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YELLOW FEVER COMMISSION

(WEST AFRICA).

FIRST REPORT.

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FIRST REPORT

OF

THE YELLOW FEVER COMMISSION

(WEST AFRICA).

On January 27th, 1913, the undersigned, with Professor W. J. Simpson, C.M.G., M.D., had the honour to be appointed by the Secretary of State for the Colonies a Commission "to study the nature and relative frequency of the fevers occurring among Europeans, natives and others in West Africa, especially with regard to Yellow Fever and its minor manifestations."

2. In May, 1913, Professor Simpson was appointed by the Government to proceed to East Africa to advise as to the health conditions prevailing at Mombasa and in East Africa, and since that date the Commission have not had the advantage of his assistance.

3. The Commission is empowered to present reports, such reports to be submitted to the Advisory Medical and Sanitary Committee for Tropical Africa for transmission to the Secretary of State.

4. The Commission being of opinion that it is advisable that a report on certain matters connected with their work, so far as it has progressed, should be furnished, beg to present this their First Report.

5. The members of the Advisory Committee who subsequently were appointed as the Commission held two meetings, as a sub-committee, to draw up the necessary scheme and instructions for the work of the Commission, and their report, which was adopted by the Advisory Committee, forms Appendix I. (*a*) of this report.*

6. The Commission have held twenty-one meetings and have had interviews with eight members of the West African Medical Staff and six others whose knowledge appeared likely to be of service to the enquiry.

7. The Commission drew up a form which was sent to the West African Medical Staff and to medical practitioners in the various Colonies informing them of the object of the enquiry, and the problems before the Commission, and inviting their co-operation. (Appendix II.)

8. Cards for the record of cases of fever were also sent to the staff and to practitioners with directions as to procedure in the event of the occurrence of a case suspicious of Yellow Fever. (Appendix III.)

9. The Commission have appointed the persons whose names and qualifications for the work are set out in Appendix IV. as Investigators, and they are now, or have been, engaged in West Africa upon the work of the Commission at the centres mentioned therein.

10. The instructions which were given to the Investigators upon their appointment form Appendix V. of this report. Before leaving for West Africa they were in all cases interviewed by the Commission.

11. Dr. J. M. O'Brien, of the West African Medical Staff, upon his own initiative, has proceeded to Guayaquil, Ecuador, one of the chief endemic centres of Yellow Fever, to spend his leave there in the study of that disease. Dr. O'Brien's action has been approved by the Government of the Gold Coast and by the Commission, to whom he will report upon his return.

* The despatch from the Secretary of State to the Governors of the West African Administrations announcing the appointment of the Commission is printed as Appendix I. (*b*).

12. In the selection of the centres at which the Investigators were to work the Commission were influenced mainly by the distribution of the cases of Yellow Fever in the epidemics of 1910, 1911 and 1912, as if the virus of the disease lies latent between the outbreaks it was thought that evidence of its presence would most probably be discovered in such places.

13. As no cases of Yellow Fever had been reported from Southern Nigeria during those years, and as the Principal Medical Officer reported that no suspicious cases of fever had since occurred, no Investigators were at first sent to that Colony, but the Staff of the Medical Research Institute at Lagos were requested to receive and examine any reports and material and to act as the local centre of investigation.

14. Since then an unexpected epidemic of Yellow Fever has occurred at Lagos, where twenty-two cases have been locally diagnosed as such.

15. The staff of the Medical Research Institute at Lagos, with Investigators of the Commission, have observed many of these cases with great care, and their reports and the pathological material from these cases are now, with other reports and material from elsewhere, being examined by the Commission in London.

16. Cases of Yellow Fever have also been diagnosed since the work of the Commission commenced at the following places: Accra (10), Burutu (5), Forcados (1), Abokabi (1), Quittah (3), Abeokuta (5), Warri (2), Cape Coast (1), of which five in Europeans have proved fatal.

17. Scientific observations which, if confirmed, are of the highest importance have been made at Lagos, but the Commission, having regard to the serious responsibility attaching to any official announcement of the kind, unless supported by the strongest evidence, do not propose at this stage of their investigation to do more than mention the fact. The researches are being continued, and Dr. Harald Seidelin, one of the Investigators at Accra, has been ordered by telegram to proceed at once to Lagos and confer with the staff there. It may be mentioned that in 1909 Dr. Seidelin claimed to have

discovered the organism of Yellow Fever, a protozoon-like body which he named *Paraplasma flavigenum*, but the matter is still *sub judice*.

18. Although, as stated above, the Commission intend to exercise the greatest caution before accepting these and other results which the Investigators may claim to have obtained from their researches, they think it right to mention that it may be necessary to allow the Investigators on their own individual responsibility to announce the results of their work, as otherwise they may be forestalled by other observers (and they are many) belonging possibly to other nationalities, who are working at the problems of Yellow Fever. It is certain that such an occurrence would greatly dishearten them.

19. In 1910, when the attention of the Advisory Medical and Sanitary Committee was first drawn to the occurrence of Yellow Fever on the West Coast of Africa, the opinion was expressed that each appearance of the disease in the coast towns was due to its importation from an infected ship. A careful examination of all possible sources of infection of that nature was then made, but with negative results.

20. As regards the cases which have since occurred, no evidence of such a mode of importation has been forthcoming, and their wide distribution and the inland position of some of the centres of infection would tend to negative such a mode of origin.

21. The possibility of the virus being introduced from the interior has not been lost sight of, and maps of the trade routes and lines of native travel from the interior have been prepared and studied, but no evidence of such a mode of transmission has so far been elicited.

22. It is a matter of common knowledge that the late Sir Rubert Boyce, after his visit to the Coast in 1910 at the request of the Government, returned fully convinced that Yellow Fever is endemic in all the West African Colonies, irrespective of nationality, and that the partial immunity of the natives was acquired by infection in childhood and possibly again in later life. His views were thus stated :

> " Those living in a country where disease is endemic at a very early period in their life get an attack of the disease, which naturally confers a certain degree of immunity ; later they may get subsequent attacks, but each successive attack is less serious ;

when manhood is reached the subject is, in all probability, completely immune." (*British Medical Journal, December 3rd*, 1910).

and again :—

> " I maintain with the French, German, Brazilian, Cuban and American Investigators in Yellow Fever, that the only way endemic Yellow Fever is kept up is by means of the native residents of any country ; and that the way in which the fever becomes obviously manifest is by the breaking out of the disease in its severer or rarer form in the non-immune new arrival of any nationality, and the greater number of these the greater the chance." (*Memorandum for Advisory Medical and Sanitary Committee for Tropical Africa, 17th November*, 1910.)

23. The Commission are not, as the result of their investigations, in a position to affirm or deny the truth of the theory that the natives form the reservoir from which the virus of the disease is from time to time abstracted and distributed by the stegomyia mosquito. If the outcome of the researches which are now being carried on under their direction should be to provide a certain test of the presence of the disease, one of the many difficult problems which now surround the subject of Yellow Fever will be solved.

24. In the report of the sub-committee already referred to (Section 5), some of the problems before the Commission are stated ; of these the first is :—

> " The nature of the disease which during the years 1910-11 and 1912 has been locally diagnosed as Yellow Fever, and which has been the cause of a heavy case mortality."

Bearing in mind that accuracy of diagnosis is not at present possible, in the opinion of the Commission that disease was extremely probably Yellow Fever.

25. The second is stated thus :—

> " Was it probably the same disease which is recorded in literature under the name of Yellow Fever as having occurred from time to time in the West African Colonies ? "

In the opinion of the Commission the answer is " Yes."

26. The Commission are satisfied that of the cases which have been recently diagnosed at Lagos and elsewhere in West Africa as Yellow Fever a certain number were examples of that disease.

27. As already stated the Commission have obtained no evidence that since the epidemics of 1910-11 and 1912 the disease has been introduced into the Colonies from without.

28. The Commission observe from despatches recently received that the question of the necessity for quarantine for Yellow Fever has been raised. They are of opinion that, with the evidence at present before them on this point, it would be premature to recommend any alteration in the Quarantine Regulations now in force.

29. The Commission do not recommend any relaxation of the regulations as regards observation and removal of contacts and disinfection of dwellings which are now in force. They are of opinion that in dealing with Yellow Fever cases the destruction of the stegomyia mosquito, the screening of patients, and the segregation of the non-immunes are the measures upon which reliance should chiefly be placed.

30. In view of some of the evidence which has been given to them, the Commission conclude that the general measures for the reduction of stegomyia in the towns of the West African Colonies are still very defective, and would urge that this question should receive prompt consideration.

