing to its being a subsidiary supply and not required, the output from the usual sources being adequate for the requirements of the population.

As already stated, I had started investigating the subject of the prevalence of enteric fever in Kingston, and the results of these researches up to the present time are spoken of in detail in Part II. of this report (see pages 7-11).

6. One hundred and twelve post-mortem examinations of special cases have been performed. Of these the following are worthy of particular mention as being of more than passing interest:—

1.—A. G., male, aged 38 years. Admitted to hospital on 20th January and died 30th March, 1914. Briefly his history was as follows: On admission he stated that he had been ill for four months with "pains in abdomen and back." For the last two weeks he had noticed a hard swelling to the left of the middle line of the abdomen, extending to the left iliac fossa. Below the umbilicus the tumour could be felt to the right of the midline. Outwards it completely filled the space between the ribs, iliac crest, and vertebral column. It was tender to the touch, quite hard, without any soft spots (Taken from the notes made by the Medical Officer in charge of the patient). Stated that he had been losing flesh. Urine high-coloured and contained blood and blood-casts. The progress was steadily downhill till death occurred two months later.

Post-mortem: Left kidney filled up the space as above described. Firmly adherent to all the surrounding organs. Many cystic bosses. *Weight*, 7 *lbs.* 11 *ozs.* On opening there was no trace of kidney tissue, the whole was made up of cysts of various sizes up to five inches in diameter, filled with blood and blood-stained urine. The right kidney was similar, but smaller. *Weight*, 4 *lbs.* 11 *ozs.* Heart enlarged, left ventricle hypertrophied, no valvular incompetence.

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It is astonishing how this man could have lived so long in apparently perfect health, to the age of 38 years, with kidneys in such a condition. The specimens have been preserved.

2.—E. B., female, aged 22 years. Admitted to hospital 8th May, with a history of having been delivered ten days previously, the membranes having been retained for that time. There was a very fetid discharge. The uterus was cleared out on the day of admission. On 10th May patient developed a cough and became dyspnœic, temperature 104° Fahr. on evening of 9th May. The base of the left lung was dull, pleuritic friction audible. Death occurred on the 12th at 8.30 p.m.

At the autopsy the lungs showed a large infarct at the base of the left and a small one in the lower lobe of the right. The heart showed ulcerative endocarditis of the tricuspid valve. The uterus was lined with dark, almost gangrenous material; an abscess 2·5 × 1·5 cm. in right ovary. The inferior mesenteric vein was thrombosed for 16 cm. of its length, and the clot was purulent.

The sequence of events in this case, therefore, was: Retained placenta and membranes, sepsis, endometritis, ovarian abscess, infective thrombosis of the inferior mesenteric vein, malignant endocarditis of the right side of the heart, with the production of septic infarcts of the lungs.

3.—C. E., female, aged 22 years. Admitted 25th August, 1914, complaining that since 21st she had been suffering from abdominal pain, at first about the umbilicus, then in hypogastric, and afterwards in right pelvic, region. On examination the abdomen was seen to be very distended and painful on palpation. The right flank was dull on percussion. Clinical signs of peritonitis present. Laparotomy performed the same day, and the intestines were found to be the seat of extensive malignant disease with perforation of the small intestine through the cancerous mass. She died early the following morning.

At the autopsy: On opening the abdomen it was found to be full of pus. Intestines and other viscera glued together by purulent lymph, but they were easily separated. The jejunum was found to be the seat of an intensely hæmorrhagic malignant growth, which had started in its wall and fixed itself on to (*i*) the intestine in the neighbourhood of the cæcum and appendix, (*ii*) the broad ligament and the ovary on the left side, (*iii*) the anterior abdominal wall in the region of the linea alba. The left portion of the broad ligament contained a cyst (parovarian ?) and the ovary on that side showed some hæmorrhage.

The cause of death was general peritonitis following on perforation of a spindle-celled sarcoma, which had started in the wall of the jejunum.

The next two cases are recorded for their rarity out here and for the strange fact that they constituted two consecutive autopsies.

4.—T. P., male, aged 22 years. Admitted 29th August, 1914, with a thready pulse and obviously very ill. The abdomen was rigid, dull on percussion in right iliac region Temperature 101·4°. Tenderness all over the abdomen, but especially at McBurney's point. Operation performed: there was a great deal of watery fluid free in the abdominal cavity, the appendix was found to be normal. A drainage tube was inserted, but no further operative measures carried out, as patient was too ill. He died the same afternoon. At the autopsy the abdominal cavity contained abundant yellow purulent fluid, and lymph deposit matted the coils. The cause of the condition was a small, punched-out perforation of a duodenal ulcer, the size of a threepenny piece, in the first part just beyond the pylorus. There were no adhesions around it to localize the escaping contents, and the patient had succumbed to general peritonitis.

5.—C. B., male, aged 27 years. Admitted 2nd September with a history of only one day's illness. He had been quite well till the onset of a sudden abdominal pain the previous day. When admitted he was in extremis, pulse rapid and thready, temperature 96·4° Fahr., abdomen rigid, distended, tympanitic. He died the same evening three hours after admission.

At the post-mortem the abdomen was filled with a similar yellow watery fluid: the intestines showed lymph formation on the surface; a perforating ulcer, the size of a threepenny bit, was present on the anterior surface of the duodenum, about half-an-inch from the pylorus, without any adhesions at all.

Both had a sudden onset in apparently perfect health; the rapid termination, the situation of the ulcer, and the failure of all attempts at localization of the mischief were the same in both.

7. Of the routine examinations of pus, urines, and sputa, very little need be said. The numbers of each examined are stated in Table I. One case of bronchomycosis occurred in a native, and one case of streptothrix in an East Indian coolie. The signs and symptoms of the latter were almost identical with those given in my previous report. Culturally it behaved like the St. Hominis I. of Foulerton.