31. At the outset of the investigation the Commission recognised that further research on the nature of the virus of Pappataci fever (Sand-fly fever), a disease which, like Dengue, is closely allied in its manifestations to the milder form of Yellow Fever, might possibly throw light upon the nature of the virus of Yellow Fever, and they desire to thank the Trustees of the Beit Memorial Fellowships for Medical Research for undertaking to bear the cost of such a research. The Army Council kindly consented to Captain Marett, of the Royal Army Medical Corps, who has published valuable papers on the subject of Sand-fly fever, being posted to Malta, where the time not required for his official duties will be devoted to this research.

32. Although this is a first report, the Commission desire to place on record their appreciation of the cordial co-operation they have experienced in their work from the Governments of the various Colonies, the members of the West African Medical Staff, and the appointed Investigators.

33. They specially desire now to record their sense of the very valuable services rendered to them by Dr. T. F. G. Mayer, their Medical Secretary, as he is shortly vacating his appointment at the Colonial Office in order to resume his duties as a member of the West African Medical Staff.

JAMES KINGSTON FOWLER,
R. ROSS.
W. B. LEISHMAN.

7th *October*, 1913.

APPENDIX I. (a.)

Report of the Sub-Committee Appointed by the Advisory Medical and Sanitary Committee for Tropical Africa to Formulate Proposals for the Investigation of the Question of Yellow Fever in West Africa.

At the meeting of December 3rd, the Advisory Committee, on learning that Mr. Harcourt had approved the proposal to appoint a Commission to enquire "whether Yellow Fever exists in West Africa, and if so what is its relation to other fevers," decided to appoint the professional members of the Advisory Committee to be a Sub-Committee to draw up the necessary scheme and instructions, and to have powers to interview members of the West African Medical Staff and other persons; their recommendations to be laid before the main Committee for reconsideration.

The Sub-Committee have met twice. Sir Patrick Manson and Dr. Prout are out of England and Dr. Thomson is ill, and Professor Simpson was unavoidably absent on the first occasion; but with these exceptions all the members attended. Mr. Fiddian and Dr. Mayer acted as Secretaries. Mr. J. A. Pickels, M.B. (Senior Sanitary Officer, Southern Nigeria), was present during the latter part of the first meeting.

Commission.—The Sub-Committee recommend that the four professional members who are now available should be appointed to be the Commission for the purpose of the enquiry.

Powers of Commission.—The Commission should have power:—

(1) Subject to the approval of the Secretary of State, to appoint Investigators to proceed to West Africa or elsewhere; to fix the salaries, allowances, and conditions of service of such Investigators, and to determine their engagements.

(2) To hold interviews with members of the West African Medical Staff and other persons likely to be of assistance in the work of the Commission.

(3) To present reports, from time to time, and a final report; such reports to be submitted to the Advisory Medical and Sanitary Committee for Tropical Africa, for transmission to the Secretary of State.

Object of Enquiry.—They recommend that the object of the enquiry should be defined as "to study the nature and the relative frequency of the fevers occurring among Europeans, natives and others in West Africa, especially with regard to Yellow Fever and other non-malarial fevers in that country."

Problems for Investigators.—In the opinion of the Sub-Committee, the following are some of the problems to which the attention of those engaged in the work of the Commission in this country and elsewhere should be specially directed:—

1. The nature of the disease which during the years 1910-11-12 has been locally diagnosed as Yellow Fever, and which has been the cause of a heavy case mortality.

2. Was it probably the same disease which is recorded in literature under the name of Yellow Fever as having occurred from time to time in the West African Colonies?

3. If this disease was not Yellow Fever was it (*a*) some other recognised disease, or (*b*) a disease of unknown nature?

4. What fevers are known to occur at the present day in epidemic form amongst (*a*) Europeans, (*b*) other non-natives, (*c*) natives in West Africa?

5. What is the clinical course, probable pathology, and mode of infection, in such fevers?

6. What is the probable nature of the fevers which have been termed:—

(*a*) bilious remittent fever,
(*b*) malignant bilious remittent fever,
(*c*) inflammatory, endemial, or acclimatising fever,
(*d*) hyperpyrexial fever,
(*e*) three days' fever,
(*f*) seven days' fever,
(*g*) low fever,
(*h*) febricula?

7. How can these fevers be distinguished from—
   (*a*) Yellow Fever,
   (*b*) Malaria,
   (*c*) other known diseases?

8. Do the following diseases occur in West Africa? If so, to what extent; and are they likely to be mistaken for other diseases of a fatal or mild character :—
   (*a*) dengue fever,
   (*b*) pappataci fever,
   (*c*) typhus,
   (*d*) Rocky Mountain fever,
   (*e*) double continued fever,
   (*f*) typhoid,
   (*g*) paratyphoid,
   (*h*) undulant fever,
   (*i*) para-undulant fever and
   (*j*) cerebro-spinal fever.

9. What are the diseases to which may be attributed the large infant mortality rate amongst the natives?

10. Is there any evidence that some or any of these diseases confer immunity to Yellow Fever, either (*a*) temporary or (*b*) lasting?

11. Is there any evidence of—
   (*a*) racial immunity,
   (*b*) hereditary transmission of immunity?

12. What is the nature of the virus of Yellow Fever?

The Sub-Committee wish to make it plain that the foregoing is not a list of questions to which the Investigators will be expected to find answers, but merely an attempt to define and circumscribe the enquiry in detail.

Initial Plan of Work.—They suggest the following scheme of work :—

1. A study of the reports of the cases of "Yellow Fever" which have recently occurred in the West African Colonies, to be carried out by the members of the Commission in this country.

2. Investigators to be sent, as may be decided in the future, to various towns in West Africa to study the fevers on the spot, according to the following general directions :—

(*a*) To study the nature of all cases of fever, European or native, in the hospitals and dispensaries.

(*b*) To extend the enquiry, where practicable, to similar cases occurring among Europeans or natives outside the hospitals.

(*c*) To make a systematic local investigation of the fevers occurring among natives and others in selected places.

3. A letter to be sent by the Principal Medical Officer of each Colony to the officers of the West African Medical Staff, giving the following information :—

(*a*) Of the appointment and composition of the Commission.

(*b*) Of the problems before the Commission—i.e., the points to which attention should be specially directed.

(*c*) As to the duty of all Government Medical Officers to assist in every way the work of the Commission.

(*d*) As to the names and places of work of Investigators (if any) employed by the Commission in the particular Colony, to whom information is to be immediately sent of all cases occurring within their cognisance, of fever in Europeans and natives, which are not clearly due to ordinary malaria, trypanosomiasis, spirochætiasis, undulant fever, tuberculosis, hepatic abscess, and other well-known causes.

4. Forms for the clinical record of a case of fever to accompany the above letter, and instructions that they are to be used in all cases coming under paragraph (3) section (*d*) as above, whether such case has been notified to an Investigator or not. Forms when filled up, to be sent to the Principal Medical Officer.

5. A somewhat similar letter, with forms to be sent by the Principal Medical Officer to the medical officers of mining companies and private practitioners in each Colony, with the expression of a hope that they will give all possible assistance to the work of the Commission. Forms, when filled up, to be sent to the Principal Medical Officer.

6. Instructions to be given to those in charge of Government hospitals and laboratories that all possible assistance and accommodation are to be afforded to the Investigators of the Commission.

7. Instructions to be given to coroners and those in charge of mortuaries that the Investigators are to be allowed to attend autopsies and to take such material for study as they may require.

Initial Instructions to the Investigators in West Africa.—

1. *A. Pathological Investigations.*—To make an exhaustive diagnostic study of as many cases of fever as possible, by all the means, clinical, microscopic, bacteriological, and chemical at their disposal.

2. Such study to commence with cases in hospitals or dispensaries, and to be extended later, as time and opportunities allow, to outside cases.

3. When individual cases have been clearly shown to be due to ordinary malaria, typhoid, trypanosomiasis, spirochætiasis, undulant fever, tuberculosis, hepatic abscess, and other well-known causes, they need not be studied further, unless they show points of special importance to the investigation.

4. The closest possible attention must be paid to all cases of fever not coming under these headings; and the study of these should be continued daily by all possible means until recovery or death. They include all cases of what may be, or what may resemble, the following diseases :—

(*a*) Yellow fever.
(*b*) Pernicious malaria.
(*c*) Blackwater fever.
(*d*) Typhus.
(*e*) Rocky Mountain fever.
(*f*) Dengue.
(*g*) Seven-days' fever.
(*h*) Pappataci fever.
(*i*) Three-days' fever.

(*j*) Hyperpyrexial fever.
(*k*) Low fever.
(*l*) Double continued fever.
(*m*) Paratyphoid fever.
(*n*) Cerebro-spinal meningitis.
(*o*) Any obscure fevers which do not come under the previous headings.