8. *Miscellaneous specimens.*—This subdivision includes a variety of examinations which cannot be placed under any of the previous headings. The group comprises samples of effusions, exudations, gastric contents, vaccines, cultures of suspicious pestis-like organisms from rats, Rideal-Walker estimations of disinfectant values, and finally Wassermann reactions.

A considerable number of autogenous vaccines have been prepared, and the results of their employment have been, and are, in the main, very satisfactory; so much so that they are very largely replacing stock vaccines here.

With the exception of Wassermann reactions the various items of this section need not be specifically spoken of, as they form part of the routine work of every pathological laboratory.

A new method, however, of performing Wassermann's reaction has been adopted during the last six months which has given much more satisfactory results than any of the previous ones employed here. It certainly takes longer and is more laborious than former methods, but this is more than compensated for by the increased reliability. The method is that of MacIntosh and Fildes. Briefly stated, the reliability is enhanced by standardizing all the various components each day that the reactions are performed.

Thus, the rabbit-sheep hæmolytic amboceptor is first standardized and the minimal hæmolytic dose ascertained; two-and-a-half times this is used for the test. Next, the complement obtained from the guinea-pig is standardized and the smallest quantity causing complete hæmolysis of 0·5 c.c. of a 5 per cent. suspension of fresh washed sheep's red cells, sensitized by two-and-a-half times the minimum hæmolytic dose of the amboceptor in one hour is ascertained, and for the test twice this quantity is used. It was found at first that the complement deteriorated somewhat rapidly out here, so our plan now is to obtain the blood from the guinea-pig about 3.30—4 p.m. on the day before that on which the tests are to be carried out, and place it in centrifuge tubes in the ice-chest till the following morning. After withdrawal of the blood, the heart of the animal is removed, separated from any fatty and fibrous tissue present, weighed and ground up with well-washed silver sand; 10 c.c. of absolute alcohol is added for every gramme of heart muscle, and the whole is well shaken at intervals for an hour. This constituent of the antigen is made up fresh every time. Alcoholic solution of cholesterin (1 per cent.) is added in proportion of four parts to five of guinea-pig heart extract. This is standardized, and one-third to one-fourth of the amount found necessary to completely inhibit hæmolysis of the sheep's red corpuscles, sensitized and complemented with the amounts previously determined, is used for the reaction. The antigen dilution is made immediately prior to its being used, the mixture with normal saline being rapidly performed in order to produce the minimum precipitation.

The patients' and the control sera are all inactivated by keeping them at 56° C. for half-an-hour, and are then placed in the ice-chest until required.

Thus, the amboceptor, complement, and antigen are all standardized afresh each day the reaction is to be carried out, that is, once a week. The result of the test in each case is stated according to the degree of hæmolysis as compared with a standard made as follows:—18 c.c. of tap water is added to 2 c.c. of the 5 per cent. of suspension of sheep's red cells; 5 c.c. of this is placed in a "Wassermann tube," and this is called 100 per cent. hæmoglobin. Dilutions are made from this, namely 3·75 c.c. with 1·25 c.c. saline; 2·5 c.c. with 2·5 c.c. saline; and 2·25 c.c. with 3·75 c.c. saline; to equal 75 per cent., 50 per cent., and 25 per cent. hæmoglobin respectively. In notifying the result 100 per cent. hæmoglobin = negative, 75 per cent. = very slightly positive, 50 per cent. = slightly positive, 25 per cent. = positive, while no hæmolysis = markedly positive.

APPENDIX VIII.

REPORTS ON WORK CARRIED OUT IN COLONIAL LABORATORIES.

GROUP II.—SPECIAL INVESTIGATIONS.

1. *Contagious Abortion in Cattle.*—At the request of the Director of Agriculture, I undertook some work in connexion with an outbreak of abortion amongst the cattle at the Government farm.

From the uterine exudate of one case a growth was obtained having the morphological and cultural characters of the *Bacillus abortus*, originally isolated by Bang.

A brief description may with advantage be given: It is a slender, non-motile bacillus, of an average length of 1-2 micra, gram-negative, non-acid-fast, often showing barred staining. The optimum temperature of growth is about 37° C. and the organism dies in ten minutes at 60° C. It is an obligatory aërobe. It produces little, if any, soluble exotoxin, but an endotoxin sets up febrile symptoms. On examination of smears from the uterine exudate they are seen disposed singly or in clumps between the leucocytes and catarrhal cells from the mucous membrane. They are said never to be found in the heart blood of the fœtus, but may be present in the fluid contents of the fœtal stomach. Therefore, the uterine exudate and the fœtus must both be regarded as infective; moreover, the post-abortion discharge is similarly infective. The material, if kept fluid and free from putrefaction, can retain its virulence for at least six months, which compensates for the inability to propagate outside the body.

From the foregoing it is clear that there are several ways in which infective material may be distributed to healthy animals and to other parts of the pasture, for example:—

1. The surface drains of a byre may carry the infective uterine contents to other stalls.
2. The material may be conveyed elsewhere by the removal of the soiled manure.
3. By the roaming about of infective animals and others carrying the material on their coats, soiled by lying in infective discharge.
4. By the boots and hands of attendants.
5. By dogs carrying parts of the expelled fœtus or membranes to other parts of the farm.
6. The bull may convey the infection from one animal to another, though this is probably an infrequent method.

It must be borne in mind that infection readily occurs by the mouth, that is, ingestion of the virus by pasturing on grass which has been contaminated by the discharges of an infected animal. The natural inference from this fact is that, in order to minimize the dangers of conveyance, which are very considerable, cows which have aborted must be regarded as potential sources of infection so long as the genital discharge continues, and an important fact to keep in sight is that the discharge may intermit and continue for weeks if untreated.

If isolation, therefore, is not carried out, the sheds may be constantly reinfected, or, if the animals are turned out to graze, the pastures may be similarly contaminated.

Finally, a few words as to my own work in this connexion. It is generally held that the agglutination test for the purposes of diagnosis of this condition is not very reliable. The reason for this arises, in my opinion, from the fact that the bacillus isolated by Bang in Denmark differs in several particulars from the English bacillus, and that the serum of an animal infected by the one may not necessarily agglutinate a culture of the other (Compare, e.g., the results of testing the sera of patients suffering from enteric fever due to the true typhoid (Eberth's) bacillus in one case, and paratyphoid in the other; clinically the symptoms may be identical, but the serum of the second will not agglutinate the *Bacillus typhosus*—except in low dilution—and vice versa).

In the present investigation of the cows at the Government farm, the results have been singularly accurate. Twenty-five specimens of blood were brought or sent to me to be tested, and I carried out the examination with a twenty-four to thirty-six hours' culture of the bacillus in dilutions of the sera of 1 :100, 1 :200, and 1 :500. No hint was given to me as regards the histories of any of the animals, whether they had shown any of the symptoms of the disease or not. Some had undoubtedly

suffered from the disease, some were suspected, and some were healthy, and sera from these last were sent with the others as controls, but in no instance was I told which was which.

The results obtained are given in the appended Table VII. It will be seen that seven gave a marked agglutination in all three dilutions; seven in low dilutions only, though four gave partial reactions in high dilutions also, while two gave only partial reactions, that is, there was a considerable degree of clumping in all the dilutions, but many bacteria still remained isolated, while again nine were negative. Arguing on the lines of my previously published work on the interpretation of the reaction in enteric fever, one inferred that those giving a positive in low dilution were either in an early stage and liable to abort, or more probably had aborted a considerable time previously, and the immunity conferred by that former attack was gradually passing off.

On my reporting my results to the Director of Agriculture, I received a letter from him in which he states: "The results (of the tests) are truly remarkable, and I am able to confirm every reaction as undoubtedly correct from our own records and observations of the animals."

This fact is worthy of note in view of the somewhat adverse opinions which have been held elsewhere relative to the value of the agglutination test.

2. *Research Work on Enteric Fever.*—It has been stated above that, owing to the extensive prevalence of enteric fever in Kingston, I determined to make some efforts to discover the cause.

Naturally one's thoughts were first directed to the usually recognized sources of the spread of the disease, namely, food (including water), flies, and dust.

The regular examinations of the Kingston water supplies undertaken at the laboratory have the result of keeping the Kingston General Commissioners always on the alert to detect any evidence that the quality of any of these supplies is changing, and the fact of any additional contamination occurring would be soon discovered. It came as a matter of great surprise, therefore, when Kingston was scared by a report from their Medical Officer of Health that the water supply, and especially that auxiliary one recently installed at great expense, consisted of "diluted sewage," and could "by no method be rendered fit for drinking purposes." Fortunately, it proved to be a mere canard, for the incriminated source of supply was not in use at the time, this being only a subsidiary supply pumped up when the usual sources prove inadequate for the demands of the population, which was not then the case.

Although there were undoubtedly a larger number of cases of enteric fever notified during May, June, and July than at other times of the year, and this year perhaps more than in previous years, I do not by any means think that one can infer from this that enteric fever has been actually more prevalent than at corresponding times in previous years. It is possible but not certain. It must be remembered that the uses of the bacteriological laboratory are now firmly established, and blood is sent up from many more cases of fever now than formerly. A considerable proportion of these which would have formerly been diagnosed by the medical attendant as "malaria," "fever undefined," etc., now has to be notified as enteric, and this swells the numbers.

Again, other cases of similarly doubtful fever prove on bacterial examination to be suffering from paratyphosus infection; these also, by the present law, are notifiable under the heading of enteric fever (formerly these were not required to be notified at all), causing a further increase.

These two causes together would lead to a marked increase in the number of notifications, even if the actual prevalence were no greater than in previous years.

Against the supposition of the disease in Kingston being water-borne are the following facts:—

1. The population of Kingston is estimated at 58,352, and the notifications of cases of enteric fever include all those in the Public General Hospital, which draws also from the neighbouring parish of St. Andrew, at all events the lowest and most densely populated part of it; so that the population was over 60,000 at the very smallest computation. During the month referred to there were 50 notifications, that is,

less than 1 per 1,000, a large proportion in a town with every natural advantage for drainage, but a very small proportion as compared with what would occur if the infection were water-borne, since 58,352 individuals drink this water.

2. There were no notifications from the penitentiary or the asylum, although the same water is used there, and water from no other source.
3. The different quarters of the town, though having the same water supply, contributed very different numbers of enteric fever; thus, from the north-east, north-west, south-west, and south-east districts there were notified respectively 11, 23, 7, and 5 cases in one month, that is, 34 in the northern to 12 in the southern parts.

The water conveyance of infection being thus excluded, inquiries were made as to the other, more likely, sources.

1. Food, such as milk, etc., were possible sources, for, as in most tropical countries, milk is carelessly handled, and the cleanliness of the vendors and their receptacles is by no means above suspicion.

   Also sweets, cakes, and so forth are sold at various dusty street corners, and up to a short time ago there was no compulsion to keep these articles of food protected from dust, flies, or the fingers of would-be purchasers, who commonly take up one article after another before deciding as to which is most value for their money. I know also of one case where the sweets so sold were actually being made in a hut in which an enteric patient was lying.
2. Flies.—These are very troublesome in some parts of the city, particularly the poorer parts, whence many of the enteric cases come. In these quarters they are troublesome at most seasons of the year, but the time when they become a positive pest is that of the "mango season," from May onwards to September, and this is the time when the enteric rate goes up.