5. The closest possible attention must also be paid to any pathological conditions which may at times simulate any of the above list of fevers, especially Yellow Fever; such as obscure septic lesions, nephritis, tuberculosis, hepatitis, &c.

6. The greatest care must be given to all cases which lead even to a remote suspicion of Yellow Fever. Minute records must be kept of the fever, the symptoms, and the microscopical, biological, and chemical examinations. The blood should be examined for malaria by thin film, thick film, and wet film, at least thrice a day, and stained specimens should be kept for future study even if no parasites have been found by the observer, and however much quinine has been previously given. Similar studies must be repeated at autopsies, and sufficient material must be retained for subsequent study. Parasite counts may be required.

7. The Investigators may be required to submit all their reports, permanent specimens, and pathological material for study in England.

B. Clinical Investigations.—See 4, 5 under preceding section (Initial plan of work). Specimen card annexed.

C. Epidemiological Investigations.—(To be deferred for consideration at a later period.)

7th January, 1913.

Card Summary of Clinical details of Fever Cases.

(It is suggested that these cards should be issued to all medical men practising in the suspected areas, with an invitation that they should co-operate with the Commission by filling them in, as far as possible, in connection with all cases of fever under their care.)

Name (or initials) of Patient *Race* *Age* *Sex*

Place *Date of attack*

Diagnosis *Result* (Recovery, improvement, death, &c.)

Character of fever

Duration in days *Relapses*

Summarised Temperature Chart

Day of Disease.

—	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30
106 ...																														
105 ...																														
104 ...																														
103 ...																														
102 ...																														
101 ...																														
100 ...																														
99 ...																														
98 ...																														
97 ...																														

Premonitory symptoms (e.g., pain, chill, rigor.)

General appearance (flushing, pallor, conjunctival injection, &c.)

(presence of jaundice and when it first appeared)

Gastric disturbance.—Nausea *Vomiting*

Character of Vomit *Pain*

Stools (frequency, special character of, &c.)

Pulse and Respiration. (Any special feature.)

Nervous System. (Excitement, depression, reflexes, &c.)

Urine.—Quantity *Albumen* *Casts*

Blood *Bile pigments*

Skin.—Rashes *Sweating*

Hæmorrhages

Blood examinations.—Parasites.—Malarial, Filarial, &c. (variety, numbers, frequency of examinations, &c.)

Agglutination *Blood culture*

History of bites by mosquitoes, ticks, &c.

Whether similar cases among family or neighbours

Autopsy (brief summary, if made)

(necessary material to be retained, if possible, for future study if required).

Signature of Medical Officer

Name of town,

district,

Colony,

in which the case occurred.

APPENDIX I. (b.)

THE SECRETARY OF STATE TO THE GOVERNORS OF THE WEST AFRICAN DEPENDENCIES.

DOWNING STREET, 11*th February*, 1913.

SIR,

In my despatch of the 7th February, 1911,* I had the honour to transmit to you copies of the report of the late Sir Rubert Boyce on his visit to West Africa in connection with the outbreak of Yellow Fever in 1910.

2. In the early part of that report Sir R. Boyce discussed the origin of the disease, expressing the opinion that it was endemic in some parts of British West Africa.

3. I informed you in my despatch that this opinion had been discussed in detail by the Advisory Medical and Sanitary Committee, as well as elsewhere, and that pending further investigation the Committee did not desire to express an opinion on the question. I then proceeded to suggest lines on which information might be accumulated with a view to throwing light on the disputed problem.

4. Since that despatch was written a good deal of further evidence has been submitted to the Committee, and they have had the advantage of discussing the matter in detail with medical officers from West Africa, and as the result they have recommended, and I have agreed to, the appointment of a Commission to enquire whether Yellow Fever exists in West Africa, and, if so, what its relation is to other fevers.

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* No. 4 in [Cd. 5581], March,

5. A Sub-Committee of the Advisory Committee has drawn up proposals for the conduct of this investigation, and their report, of which copies are enclosed, has been adopted by the Committee and has received my approval.

6. I have appointed the following medical men to be members of the Commission :—

Sir James Kingston Fowler, M.D., K.C.V.O., D.Sc., F.R.C.P. (Chairman) ;

Major Sir Ronald Ross, M.D., K.C.B., F.R.C.P., D.P.H., F.R.S. ;

Colonel Sir William Leishman, M.B., R.A.M.C., F.R.S. ;

Professor W. J. R. Simpson, M.D., C.M.G., F.R.C.P., D.P.H.

7. As will be observed from the report it is proposed that the fevers prevalent among the native population shall be the first object of study and that special Investigators should be appointed for the purpose ; and I understand that it is the intention of the Commission that certain specially trained medical men should be sent out from this country and others lent from the West African Medical Staff.

8. The lines on which the investigation will proceed are, I think, sufficiently clear from the report. It remains for me to discuss the question of ways and means.

9. It is naturally at present difficult to furnish more than a roughly approximate estimate of the cost of this investigation, but judging from experience of similar enquiries elsewhere and making allowance for the special expenses entailed by West African conditions, I think that the sum of £5,000 per annum will not be excessive.

10. The Crown Agents have been instructed to open a special account, to be known as the Yellow Fever (West Africa) Commission Account, to be financed in the first instance by advances from Gold Coast funds.

11. I expect to be in a position to inform you on or before August next what provision should be made in the estimates for the ensuing year for the share of the expenses of the Commission which will be properly chargeable to your administration.

12. I hardly think it necessary to dwell at any length upon the importance of the work which is to be assigned to the Commission.

The outbreak in the Gold Coast and Sierra Leone and at a somewhat later date in the Gambia of the disease which has been diagnosed as Yellow Fever and which was productive of so heavy a case mortality among Europeans, is sufficiently disquieting in itself; but regarded from the point of view of its influence on the economic development of West Africa it is a matter of the gravest concern.

13. The vital statistics of the European officials employed in West Africa, as recorded in this Department, are a sufficient indication of the fact that a steady attention to local sanitation and to personal hygiene, coupled with increased knowledge of tropical therapy, are bringing about a progressive decline in sickness and mortality among European residents. This result, which has been achieved in spite of the outbreak in question, must, in process of time impress the public mind with the fact that the evil reputation of West Africa from a health point of view is no longer deserved.

14. But the repeated occurrence of death from so well known and dreaded a cause as Yellow Fever is bound to have the opposite effect, as was indeed sufficiently manifest in 1910 at the time of the outbreak and subsequently. It is hardly necessary for me, I think, to indicate the ways in which the bad reputation of West Africa from a health point of view operates to restrict its progress and commercial prosperity.

15. I am aware that since the outbreak in Bathurst in 1911 admitted cases of Yellow Fever in British West Africa have been sporadic and confined to the Gold Coast. I cannot however attach much importance to this fact, and if Sir R. Boyce's view is correct it would be wrong to do so. I may point out, moreover, that during the last quarter of 1912 there has been a serious outbreak in Senegal.

16. There is moreover a broader aspect of the case which specially appeals to me. The West African Medical Staff was brought into existence primarily for the purpose of looking after the health of European officers, and members of the Staff are also allowed to engage in private practice, which must, in the nature of things, be mainly among Europeans. I should be slow, indeed, to depreciate the value of the services rendered by the Staff to the European community, and I am aware that a great deal of useful work is also done among the

natives ; but it has been borne in upon me from a perusal of the correspondence connected with the present question that it has not been found possible hitherto for any considerable degree of time and attention to be devoted to the scientific study of the fevers of various characters that are prevalent among the indigenous community.

17. It is difficult to blame anyone for this state of things ; the obstacles due to lack of opportunity for following up and studying individual cases, to the calls of work among Europeans, sanitary duties, and so on, may justifiably be pleaded in, at any rate, many cases. This makes it all the more desirable in my judgment that a systematic attempt should be made to carry out an investigation of the less known fevers affecting natives ; and the fact that this can be done as part of a scheme for enquiring into the cause of outbreaks primarily affecting Europeans is, in my opinion, a fortunate coincidence.

18. This investigation will require to be carried out on the spot by specially trained and specially qualified men set apart for the purpose ; but it cannot be too strongly emphasised that no considerable degree of success can be expected to reward their efforts unless the cordial and active co-operation of the medical men already practising in West Africa is secured. I do not mean merely the Government Medical Officers, who, of course, constitute the great majority of the local practitioners ; I hope that it will be found possible to enlist the assistance of all medical men employed in connection with the mines or missionary societies, of the Royal Army Medical Corps, and of qualified native practitioners.

19. For this purpose the cards of which the form is indicated in the enclosed report are being printed for distribution to all medical men in West Africa. I trust that you and your Principal Medical Officer will take such steps as may be possible to ensure the supply by this means of ample clinical records for examination by the Investigators.

20. I shall address you further at a later date with regard to questions of detail and organisation.

I have, &c.,

L. HARCOURT.

APPENDIX II.

CIRCULAR NOTICE TO THE WEST AFRICAN MEDICAL STAFF AND OTHER MEDICAL PRACTITIONERS.

YELLOW FEVER COMMISSION (WEST AFRICA), 1913.

The Secretary of State has appointed a Commission, under the above title. (The names of the Commissioners have already been given).

Object of the Enquiry.

The object of the enquiry is to study the nature and the relative frequency of the fevers occurring amongst the Europeans, natives and others in West Africa, especially with regard to Yellow Fever and its minor manifestations.

DIRECTIONS.

1. It is hoped that all members of the West African Medical Staff, and also the medical practitioners in the various Colonies, will assist in the work of the Commission by filling up the cards for the record of cases of fever in Europeans or natives.

2. The points to which in each case special attention should be given are sufficiently indicated by the headings upon the cards.

3. When individual cases have been clearly shown to be due to ordinary malaria, trypanosomiasis, spirochætiasis, tuberculosis, hepatic abscess, and other well-known causes, they need not be recorded unless they show points of special importance to the investigation.

4. The closest possible attention should be paid to all cases of fever not coming under these headings, and particularly to the signs and symptoms attending the onset of the attack.

NOTE.—It must be borne in mind that obscure septic lesions, nephritis, tuberculosis and hepatitis are conditions which may simulate one or other of the fevers mentioned.

5. The greatest care should be given to all cases which lead even to a remote suspicion of Yellow Fever, and every available method of blood examination, whether by thin film, thick film, or wet film, should be used in order to determine that the case is not one of malaria.

If no parasites are found, stained specimens may nevertheless prove useful for future study, even if quinine has been previously given.

6. Pathological material from cases of interest should also be preserved.

7. In the event of the occurrence of a case suspicious of Yellow Fever or of a group of cases of fever presenting similar characteristics, every effort should be made to communicate the fact to any Investigator appointed by the Commission who may be within reach in order that he may, if possible, either see the cases or suggest points for special investigation.

8. The completed cards, together with clearly labelled blood films and pathological material from individual cases, should be sent to the following officers in the various Colonies :—

GAMBIA : Senior Medical Officer.

SIERRA LEONE : Senior Medical Officer.

GOLD COAST : (Ashanti, Northern Territories, and Western Province of Colony) Senior Medical Officer at Sekondi ; (Central and Eastern Provinces) Senior Medical Officer at Accra.

NORTHERN NIGERIA : } Director, Medical Research Institute,
SOUTHERN NIGERIA : } Yaba, Lagos.

COLONIAL OFFICE,
19th March, 1913.

APPENDIX III.

Case Card, Case Book Form* and Form for Recording the Results of Post-mortem, Bacteriological and Microscopical Examinations.

* The arrangement of the "Case Book Form" is exactly similar to that of the "Case Card," except that it is printed on paper approximating to foolscap size, and more space is allowed for filling in the details.

CASE CARD.

To be left blank.

Name (*or initials*) of Patient_____

Race_____ Tribe_____

Age_____ Sex_____

Place_____ Date of attack_____ Diagnosis_____

Result (*Recovery, improvement, death, &c.*)_____ Character of fever_____

Duration in days_____ Relapses_____

SUMMARISED TEMPERATURE CHART.

DAY OF DISEASE.

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30
106																														
105																														
104																														
103																														
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98																														
97																														

PREMONITORY SYMPTOMS (e.g., *pains, chill, rigor, frontal headache*).

GENERAL APPEARANCE (*flushing, pallor, conjunctival injection, &c.*

Jaundice *and when it first appeared* :—

DIGESTIVE SYSTEM. Tongue

Epigastric tenderness

Nausea

Vomiting—character of Vomit

Stools (*frequency, any special character*)

PULSE AND RESPIRATION (*any special features, Faget's sign*).

NERVOUS SYSTEM (*Excitement, Depression, Reflexes*).

URINE. Quantity Albumen

Blood Casts

Bile Pigment

SKIN (*Rashes, Sweating, &c.*)

HÆMORRHAGES (*including condition of gums*).

BLOOD EXAMINATIONS.

Malaria parasites (*variety, numbers, frequency of Exams.*)

Other parasites

Leucocyte count

Agglutination

Blood Culture

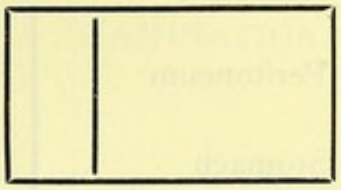
HISTORY OF BITES BY MOSQUITOES, TICKS, &C.

WHETHER SIMILAR CASES AMONG FAMILY OR NEIGHBOURS.

AUTOPSY. Brief summary, if made.
(*Necessary material to be retained, if possible, for future study*).

Signature of M. O.

POST MORTEM RECORD.



Skin	*Colour, hypostatic or other conjestion, petechiæ, ecchymoses or purpuric spots, rashes, scars, ulcers, &c.*
General nutrition and development	
Rigor mortis ...	*Any staining or pigmentation of subcutaneous tissues.*
Brain	
Spinal Cord ...	
Membranes .	
Heart	*Weight, condition of muscle and valves.*
Large vessels ...	
Lungs : R. ...	
„ L. ...	
Pleuræ	
Larynx, Trachea, and Bronchi.	

Peritoneum ...	
Stomach ...	*Walls, vessels, mucous membrane, contents.*
Small Intestine...	*Do. do. do.*
Large Intestine...	*Do. do. do.*
Helminths ...	
Liver	*Colour, Weight, consistence, &c.*
Gall Bladder ...	*Contents, &c.*
Pancreas ...	
Spleen	*Weight, colour, consistence, pigmentation.*
Kidneys : R. ...	*Weight, size, capsule, hæmorrhages.*
„ L. ...	
Suprarenal capsules	
Lymphatic system	
Bladder	*Contents.*
Ovaries	*Hæmorrhages.*
Uterus and Fallopian Tubes	

BACTERIOLOGICAL AND MICROSCOPICAL EXAMINATION.

Cultures .. ...

Heart's blood.

Spleen.

Gall bladder.

(Cultivations of the above are desired in all cases where practicable; also from other sites if suggested by the nature of the case.

Microscopical ..

1. *Smear preparations from the following organs, with special reference to the occurrence of bacteria or parasites :—*

   (a) Spleen;

   (b) Liver;

   (c) Mesenteric glands;

   (d) Bone marrow;

   (e) Any other organ or tissue which appears to be abnormal.

2. *Histological examination of sections from the following organs :—*

   Liver.

   Spleen.

   Kidney.

   Any other organ or tissue which appears to be abnormal.

3. *Examination of urine (only necessary in the absence of records of examination during life).*

   (1.) Albumen.

   (2.) Bile Pigments.

POST MORTEM DIAGNOSIS AND GENERAL CONCLUSIONS.

APPENDIX IV.

NAMES AND QUALIFICATIONS OF THE INVESTIGATORS APPOINTED BY THE YELLOW FEVER COMMISSION (WEST AFRICA).

AT FREETOWN, SIERRA LEONE:

Major J. C. B. Statham, R.A.M.C., M.R.C.S. (Eng.); L.R.C.P., (Lond.), D.P.H., R.C.P.S. (Eng.); Sanitary Officer, Sierra Leone Command. Major Statham resigned his position as Investigator shortly after his appointment, but continued to do similar work, and to collaborate with Dr. Butler in a private capacity.

G. G. Butler, M.A., M.B., B.C. (Cantab.), M.R.C.S. (Eng.), L.R.C.P. (Lond.); W.A.M.S. (Sierra Leone).

AT SEKONDI, GOLD COAST:—

H. S. Coghill, M.B., Ch.B. (Edin.), D.T.M. & H. (Cantab.); W.A.M.S. (Assistant at the Medical Research Institute, Yaba, Southern Nigeria), late Demonstrator, London School of Tropical Medicine.

H. M. Hänschell, M.R.C.S. (Eng.), L.R.C.P. (Lond.), D.T.M. (Liverpool); late Senior Demonstrator, London School of Tropical Medicine; W.A.M.S. (Gold Coast).

AT ACCRA, GOLD COAST:—

G. E. H. Le Fanu, M.B., C.M. (Aberdeen), D.T.M. (Liverpool); W.A.M.S. (Gold Coast).

Harald Seidelin, M.D. (Copenhagen); Director, Yellow Fever Bureau, Liverpool; late Professor of Pathology and Bacteriology at the Medical School, and Director of Laboratories of the Hospital at O'Horan, Meriba, Yucatan, Mexico.