   A fly census in different parts of the town, and the establishment of a correlation between this and the district whence notifications of enteric fever come, would be an interesting matter, but is more within the province of the Medical Officer of Health than that of myself.

   With his consent I would like to undertake this at some future period, if my other duties will permit.
3. Sewage disposal.—The water carriage system is only laid on for the lower part of the town, the upper parts, north-east and north-west districts, are largely furnished with privy middens, dry earth, and so forth, nothing less than an open invitation to flies, which freely avail themselves of it.

   This also is a matter for the Medical Officer of Health, and with it I cannot interfere, but, granting all the above, there was still unaccounted for the source whence the flies or the food or the dust obtained the organisms of the disease, and one, therefore, suspected—
4. Carriers.—This was a matter with which my special work was connected, but there were several difficulties in the way of obtaining material, as people in health cannot be prevailed upon (and it is quite a natural objection) to send up excreta in order that one may find out whether they are typhoid carriers. Moreover, if negative, the case was by no means proven, as the carrying might be intermittent.

My suspicions were that there might be, and probably were, individuals going about apparently in good health who were unwittingly spreading the disease, and considering the fact, firstly, that enteric fever is a common disease here, and that probably a certain percentage of them become carriers; and, secondly, that many cases are overlooked and wrongly diagnosed, I determined to make bile cultures of every patient dying in the hospital, no matter from what condition, and to see whether any of them were carrying the bacillus in their gall-bladders at the time of death.

Of course, in patients coming in with a history of enteric fever and dying from it, and in patients wrongly diagnosed but actually suffering from the disease, one would naturally expect to find the organism, but there was a third class for which I particularly wished to examine, namely, those who were admitted into

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hospital with some illness unconnected or not suspected of being connected with enteric fever, and who, by harbouring the *Bacillus typhosus* in their gall-bladders had probably been acting as carriers, and who, had they chanced to recover, would have again gone about spreading these germs broadcast. These were the ones who were dangerous to the community, and, if such were found to exist, the fact would go far to explain the undue prevalence of typhoid fever in Kingston.

The method of procedure has been as follows:—As soon after death as possible the gall-bladder was exposed, and, with the usual precautions for sterilizing the surface, an incision was made into the organ and a platinum loopful of the bile was inoculated into tubes of peptone broth (5 c.c.), to which varying quantities of brilliant green had been added immediately before. Sometimes six tubes were inoculated, but never less than three, the proportions being 5 c.c. of the broth and of the brilliant green (1 : 10,000) 0·03 c.c.; 0·06 c.c., 0·12 c.c., 0·18 c.c., 2 c.c., and 3 c.c. respectively. They were then placed in the thermostat at 37° C. and examined the following day.

If the growth was slight further examination was postponed for another twenty-four hours. If there was no growth the tubes were kept for a week. If growth took place the broth culture was plated on to rebipelagar, and subsequently any suspicious colonies into nutrient broth. Secondary tests were then carried out with various sugars, namely, lactose, saccharose, glucose, maltose, mannite, and sorbite.

I also prepared an immune serum, which gave a titre of 1 : 4000 with its own producing strain of *B. typhosus*, and any isolated organism which gave the usual typhosus reactions was tested with this potent immune serum.

I not infrequently found, as has been noted by others, the following two facts:—

1. That recently isolated organisms had in many cases lost their motility, or perhaps it would be more correct to say had not yet acquired motility. This was frequent in the primary growth in the brilliant green peptone-broth, but subculturing into nutrient broth led to a development of normal motility.
2. That at times a recently isolated strain is not readily agglutinated except in low dilutions.

In consequence of these two facts the work was increased, and the results sometimes delayed owing to the subculturing necessary before the tests could be declared definitely positive or negative. Organisms, however, which gave the typical sugar reactions were always tested, and, if necessary, re-tested again and again after an interval with the immune serum.

Only such as gave the sugar reactions and a high agglutinability with the immune serum were regarded as positive.

Agglutination of a bacillus with the serum of a patient suffering from enteric fever, as Bruns, Kayser, and others, have pointed out, is not sufficient to establish the identity of such a bacillus as *B. typhosus*, and to rely on such is open to many pitfalls.

This description of my method is very brief, but only the main points of it have been sketched. We have now made cultivations from 100 cases, and, since a description of them all would unduly prolong this report, I will only briefly summarize the results:—

1. Out of the 100 cases 25 were shown at the autopsies to be suffering with enteric fever, that is, definite macroscopic lesions of the disease were present. In 20 of these the bacillus was isolated from the bile, in other words, in 80 per cent. of the cases so far who showed definite signs of enteric fever at the post-mortem, the bacillus was found in the gall-bladder.
2. Twenty-two cases had been diagnosed clinically as enteric fever, and 18 of them were confirmed as such at the autopsies. The remaining four were (1) tuberculosis of pleura, pericardium, and bronchial glands, (2) phthisis, (3) cirrhosis of liver, (4) dysentery.
3. Eight cases were found to have died from enteric fever which had been wrongly diagnosed, or had had no definite diagnosis made at all.
4. Three cases gave no history of enteric fever and showed no typhoid lesions at the autopsy, but gave a positive result on cultivation of the bile.

Remarks. Group 1 calls for no comment. Group 2 is only so far important in that notification of them would tend to swell the number of actual cases occurring, but, on the other hand, these are more than counterbalanced by the eight included in group 3.

This last (group 3) is important in that, had they recovered there would have been no record of their having suffered from enteric fever; they might not unreasonably be regarded as possible carriers, and at any rate no warning would have been given to them relative to the risks they constituted in conveying the disease to their associates.