A. Hutton, M.B., Ch.B. (Aberdeen), D.T.M. & H. (Cantab.); late Demonstrator at the London School of Tropical Medicine; W.A.M.S. (Southern Nigeria).

AT LAGOS, SOUTHERN NIGERIA:—

*T. M. R. Leonard, L.R.C.S., L.R.C.P. (Edin.), L.F.P.S. (Glas.); W.A.M.S. (Southern Nigeria).

*J. W. S. Macfie, B.A. (Cantab.), M.B., Ch.B. (Edin.), D.T.M. (Liverpool), Acting Director, Medical Research Institute, Yaba, Southern Nigeria; W.A.M.S. (Northern Nigeria).

*E. J. Wyler, M.D., B.S. (Lond.), M.R.C.S. (Eng.), L.R.C.P. (Lond.), W.A.M.S. (Southern Nigeria).

*J. E. L. Johnston, M.B., B.S. (Lond.), M.R.C.S. (Eng.), L.R.C.P. (Lond.), D.T.M. & H. (Cantab.), Acting Assistant, Medical Research Institute, Yaba, Southern Nigeria; W.A.M.S. (Northern Nigeria).

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* No definite appointments as Investigators were made at Lagos, but these officers assisted in the work of investigation on and after the outbreak of the disease in May, and Dr. Seidelin proceeded from Accra to Lagos on the 26th September.

APPENDIX V.

YELLOW FEVER COMMISSION (WEST AFRICA), 1913.

INSTRUCTIONS TO INVESTIGATORS.

The objects of the enquiry and the problems before the Commission have already been sufficiently stated in Appendix I. (a), p. 9.

General Scheme of Work.

1. Investigators to be sent to various towns in West Africa to study the fevers on the spot, according to the following general directions:—

(*a*) To study the nature of all cases of fever, European or native, in the hospitals and dispensaries.

(*b*) To extend the enquiry, where practicable, to similar cases occurring among Europeans or natives outside the hospitals.

(*c*) To make a systematic local investigation of the fevers occurring among natives and others in selected places.

(*d*) To undertake special investigations, the nature of which will be dependent upon indications afforded by the work as it proceeds.

2. Cards to be used in recording the details of cases of fever have been issued to all members of the West African Medical Staff and to all medical practitioners in the various Colonies.

3. Instructions have been given to those in charge of Government hospitals and laboratories that all possible assistance and accommodation are to be afforded to the investigators of the Commission.

4 Instructions have been given to coroners and those in charge of mortuaries that the investigators are to be allowed to attend autopsies, and to take such material for study as they may require.

Clinical and Pathological Investigations.

1. Investigators are desired to make an exhaustive diagnostic study of as many cases of fever as possible, by all the means—clinical microscopic, bacteriological, and chemical—at their disposal.

2. Such study to commence with cases in hospitals or dispensaries, and to be extended later, as time and opportunities allow, to outside cases.

3. When individual cases have been clearly shown to be due to ordinary malaria, typhoid, trypanosomiasis, spirochætiasis, undulant fever, tuberculosis, hepatic abscess, and other well-known causes, they need not be studied further, unless they show points of special importance to the investigation.

4. The closest possible attention must be paid to all cases of fever not coming under these headings; and the study of such cases should be continued daily by all possible means until recovery or death.

NOTE.—It must be borne in mind that obscure septic lesions, nephritis, tuberculosis and hepatitis are conditions which may at times simulate one or other of the fevers mentioned.

5. The greatest care must be given to all cases which lead even to a remote suspicion of Yellow Fever. Minute records must be kept of the fever, the symptoms, and the microscopical, biological, and chemical examinations. The blood should be examined for malaria by thin film, thick film, and wet film, at least thrice a day, and stained specimens should be kept for future study even if no parasites have been found by the observer, and however much quinine has been previously given. Similar studies must be repeated at autopsies, and sufficient material must be retained for subsequent study.

The Investigators will not be at liberty to make any communication to the Press or to publish any reports on their work except through the Commission.

7. The Investigators may be required to submit all their permanent specimens and pathological material for study in England.

METHOD OF DEALING WITH CLINICAL RECORDS AND CASE-CARDS.

1. Cases in which the Investigator is unable to make a definite diagnosis should be classified separately as "doubtful," and especial care taken to obtain as full details as possible.

2. As the records of these doubtful cases accumulate the Investigator should endeavour to separate them into groups, and should try to refer later cases to one of these groups.

3. All the case-cards will be seen by the Investigators to whom they are allotted before being sent to London. As these cards come in they should be studied closely with a view to identify cases as belonging to one or other of the groups into which the doubtful cases have been divided or as possible cases of any of the fevers mentioned in paragraphs 3 and 4 (page 1).

4. When sufficient evidence in connexion with a group of cases of undetermined nature is forthcoming in the view either of the Investigators or the Commission, a special research will be organised.

5. Investigators who may observe any indications of importance, either in the course of their own work or from a study of the case-cards, should communicate them to Investigators working in other Colonies and also to the Commission in London.

COLONIAL OFFICE,
19th March, 1913.

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1914.

YELLOW FEVER COMMISSION

(WEST AFRICA).

SECOND REPORT.

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SECOND REPORT

OF

THE YELLOW FEVER COMMISSION

(WEST AFRICA).

In their First Report the Commission reviewed briefly the circumstances which led to their appointment and the steps which they had taken to organise the enquiry which they have been instructed to carry out.

2. Since their appointment the Commission have held forty-nine ordinary meetings and four laboratory meetings, for the examination of microscopical and other specimens, and have had interviews with forty-two persons whose knowledge on various subjects might prove useful in the research upon which they are engaged.

3. The Commission desire to express their acknowledgment to Surgeon-General Gorgas, formerly Chief of the Sanitary Department, Panama, for kindly attending one of their meetings and placing at their disposal his great experience of the administrative measures necessary in dealing with Yellow Fever. Surgeon-General Gorgas was accompanied by Dr. Darling, the Pathologist of the Colon Hospital,

who possesses an exceptional knowledge of the morbid anatomy and histology of the disease.

4. The epidemic of Yellow Fever which was in progress at Lagos at the date of their last report has not yet completely died out, and cases have also been reported from the following places: Lagos, Ebute Metta, Warri, Forcados, Burutu, Onitsha and Calabar in Nigeria; Accra, Quittah and Saltpond in the Gold Coast; Kintampo and Ayinam (near Obuasi) in Ashanti; Bole* and Tumu in the Northern Territories: Boia in Sierra Leone.

The total number of cases to May 31st, 1914, is seventy. Of these 41 occurred in Europeans, including 4 in Syrians, and 29 in natives. Twenty-one cases amongst Europeans § and one case amongst natives proved fatal.

5. Reports have been received from time to time from the Investigators appointed by the Commission who have been working chiefly at Freetown, Accra, Seccondee and Lagos. Special investigations have been carried out by them and also by other Members of the West African Medical Staff, into the possible mode of origin and the clinical features of the cases which have occurred at a distance from those centres of work. Two officers of the West African Medical Staff in succession have suffered from Yellow Fever at Bole, in the Northern Territories of the Gold Coast, but fortunately both cases ended in recovery. A fatal case in a European Officer has occurred at Tumu, close to the northern boundary of the Northern Territories, a distance of more than 430 miles in a direct line from the coast.

6. At Lagos a prolonged research has been conducted by Dr. J. W. Scott Macfie and Dr. J. E. L. Johnston of the West African Medical Staff, on the occurrence and significance of the bodies with which the name of Dr. Harald Seidelin is associated. Dr. Seidelin, who is one of the Investigators appointed by the Commission, was transferred from Accra to Lagos in order that he might have further opportunities of research on this subject of the enquiry, upon which the Commission reserve their opinion until the issue of

* Cases from Bole were notified previous to the date of the first report of the Commission, but were not included in the list of localities given in paragraph 16 of that report.

§ Three of these cases were Syrians.

their Third Report, by which time they will have completed the examination of the microscopical and other material which they have received, illustrating the appearances presented by the "Seidelin bodies" and their possible connection with the virus of Yellow Fever.

7. In accordance with their instructions the Investigators have examined a very large number of patients presenting symptoms of fever, with the view of determining the nature of the fevers prevalent amongst the Europeans and natives; this forms an important part of the enquiry upon which the Commission is engaged.

The classification of these cases, and also of those locally diagnosed as Yellow Fever, upon the basis adopted by the Commission is well advanced.

8. Pathological and microscopical material from the cases at Lagos and elsewhere has been examined and reported on by Members of the Commission, and by others to whom some of the work has been delegated.