Group 4 is the most interesting and most important of all, and proved the suspicion on which the investigation was undertaken, namely, that unrecognized carriers are going about Kingston in larger proportions than have been estimated elsewhere.

It has been stated that 3 per cent. of patients become carriers, but out of this first series of 100 cases there have been found three who up to the time of the onset of their final illness had been going about apparently in perfect health, who gave no history of having had an attack of typhoid fever, who mixed freely with their fellows, and lived in the poorer, badly ventilated, and unsewered parts of the city.

These cases are worth quoting briefly:—

1. C. C., male, aged 49 years, white. (No. 7 in the appended list.) Admitted to hospital at 4 p.m., 31st March, with a history of having at 9 a.m. "taken rat poison in mistake for phenacetin." He died at 11.40 p.m. The fact that more than 400 grains of arsenious acid were found in the stomach and viscera, even after the vomiting which had continued for ten hours, points to deliberate suicide, for no one would take close on an ounce of phenacetin for a single dose. His neighbours stated that he went in and out amongst them apparently in perfect health until the day of his death.
2. B., a coolie woman, aged 21 years. (No. 34 in the list.) Admitted complaining of "fever, cough, and pain in the right side of the chest." Expiration was prolonged, and there were rhonchi audible over both lungs.

   The diagnosis of phthisis was made, and the patient died early the following morning.

   At the autopsy the lungs showed minute scattered nodules with caseous contents, possibly tuberculous, but the chief finding of interest was that the gall-bladder had practically disappeared, and there was an ulceration into the duodenum just beyond the pylorus, with a gall-stone about the size of a small hazel nut in the aperture.

   There were three abscesses in the liver, one cavity being the size of a tangerine orange.

   From the nucleus of the gall-stone (the only one) a pure culture of *B. typhosus* was obtained.
3. S. D., male, aged 19 years, black. (No. 73 in the list.) Was admitted with a history of six days' "cough, pain in the right side of the chest, and fever." The percussion note over the lower lobe of the right lung was quite dull. "No breath sounds could be heard, but vocal resonance and fremitus increased." Widal reaction was negative. The patient died ten days later.

   At the post-mortem the right lung was quite solid; the upper and middle lobes in a state of grey hepatization, the lower lobe in a condition of purulent infiltration, and in one place broken down to abscess formation. The lung was large and heavy, and the liver so displaced that the upper margin only reached one-and-a-half fingers' breadths above the costal edge.

   This, then, was a case of unresolved lobar pneumonia. No history whatever was obtained pointing to enteric fever, but a culture of *B. typhosus* was yielded by the bile.

It would hardly be fair to draw conclusions from 100 cases, and the investigation is being continued, but if, apart from cases treated as enteric fever at the hospital, and apart from cases showing signs of this disease post mortem, there have been among the first 100 autopsies three who were harbouring the *Bacillus typhosus* in their gall-bladders, it is not surprising that there is so much enteric fever in Kingston.

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The tables of these 100 cases reveal many more points of interest, but as these are not intimately concerned with the object for which the investigation was undertaken, I do not propose treating of them here, but hope, if time permits, and I have sufficient opportunity, to make notes of further cases and publish them as a separate paper.

I have, &c.,
H. Harold Scott,
M.D. London, D.P.H.,
Government Bacteriologist, Pathologist to the Kingston General Hospital.

The Honourable
The Superintending
Medical Officer.

Table I.

Showing the numbers of specimens examined month by month.

	March 21st—31st.	April.	May.	June.	July.	August.	September 1st—20th.	Totals.
Blood for Widal's test	33	101	168	167	109	124	65	767
Fæces for helminthiasis...	79	140	297	266	291	199	150	1422
Fæces for dysentery, typhoid, &c.	7	11	46	25	9	8	5	111
Blood smears	33	156	164	148	76	69	43	689
Pus	3	15	20	11	13	6	5	73
Urines	11	16	65	31	52	19	11	205
Sputa	12	28	42	27	35	33	18	195
Tissues for section	7	59	37	13	66	11	10	203
Water analyses	7	10	9	12	9	12	4	63
Special autopsies	3	22	35	14	20	13	6	113
Rats dissected for plague	19	120	505	665	494	327	170	2300
Miscellaneous	29	82	133	76	59	47	45	471
Totals	243	760	1521	1455	1233	868	532	6612

Table II.

Numbers of blood specimens examined by Widal's reaction for Enteric Fever, with results month by month, and for whole period of six months.

Month.	Positive.	Negative.	Doubtful.	Total.
March 21st—31st	15	16	2	33
April	34	57	10	101
May	60	104	4	168
June	89	73	5	167
July	39	60	10	109
August	42	69	13	124
September 1st—20th ...	27	35	3	65
Totals...	306	414	47	767

Table III.

Numbers of Widal examinations made of blood sent up from Kingston and the Public General Hospital, with percentage results month by month, and for the whole period.

Month.	Total Numbers.	Percentage Positive.	Percentage Negative.	Percentage Doubtful.
March 21st—31st	21	38·09	52·39	9·52
April	68	30·88	57·36	11·76
May	119	33·61	63·03	3·36
June	109	54·12	43·13	2·75
July	62	30·64	64·52	4·84
August	65	30·77	55·39	13·84
September 1st—20th ...	38	36·84	60·53	2·63
Whole period...	482	37·55	56·22	6·23

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Table IV.

Districts from which blood has been sent for examination by Widal's reaction for Enteric Fever with results.

District.	Positive.	Negative.	Doubtful.	Total.
Kingston and Hospital ...	181	271	30	482
St. Andrew	15	30	1	46
Buff Bay	14	22	2	38
Port Antonio	13	17	3	33
Mandeville	12	9	1	22
Spanish Town	11	4	2	17
Lucea	11	5	—	16
Linstead	10	4	1	15
Montego Bay	6	6	1	13
St. Ann's Bay	5	4	1	10
Lionel Town	5	1	1	7
Plantain Garden River ...	4	10	1	15
Morant Bay	4	2	2	8
Port Maria	3	3	—	6
Chapelton	3	1	—	4
Annotto Bay	2	11	—	13
Richmond	2	3	—	5
Manchioneal	2	—	—	2
Old Harbour	1	2	—	3
Malvern	1	2	—	3
Brown's Town	1	1	—	2
May Pen	—	2	—	2
Grange Hill	—	1	1	2
Alexandria	—	1	—	1
Black River	—	1	—	1
Newport	—	1	—	1
Totals	306	414	47	767
Percentages	39·89	53·97	6·12	—

Table V.

Details of Helminthiasis in the various districts from which specimens have been sent to the Laboratory.

District.	Number Sent.	Negative.	Ankylostome only.	Ascaris only.	Trichocephalus only.	All three.	Ankyl. and Ascaris.	Ankyl. and Trichocephalus	Ascaris and Trichocephalus
Annotto Bay	34	1	22	0	0	0	9	2	0
Black River	100	22	17	5	16	11	9	14	6
Buff Bay	167	18	125	1	2	5	10	5	1
Chapelton	118	12	21	12	10	27	14	11	11
Croft's Hill	15	0	1	3	0	3	4	3	1
Falmouth	84	7	9	5	9	20	6	10	18
Kingston and Hospital	66	17	15	3	6	4	6	14	1
Linstead	97	4	10	3	9	37	11	18	5
Lionel Town	168	63	43	15	11	9	13	10	4
Mandeville	97	7	14	4	4	26	20	13	9
Montego Bay	120	29	37	3	7	21	11	8	4
Plantain Garden River	53	13	31	2	2	2	1	2	0
Port Maria	136	8	99	1	1	4	16	6	1
Spanish Town...	13	1	4	0	1	3	1	3	0
St. Ann's Bay...	86	5	5	6	6	36	9	12	7
St. Mary's Poor House	39	0	7	1	0	10	6	12	3
Others	29	5	7	4	3	7	3	0	0
Totals	1,422	212	467	68	87	225	149	143	71
Percentages on Positive Results ...	Number Positive 1,210	—	38·59	5·62	7·19	18·59	12·31	11·81	5·86

Appendix VIII.

REPORTS ON WORK CARRIED OUT IN COLONIAL LABORATORIES.

Table VI.

Showing the percentage of Helminthiasis and the relative frequency of the various ova in districts from which 100 *or more specimens were sent during the six months, March-September,* 1914.

District.	Helminthiasis.	Ankylostome alone.	Ankyl. alone and in combination.	Ascaris alone.	Ascaris alone and in combination.	Trichocephalus alone.	Tricho. alone and in combination.
Black River	78	21·79	65·38	6·41	39·74	20·51	60·25
Buff Bay	89·22	83·89	97·31	0·67	11·41	1·34	8·45
Chapelton	89·83	19·81	68·87	11·32	60·36	9·43	55·66
Lionel Town ...	62·50	40·95	71·43	14·28	39·04	10·47	32·38
Montego Bay ...	75·83	40·66	84.61	3·29	42·85	7·69	43·95
Port Maria	94·91	77·34	97·65	0·78	17·18	0·78	9·37
Whole Island ...	85·09	38·59	81·32	5·62	42·39	7·19	43·47

Table VII.

Results of Agglutination Tests of Sera of Cattle with Bang's Bacillus abortus.

± Implies agglutination but incomplete, several bacteris remaining isolated; see page 239.

Name of Animal.	Dilution 1 : 100	Dilution 1 : 200	Dilution 1 : 500
1. "Blossom"	+	+	—
2. "Rosa"	±	±	±
3. "Lydia"	+	—	—
4. "Dainty"	+	+	+
5. "Brownie"	—	—	—
6. "Duchess"	—	—	—
7. "Grey"	—	—	—
8. "Brisk"	+	+	+
9. "Pretty"	—	—	—
10. "Butterfly"	+	—	—
11. "Gena"	+	±	—
12. "Pansy"	—	—	—
13. "Gloria"	—	—	—
14. "Bee"	+	±	±
15. "Honeybelle"	+	+	+
16. "Sophie"	+	+	+
17. "Janetstein"	+	+	+
18. "Priceless"	—	—	—
19. "Timora"	+	+	+
20. "Queen of Diamonds"	—	—	—
21. "Sunshine"	+	+	+
22. "Ethel"	±	—	—
23. "Abdullah"	—	—	—
24. "Pear"	+	+	±
25. "Betty"	+	+	±

TABLE VIII.

Details of 100 *cases from which Bile Cultures were made for* Bacillus typhosus.