9. Maps have been prepared showing the trade routes from the interior into the various colonies, as it is possible that along such lines of travel Yellow Fever may be brought into the British Colonies. A more complete examination is contemplated of the shipping (including the small craft and canoes) engaged in the coastwise trade, with regard to the possibilities of mosquito transference, where such a measure is possible.

10. The Commission desire to acknowledge the loyal support which they have received from all the Members of the West African Medical Staff, and specially to thank those who have been engaged upon such of the enquiries as are already completed.

11. The Investigators appointed by the Commission have devoted all their energies to the work entrusted to them and have furnished a number of valuable reports, which it is intended to publish separately, in order to preserve a complete record of the researches which have been undertaken by the Commission.

A list of these reports will be found in Appendix III.

12. Having given the above brief report of the progress of their work, the Commission now propose to consider certain questions of a preliminary character which are closely associated with the main object of their enquiry.

These are as follows :—

(A) An Historical Retrospect of the occurrence of Yellow Fever.

(1.) On the West Coast of Africa as a whole.

(2.) In the ships of the British Navy on the West African Station.

(3.) In each Colony, whether British or Foreign, on the West African Coast.

(4.) Health conditions in the West African Colonies in 1862.

(5.) An Analysis of the West African epidemics of 1910, 1911 and 1912.

(B) A consideration of the question of Racial Immunity to Yellow Fever and of the Clinical Types of that disease, as observed in whites and in coloured people.

(C) Yellow Fever in Childhood and early life.

(*D*) A Tabular Statement of the occurrence, as reported, of Yellow Fever in the various West African Colonies and Settlements from the year 1900 to April, 1914.

(*E*) General Conclusions.

(*A*)—AN HISTORICAL RETROSPECT OF THE OCCURRENCE OF YELLOW FEVER.

(1) ON THE WEST COAST OF AFRICA AS A WHOLE.

A knowledge of the history of the West Coast of Africa as regards Yellow Fever is almost essential to a right understanding of the epidemics of the last four years (1910-1913) and conclusively proves that the recent experience is but a repetition of that of the past which, owing to a fortunate freedom from serious outbreaks amongst Europeans for a long period, had been forgotten and had almost been replaced by a belief that Yellow Fever did not occur on the West Coast of Africa.

African Origin of Yellow Fever.

It would not, in the opinion of the Commission, serve any useful purpose to discuss the arguments which have been adduced to prove that Yellow Fever originated in Africa. Those who are interested in the question may be referred to the "History of Yellow Fever," by Augustin (1909)*, where it is fully discussed, and the theory of the African origin of the disease is rejected.

It has, however, received the support of authorities whose opinions, at any rate upon clinical questions, are entitled to respect, as, for example, of Faget, who was the first to point out the absence of the relation between the temperature and the pulse usually observed in fevers, viz. a high temperature associated with a quick pulse, whereas in Yellow Fever a high temperature is often accompanied by a slow pulse (Faget's sign).

Also of Sternberg, whose treatment of Yellow Fever (Sternberg's mixture) reduced the mortality in 374 cases treated in the United States, Cuba and Brazil to 7·3 per cent.

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* (7) p. 100 *et seq.*

The weight of evidence, however, appears to be decidedly in favour of the view that the disease had its origin in the West Indies and in the countries bordering upon the Gulf of Mexico.

Endemicity of Yellow Fever.

Apart, however, from the question of its African origin, there is another and more important question, which is thus stated by Bérenger-Féraud,† who may be regarded as the leading French authority on the disease. "Which are the countries where Yellow Fever appears so often that one may consider it to be constantly present *(maladie habituelle)* ?"

His opinion (1909) is that in America the limits of the region in which Yellow Fever is constantly present are from Charleston (32° 46′ North latitude) to Rio de Janeiro (22° 54′ South latitude); in Africa from Goree (14° 53′ North latitude), or perhaps the mouth of the Gambia, to Saint Paul de Loanda, about 10° South latitude.

A further question which he proposes is, "What regions in the Yellow Fever Zone are to be considered as generators of the disease? In other terms, what countries breed Yellow Fever?"

On this point there is great diversity of opinion, which he does not profess to be able to harmonise. It is perhaps best to give his own words with regard to West Africa. "La fréquence de la fièvre jaune à la côte occidentale d'Afrique a fait dire à plusieurs auteurs que peut-être elle y était endémique. Moi-même, j'ai incliné vers cette opinion dans mon livre sur *La Fièvre Jaune au Sènègal* (1874, p. 150); tout en faisant la réserve qu'au moment où j'écrivais, les documents venus à ma connaissance étaient insuffisants pour me permettre de juger la question d'une manière certaine, ou même quelque peu probante.

"Cette question d'endémicité de la fièvre jaune à la côte occidentale d'Afrique m'a beaucoup préoccupé depuis une quinzaine d'années; je dois avouer que tour à tour mon esprit a incliné dans un sens ou dans l'autre, sans avoir, pendant bien longtemps, pu se fixer d'une manière absolue. Cependant j'ajouterai que, de jour en jour, à mesure

† (6) Traité Theorique et Clinique de la Fièvre Jaune. Paris, 1890, p. 206.

que les renseignements me sont venus plus nombreux, j'ai penché vers l'idée de la non-endémicité ; et je suis arrivé, meme, à croire fermement à cette non-endémicité."

It will be observed that the author is not considering the constant presence of the disease in West Africa, a question which he has decided in the affirmative in the previous paragraph, but whether it is a place where the germs of Yellow Fever are, as he explains later,* "evolved, that is where the disease is born, develops, gives rise to new germs and dies, just as animals and plants are born and die."

It is not in this sense that most of those who at the present time believe that the disease has obtained a permanent foothold in West Africa use the term "endemic" ; they do so to express the idea that it is there a "maladie habituelle." In spite of the confident opinion of Béranger-Féraud that such breeding places, apart from human beings or mosquitoes, must exist, one may venture to doubt it ; certainly they have not yet been located.

If the constant presence of Yellow Fever on the West Coast of Africa is admitted, the question at issue from an administrative point of view may almost be regarded as settled ; what of it remains can safely await the advance of medical science.

Date of the Appearance of Yellow Fever in Africa.

Yellow Fever may have been brought to the Canary Islands in 1494 by the Spanish vessels "which returned to Spain after having landed Don Bartolome Colon at Ysabella, San Domingo," and it is possible that the great pestilence which visited the Island of Teneriffe in 1495, which was believed to have been introduced in a similar manner, may have been Yellow Fever. The inference that "this epidemic was undoubtedly Yellow Fever" † appears to be founded on the fact that the adventurers who returned home were of a "sickly saffron colour," but this can hardly be accepted as conclusive.

It would serve no useful purpose to consider further the evidence in favour of the presence of Yellow Fever on the adjacent islands or on the mainland of the West African coast during the sixteenth and

* (6) p. 233. † (7) p. 180.

seventeenth centuries, as in no case is it sufficient to carry conviction. As might be expected the records belonging to the eighteenth century are more detailed, and we are not likely to be in error in accepting the statements of many writers that in 1778 Yellow Fever was present on African soil.

The reasons for this conclusion are :—

(1) That it affected various towns on the coast ;

(2) That it spread from one Colony to another along the coast, e.g., the Gold Coast is said to have infected Sierra Leone, which in its turn infected the Gambia. From the Gambia it spread to Goree in Senegal, and thence to St. Louis, also in Senegal ;

(3) That it occurred as an epidemic, deaths following each other at such intervals as are characteristic of Yellow Fever epidemics ;

(4) That the period of the year, viz. June to September, is that during which many of the considerable epidemics have occurred in the Colonies on the West Coast of Africa ;

(5) That before its appearance in Senegal (end of July), it is stated that the garrison and the inhabitants were for that time of the year remarkably healthy, yet in the beginning of August "a sudden and most dreadful disease broke out" ;

(6) That the disease although chiefly affecting the Europeans was not confined to them, but affected also the native mulattoes and blacks ;

(7) That relapses occurred in some of those who had recovered, and that some of these died "as late as November" ;

(8) That the disease was apparently new to the inhabitants of that region ;

(9) That on the arrival in the following year of a large number of non-immune soldiers from France the epidemic again broke out and caused at least 180 deaths amongst these men ;

(10) That the documentary evidence furnished by Schotte, the Surgeon-in-Chief of the British garrison at St. Louis in 1778, was considered at the time to be of such importance that it was translated by the author from the Latin original into English, and by others into French and German ;

(11) The evidence itself; of which the following is an extract from

"A TREATISE ON THE SYNOCHUS ATRABILIOSA,

"By J. P. SCHOTTE, M.D. *(London, 1782.)*

"A CONTAGIOUS FEVER WHICH RAGED AT SENEGAL IN THE YEAR 1778 AND PROVED FATAL TO THE GREATEST PART OF THE EUROPEANS AND TO A NUMBER OF THE NATIVES.