No.	Initials	Sex.	Age in Years.	Enteric Fever.			Diagnosis.		Bile Culture	
				Suspected.	Found post mortem.	Widal.	Clinical.	Found post mortem.	Typhosus.	Others
1 ...	R. C.	F.	8	Yes	Yes	+	Enteric fever.	Enteric fever.	+	—
2 ...	E. C.	M.	54	No	No	...	Fractured ribs.	Also ruptured spleen and liver.	—	—
3 ...	A. G.	M.	38	No	No	...	Sarcoma; left kidney.	Double cystic kidney, L.5,610, R.2, 250 grms.	—	—
4 ...	M. H.	F.	21	No	Yes	—	Pneumonia, left.	Typhoid ulcers.	+	—
5 ...	A. T.	M.	27	No	Yes	.	Pneumonia.	Typhoid ulcers very numerous; 5 in appendix.	+	—
6 ...	L. A.	F.	40	No	No	—	Enteritis.	Tuberculosis, lungs, spleen, intestine.	—	—
7 ...	C. C.	M.	48	No	No	...	Arsenical poisoning (suicidal).	Irritant poisoning, 431 grs. ars. acid.	+	—
8 ...	J. F.	M.	31	No	No	...	None made.	Pulmonary tuberculosis.	—	—
9 ...	Q. W.	M.	?	No	Yes	...	Pneumonia.	Typhoid ulcers; old pleuritic adhesions.	+	Coli.
10 ...	R. S.	M.	22	No	Yes	...	General peritonitis.	Peritonitis from typhoid perforation.	+	„
11 ...	A. N.	F.	25	No	No	...	Phthisis.	Tuberculosis lungs and spleen.	—	Streptococci.
12 ...	C. F.	M.	41	No	No	...	None made.	Colitis.	—	—
13 ...	A. F.	M.	43	No	No	...	Dysentery.	Large intestine gangrenous, mitral regurgitations, renal infarcts.	—	Shiga type.
14 ...	I. S.	F.	28	No	No	...	Mitral regurgitation.	Mitral disease.	—	—
15 ...	Z. S.	M.	51	No	No	...	Liver abscess.	Confirmed.	—	Coli.
16 ...	A. G.	F.	19	Yes	Yes	— too early	Enteric fever.	„	+	—
17 ...	E. W.	F.	25	No	No	...	Phthisis.	„	—	—
18 ...	S. D.	F.	25	No	No	...	None made.	Tuberculosis, left lung, small intestines.	—	—
19 ...	L. B.	F.	25	No	No	—	Phthisis.	Empyema, left; fibrino-purulent pericarditis.	—	—
20 ...	E. N.	F.	22	No	No	...	None made.	Mitral disease.	—	—
21 ...	R. C.	M.	?	No	No	...	Chronic nephritis.	Confirmed.	—	—
22 ...	E. P.	F.	21	Yes	Yes	+	Enteric fever.	„	+	—
23 ...	L. G.	M.	34	Yes	Yes	+	„	„	+	—
24 ...	A. W.	M.	53	No	No	...	Chronic nephritis.	„	—	—
25 ...	G. M.	F.	$\frac{7}{12}$	No	No	...	Congenital syphilis.	„	—	—
26 ...	J. M.	M.	30	No	No	—	Subtertian malaria.	„	—	—
27 ...	P. M.	M.	49	No	No	...	Urethral stricture.	Chronic nephritis; right lobar pneumonia.	—	—
28 ...	M. H.	F.	40	No	No	...	None made.	Mitral incompetence.	—	—
29 ...	M. M'C.	F.	?	No	No	...	Nephritis and cardiac.	Confirmed.	—	—
30 ...	E. R.	F.	19	Yes	Yes	+	Enteric fever.	„	+	—
31 ...	V. W.	M.	12	No	No	...	"Vomiting sickness."	Tubercular enteritis and peritonitis.	—	Coli.
32 ...	E. J.	M.	19	Yes	No	—	None made.	Phthisis.	—	—
33 ...	M. M.	F.	24	Yes	Yes	+	Enteric fever.	Confirmed.	—	—

TABLE VIII.—(*continued.*)

No.	Initials.	Sex.	Age in Years.	Enteric Fever.			Diagnosis.		Bile Culture.	
				Suspected.	Found post mortem.	Widal.	Clinical.	Found post mortem.	Typhosus.	Others.
34 ...	B.	F.	21	No	No	...	Phthisis.	Liver abscesses, gall stone ulcerated into duodenum.	+	—
35 ...	K. C.	F.	20	Yes	Yes	+	Enteric fever.	Confirmed.	+	—
36 ...	J. S.	M.	21	No	No	...	Pernicious anæmia.	Gangrenous appendicitis.	—	—
37 ...	A. B.	F.	46	No	No	...	Lipoma left groin.	Richter's hernia strangulation.	—	—
38 ...	V. C.	M.	20	Yes	Yes	+	Enteric fever.	Confirmed.		—
39 ...	A. S.	F.	29	No	No	...	Pneumonia.	Tuberculous broncho-pneumonia.	—	—
40 ...	G. T.	M.	33	No	No	...	Extravasation of urine.	Confirmed.	—	Coli.
41 ...	E. G.	F.	12	Yes	No	+	Enteric fever.	Broncho-pneumonia ; ? typhoid.	—	—
42 ...	F. R.	M.	40	No	No	...	Epithelioma of penis.	Confirmed.	—	—
43 ...	M. B.	F.	14	Yes	Yes	Indefinite	Enteric fever.	„	+	—
44 ...	W. S.	M.	16	Yes	? Old pigmented Peyer's patches	+	„	Tuberculosis pleura, pericardium and bronchial glands.	—	—
45 ...	R. J.	M.	23	Yes	Yes	+	„	Confirmed.	+	—
46 ...	A. J.	F.	5	No	No	—	Meningitis.	Abscess of lung pyopneumothorax.	—	Streptococci.
47 ...	J. J.	M.	40	No	No	...	Phthisis.	Confirmed.	—	—
48 ...	A. F.	F.	20	Yes	Yes	+	Enteric fever.	„	—	—
49 ...	A. McM.	M.	7	No	No	...	Tuberculosis of lungs.	„	—	—
50 ...	V. H.	F.	15	Yes	Yes	+	Enteric fever.	„	+	—
51 ...	C. G.	M.	46	No	No	...	Stricture and chronic nephritis.	„	—	Coli and streptococcus.
52 ...	A. T.	M.	14	No	No	...	Dysentery.	„ (amœbic).	—	Streptococci.
53 ...	S. H.	F.	42	No	No	...	Carcinoma uterus.	„	—	—
54 ...	F. P.	M.	60	No	No	...	Cystitis.	With enlarged prostate.	—	—
55 ...	A. F.	F.	24	Yes	No	—	Enteritis.	Phthisis, and ankylostomiasis.	—	—
56 ...	J. M.	F.	17	Yes	Yes	—	Not made.	Typhoid ulcers, early stage.	+	—
57 ...	M. B.	F.	16	No	No	—	Double pneumonia.	Right pyosalpinx, septicæmia, embolic pulmonary abscesses.	—	—
58 ...	N. N.	F.	41	No	No	...	Sarcoma upper jaw.	Confirmed.	—	—
59 ...	J. S.	M.	?	No	No	...	Uræmia.	„ Contracted granular kidney.	—	—
60 ...	J. W.	M.	20	Yes	Yes	+	Enteric fever.	„	+	—
61 ...	A. D.	F.	15	No	No	...	Not made.	Tuberculosis, lungs and intestine.	—	—
62 ...	L. G.	M.	2¾	No	No	...	Enteritis.	Confirmed.	—	Sach's aërogenes.
63 ...	W. S.	F.	30	No	No	...	Intestinal obstruction.	Band from old appendicitis.	—	—
64 ...	J. B.	M.	10	Yes	Yes	+	Enteric fever.	Confirmed.	—	Coli only.
65 ...	J. D.	M.	64	No	No	...	Cellulitis of hand.	„ also mitral disease.	—	—