"PREFACE.

"The disease, which is the subject of the following sheets, does not happen annually at Senegal, but only in those years when the rains are extraordinarily frequent, heavy and of a long continuance. The common diseases of the country during moderate rainy seasons are intermitting and remitting bilious fevers and fluxes. The first of these generally yield to antimonials and bark and are not very fatal; but the latter are very stubborn and if they are not overcome in the beginning they generally carry off the patients.

"In proportion as the rains are heavier and more frequent, those diseases are more malignant and fatal. During the first rainy season that I resided there, viz. in the year 1775, when the rains were pretty heavy and frequent, many were seized with the bilious fever, which in some few were attended with very bad symptoms and might be called, from the yellow colour which it induced on the skin, Yellow Fever. The next year, viz. 1776, when we had but a few showers of rain, and they fell at intervals of many days; for which reason the season was remarkably favourable and passed over without occasioning any mortality. In the year 1777 the rains were not quite so heavy as in the year 1775, and therefore the fevers were milder; but in the year 1778 the rains set in early, they were frequent and heavy, and continued for a long time; in consequence of which the island became partly overflowed, and the very dreadful disease, of which I am about to treat, made its appearance. Mr. William Bishopp, who was at this time at the head of the medical establishment in the Province of Senegambia, and had been in the same capacity for many years past, had only seen it happen once before, viz. in the year 1766, when the rains were so heavy and frequent as to occasion the overflowing of the whole island, and to oblige the Europeans to go in canoes from one house to another. He says that it then raged with the same fury, and proved in proportion as fatal as it did at this time."

"In the month of July, 1778, the garrison and the inhabitants on the island of Senegal were, for that time of the year, remarkably healthy, from which favourable circumstances I was induced to hope that the approaching rainy season might pass over without causing much mortality. But my hopes were much frustrated when on a sudden a most dreadful disease broke out, which, raging from the beginning of August to about the middle of September following, carried off the greatest part of the Europeans, and a great number of the native mulattoes and blacks. The Europeans suffered much more by it, in proportion, than

the mulattoes, and those much more than the blacks. It ceased to rage about the 18th of September, and those who had escaped its fury were, as far as I know, not attacked with it after that day, but some of those who had recovered were seized with relapses during the following month, and some of them died as late as the month of November. Out of the number of ninety-two white people, which were on the island, when it broke out, thirty-three only were left when the French invested the island on the 28th January, 1779, and eight of those were hardly able to walk. * * * * * *

"The symptoms attending the disease were so horrid and dreadful that it seemed almost impossible that anyone could have a chance of recovering; and it was so very contagious that it spread all over the island with an amazing rapidity. Most patients died, on the fourth or fifth day; a few were carried off suddenly on the third, and some others not before the sixth or seventh day. Out of so small a number of Europeans as ninety-two, not less than four died on the 23rd of August, four on the 26th, three on the 27th, five on the 5th of September, and there was hardly a day between the 9th of August and 18th of September without one or two. Those who survived the seventh day, either recovered, or fell into lingering dysenteries. A constant and uninterrupted fever attended the disease, from the beginning to the end, in all those who died; and in some who recovered, no apyrexy took place before the seventh day, or later; in others sooner. This fever, therefore, having no intermission, and in most patients as far as I have been able to observe, no remission, cannot but be called a continued one. * * * * * *

"Most of those, who were seized with the disease, felt, just before it made its attack, a *langour** and a giddiness of the head. This was soon followed by a *rigor*, which in some was but slight, and in most patients did not last longer than a quarter of an hour; yet those, who were suddenly infected by contagion, felt no *langour*, but were soon attacked with *rigors*. * * * * * *

"They all complained of sickness and *nausea* at the stomach, and soon after threw up its contents, sometimes mixed with bile. Now the rigor subsided; the body became hot, and the face red. The pulse grew full and quick, but rather soft. * * * * * The eyes were red and shining, and seemed to project from their orbits. * * * * * * Most patients complained of a great headache, and of a pain in their back, particularly about the region of the loins, and sometimes in their arms and legs. They felt a most acute pain above and across their eyes, which often affected the sight. Notwithstanding the fullness of the pulse, there appeared in some a dejection and lowness of spirits, with a failure of strength; in others an anxiety, with deep fetched sighs, and most of them despaired of recovery. All complained of a load, pain and heat about the *præcordia*, but particularly about the pit of the stomach. The vomiting of yellow bile now took place, and was often repeated. This gave no relief to the patient, nor did the retching cease, though the stomach was quite evacuated, but a convulsive motion took place, and continued the retching, though nothing was thrown up. This caused a

*NOTE.–The words in italics are so in the original.

great thirst, which could not be quenched by any kind of liquid ; for whatever was drank was immediately rejected. The respiration was very laborious, and the expired air felt very hot to the bystanders. Some few did not vomit, nor had hardly any sickness at the stomach ; and were also suddenly seized with strong convulsions, and entirely deprived of all senses, throwing up in the meantime great quantities of a black matter which resembled the grounds of coffee, but was commonly coagulated in small lumps ; the first convulsive fit abating a little, another took place, and they died within a few hours, without recovering their senses. * * * * * * The skin was, in most patients, at first dry and felt very hot to the touch. In some it remained in this state for some days, but in others profuse sweats soon broke out, although the fever did not apparently abate. The urine was high coloured, sharp and small in quantity. * * * * * *

" The tongue was but little altered, though its borders were rather tumid and more red than natural, and the middle part of it was in some a little whitish. * * * * * *

" As the disease advanced, some of the above-mentioned symptoms abated, some grew worse, and others more dreadful acceded in some patients sooner, in others later. The tongue became furred, and changed its whitish colour in the middle for a yellow or brownish one, particularly towards the root, which might be partly owing to a tinge of the bile, continually thrown up. Though the pain of the head and back abated in some degree, in those who had any evacuations by stool, yet the weakness and dimness of the sight remained, to which deafness was often joined.

" The vomiting continued, and the bile which was before thrown up of a yellow colour, and in a liquid state, was now changed both in colour and substance. It became green, brown, and at last black, and was coagulated in small lumps.* * * * * *

" The pulse was now not so full as before, but quicker ; most patients complained of a burning heat within the pit of the stomach, attended with an unquenchable thirst. * * * * * * A deal of liquid blood came away with the fæces, which seemed to issue forth from the hæmorrhoidal vessels. * * * * * * When they made any urine, which was seldom the case, it was very high coloured. The skin was hot, mostly moist, and sometimes quite wet. The face became of a lurid colour. Some hawked up and spit blood, which seemed to me to come from the lungs, and others had small and frequent bleedings at the nose, without any relief. All of them were in some degree delirious, but those, who had a dry skin, were most so. The *singultus*, which began soon after the vomiting, became more and more frequent ; the pulse died away by degrees ; a groaning took place, and death ensued. Those who survived the third or fourth day were still afflicted with some new symptoms. The skin became now full of petechiæ ; they made their first appearance about the eyelids and on the wrists, and soon after on all the other parts of the body ; but the breast was generally most beset with them. * * * * * *

" The delirium was generally rather mild than violent. Some of the soldiers in the hospital, on being asked how they found themselves, would answer that they found themselves exceedingly well, and fit to do their duty ; in consequence of which some had dressed themselves, and

wanted a discharge from the hospital to go to the barracks, though they could not utter many words without being interrupted by hiccoughs; but they were easily persuaded to stay in the hospital till the next day which they seldom lived to see. * * * * * * If we reflect on the horrid symptoms attending the disease in the order I have related them it would almost seem impossible that any one of the patients could have recovered. But it is to be observed that all those symptoms did not accompany the disease in each individual patient, nor were those which attended it equally severe in every one of them, for which reason some got through it. But they were so very weak and emaciated, and remained so long in this state of debility that they were much subject to relapses. * * * * * *

"The diagnosis of the disease, so as to ascertain with exactitude the species to which it belongs, is difficult to be formed. In the beginning it is not to be distinguished from the fever which is called *bilious*, or from that one which goes by the name of *yellow fever*, but by the severity of its symptoms. For in those the symptoms are the same, but milder, and I am persuaded that our disease only differs in malignity from those fevers which I conceive to originate from the same causes, but proportionably less deleterious. In its progress it is not so difficult to be distinguished from them; for the bilious fever has generally intermissions, and the yellow one slight remissions; yet sometimes it happens, that the first of those continues in hot countries to the third day, before it intermits, and that the latter has hardly any remissions on the first days. I also believe the bilious fever to be contagious sometimes, but I have observed the yellow fever to be more so. The voiding of black bile upwards and downwards is almost the only symptom in which our disease differs from the yellow fever. The petechiæ, hæmorrhages and some other symptoms which do not attend the bilious, are common in the yellow fever. It is to be observed, that the petechiæ are less in number in the yellow fever than in our disease, and in proportion as the skin is more yellow the petechiæ are fewer. The skin being most of a lurid colour in the disease, I am describing, makes it differ also from the yellow fever. Some medical gentlemen have informed me, that the yellow fever was sometimes attended with the vomiting of black bile, but during a residence of four years at Senegal, I had many opportunities of seeing patients in this disease and never observed it; yet notwithstanding this I do not in the least doubt it, because I think the greatest affinity exists between our disease and the yellow fever, and I believe, as I have already said, that they only differ in the degree of malignity. The *diagnosis* was more easily formed after the disease had raged for some time. For when healthy and strong people, who either had been waiting on the sick, or visited them, were suddenly taken ill with a similarity of symptoms, it was easily conjectured that they had received the disease from contagion, and from thence it was probable, that all those who might be taken in the same manner, would labour under the same disease, and that it was contagious.