TABLE VIII.—(*continued*).

No.	Initials.	Sex.	Age in Years.	Enteric Fever.			Diagnosis.		Bile Culture.	
				Suspected.	Found post mort m.	Widal.	Clinica .	Found post mortem.	Typhosus.	Others.
66 ...	J. C.	M.	24	No	No	...	Acute pneumonia.	Confirmed.	—	Coli.
67 ...	R. J.	F.	11	Yes	Yes	+	Enteric fever.	,,	+	—
68 ...	Rh. T.	F.	19	Yes	Yes	...	,,	,,	—	—
69 ...	E. J.	F.	21	Yes	No	—	Not made.	General tuberculosis, lungs, peritoneum, pleura, liver, intestines.	—	Streptococci.
70 ...	E. B.	F.	22	No	No	...	Puerperal septicæmia.	Confirmed.	—	Streptococci and coli.
71 ...	A. McN.	M.	22	Yes	Yes	+	Enteric fever.	,,	—	—
72 ...	S. Y.	M.	40	No	No	...	Arsenic poisoning (suicide).	,,	—	—
73 ...	S. D.	M.	19	No	No	—	Lobar pneumonia.	,,	+	—
74 ...	A. C.	F.	30	Yes	No	—	Not made.	Colitis, ? dysenteric.	—	Coli.
75 ...	Not known	M.	?	No	No	...	,,	Cerebral hæmorrhage.	—	—
76 ...	J. B.	M.	40	No	No	...	Pneumonia.	Confirmed.	—	—
77 ...	J. S.	F.	19	No	No	...	Mitral disease and phthisis.	,,	—	—
78 ...	L. S.	F.	50	No	No	—	Not made.	Malignant endocarditis, embolic pyæmia.	—	—
79 ...	J. R.	M.	30	No	No	—	,,	Tuberculosis, lungs and serous membranes.	—	—
80 ...	M. W.	F.	19	Yes	No	—	,,	Tuberculous lobar pneumonia.	—	—
81 ...	F. J.	F.	23	No	No	...	Pyæmia.	Confirmed.	—	Streptococci.
82 ...	J. J.	F.	17	Yes	No	—	Not made.	Large pale kidney, ? uræmia.	—	—
83 ...	W. A.	M.	48	No	No	...	,,	Phthisis.	—	—
84 ...	W. S.	M.	19	Yes	No	?	Enteric fever.	,,	—	Coli.
85 ...	J. P.	M.	? 25	No	No	—	Not made.	Glioma, right hemisphere.	—	—
86 ...	A. R.	F.	38	Yes	No	—	? Enteric fever.	Cirrhosis of liver, chronic intestinal nephritis.	—	Coli.
87 ...	W. B.	M.	72	No	No	...	Gangrene, leg.	Confirmed.	—	—
88 ...	J. B. L.	M.	35	No	Yes	...	Cerebral hæmorrhage.	Enteric fever.	+	—
89 ...	M. L.	F.	38	No	No	...	Fibroid uterus.	Also phthisis, and old pleura effusion, left.	—	—
90 ...	J. W.	M.	52	No	No	...	Cerebral hæmorrhage.	Cerebellar tumour.	—	—
91 ...	A. McG.	F.	62	No	No	...	Malignant disease.	Carcinoma of uterus and peritoneum.	—	—
92 ...	P. L.	F.	42	No	No	...	Intestinal obstruction.	Volvulus.	—	Coli.
93 ...	C. E.	F.	? 22	No	No	...	Peritonitis.	Confirmed; perforation of malignant growth of jejunum.	—	Morgan.
94 ...	D. B.	M.	20	Yes	No	—	Enteric fever.	Dysentery.	—	—
95 ...	J. M.	F.	26	No	No	...	Not made.	Fibroids, and early pregnant uterus. (Death from hæmorrhage.)	—	Coli.
96 ...	C. V.	M.	27	No	No	...	General peritonitis.	Confirmed; perforated duodenal ulcer.	—	—
97 ...	H. W.	F.	37	No	No	...	Pleural effusion.	Malignant growth right lung and pleura.	—	—
98 ...	S. H.	M.	2	No	Yes	...	Not made.	Enteric fever.	+	—
99 ...	A. G.	F.	19	No	Yes	...	Pneumonia.	Confirmed, but also enteric fever.	+	—
100 ...	J. B.	F.	19	No	No	...	Cerebral malaria.	Tuberculosis, lungs and bronchial glands.	—	—