"To institute the *prognosis* was as difficult a task as to form a *diagnosis*. In the onset of the disease, the issue it would take could not be foretold. There were no true prognostics in the beginning, presaging death or life, except that one might guess from the severity of the symptoms that death would soon be the consequence. A slight *diarrhœa* with

a cessation of the vomiting and the *singultus* together with an abatement of the rest of the symptoms, followed by a gentle and general sweat, gave the best hopes for recovery. The vomiting of black bile was a certain sign of ensuing death. Not one, as far as I know, who had that symptom recovered, and I have little doubt but that a similar evacuation by stools was also a mortal sign, yet as it was always preceded by vomiting and never happened alone, I cannot so positively assert it."

In 1842 a Select Committee was appointed by the House of Commons "On the West Coast of Africa," and Appendix 21 of their Report contains the views of Dr. R. R. Madden, the Commissioner appointed by them to report on the "Climate of the West Coast and its Influence on Health," and on other matters.

In considering the Fever to which Europeans are subject in that region, he refers to "the greater intensity of the symptoms of common bilious remittent fever and the grade of it which goes by the name of Yellow Fever," and continues as follows: "It is impossible to read the descriptions of the post-mortem examinations in cases of seasoning fever which have taken place in Sierra Leone and not to perceive how identical the pathological appearances are in both degrees of bilious remittent fever."

Examples are then given of lesions typical of Yellow Fever found in such post-mortem examinations, and it is stated that "with the exception of the yellowness of the skin and the existence of black vomit, which are considered peculiar to Yellow Fever, but which in the majority of cases of it do not take place in that fever, the symptoms are similar, and I would defy any man to point out the difference between those cases of Yellow Fever as they exist in Cuba or Jamaica and those of African local fever as it exists on the West Coast. Of the identity of West Indian yellow fever and African local fever I have no doubt, my acquaintance with them has unfortunately been of too intimate and personal a kind to leave me in ignorance of the similar symptoms and character of both."

The foregoing evidence is, we think, sufficient to establish the fact that in 1778 Yellow Fever was to be found on African soil. It does not suggest that this was its first appearance in that region, nor does it offer an explanation as to how it got there. Such questions, although of great interest and suitable for discussion in a treatise on the history of Yellow Fever, are beyond the scope of this report.

The Difficulty of Diagnosis.

In order to realise the difficulty of accurate diagnosis in the cases of fever which came under the observation of the surgeons, it is necessary to recall the state of medical knowledge at the time, and the variety of the diseases which were to be met with on the West Coast of Africa. The diseases represented were probably somewhat as follows :—

1. A fever of prolonged duration characterised by abdominal symptoms, delirium, abdominal pain and vomiting (perforation and peritonitis), diarrhœa and hæmorrhage from the bowel. Typhoid or Enteric Fever.

2. A paroxysmal fever, not in the majority of cases of severe character, presenting more or less regular remissions at varying intervals. Malaria or Intermittent fever.

3. A fever having somewhat similar characteristics to that just mentioned but of a much more severe type, possibly accompanied by vomiting, jaundice and diarrhœa. Æstivo-autumnal malaria.

4. A fever of a very severe type and often terminating fatally, occurring either as a first attack or in a person subject to the less severe forms of intermittent fever. Restlessness, delirium, diarrhœa and hæmorrhages from the bowel and dysentric stools, vomiting, jaundice and coma might accompany this form of fever. Pernicious malaria.

5. The disease now known as Blackwater Fever, which was first so named in 1855.

6. Various irregular forms of fever due to malaria complicated with other infections.

7. A fever of sudden onset, with rigors or chills and severe frontal headache and pains in various parts of the body, and possibly later accompanied by jaundice and vomiting, in which a remission occurred after two or three days. Yellow Fever of a mild type.

8. A fever of a similar character, but of a much more severe type, occurring in epidemics specially affecting Europeans and new comers, usually accompanied by black vomit and often terminating fatally Yellow Fever.

9. Relapsing Fever, Typhus, Dengue, Epidemic Jaundice and other febrile diseases.

10. Cases in which Yellow Fever occurred in a person already the subject of malarial infection.

11. Cases in which the characteristics of these various fevers were obscured by acute or chronic alcoholism and especially by diseases of the liver, e.g., cirrhosis.

12. Cases of dysentery with various complications.

For the differentiation of these diseases few of the facilities now at hand were available. The clinical thermometer did not come into general use until about 1860; the importance of examining the urine for the presence of albumen was not made known until 1827, whilst blood examinations and differential leucocyte counts were of course unthought of.

It was not until 1848, when a circular was issued by the Director General of the Army Medical Department advising the use of quinine in large doses during the paroxysm of Intermittent Fever, instead of when it had subsided, that the full benefit of that drug in treatment was realised on the Coast.

This is well shown in the Annual Report from the Gold Coast for 1849.†

Nineteen cases of Seasoning or Remittent Fever occurred amongst newly arrived Europeans, of these six, who received no medical attendance, died; and thirteen, who were treated with large doses of quinine, all recovered. "In the most obstinate cases the fever was checked within twenty-four hours." This establishes the fact that the disease was malaria and not yellow fever.

In the Gold Coast report for 1851†† it is noted that the system of giving quinine in large doses during the hot stage had rendered the fever comparatively mild in its effects; and in that for 1852††† it is stated that "no person who had the advantage of medical aid has died of fever for four consecutive years."

† "Reports on the Past and Present State of Her Majesty's Colonial Possessions . . . for the year 1849," presented to Parliament in 1850 (page 95).

†† Presented to Parliament in 1852 (page 186).

††† Presented to Parliament in 1853 (page 198.)

This experience of the effect of quinine must have proved of great use in the differential diagnosis of the various fevers.

The non-identity of Typhus and Typhoid fevers was first established in Britain by Dr. Patrick Stewart (afterwards Physician to the Middlesex Hospital) in 1840, in a communication presented to the Medical Society of Paris, but it was not until ten years later that owing to the work of Sir William Jenner (1849–51) the differential diagnosis of these two fevers became generally known to medical men in Great Britain. Typhoid Fever was certainly one of the diseases to be met with in Sierra Leone in 1845, and it would necessarily not be distinguished from Typhus or probably from Relapsing Fever.

(II) "FEVER" IN THE SHIPS OF THE BRITISH NAVY ON THE WEST AFRICAN STATION.

Probably the most trustworthy evidence of the nature of the fevers prevailing on the West Coast of Africa in years past, is to be found in the records of the vessels of the British Navy on that Station. These ships were in frequent movement upon the coast watching the slave runners, a duty which often compelled them to send boats to the shore to lie hidden until the slave ship moved with her cargo; they were also often in port, especially in Sierra Leone, and almost without exception the fevers from which the crews suffered were brought from the shore, and very often indeed from Freetown, Sierra Leone. Sometimes, as will be apparent later, the ships became infected, when the mortality from fever was appalling.

James Lind (1716–1794), a surgeon in the Navy who had served on the Coast of Guinea and was later, from 1758–1794, Physician to Haslar Hospital, was the author of an "Essay on Diseases Incidental to Europeans in Hot Climates" (1778), and of other papers on medical subjects. He was an accurate observer, and his precepts and practice were obviously far in advance of the teaching of the time.

The regulations for the preservation of the health of seamen of the Navy on the West African station were drawn up by him and embodied his teaching and practice.

"Since the last edition of this Essay, the ships of war on the Guinea Station are ordered to be supplied, at the expense of the Government, with a large quantity of bark in powder, and of wine, to be issued occasionally to those who are sent in boats, up rivers, or on shore; and instructions have been given to the commanders of these ships not to permit any of their men to remain on shore after sunset; two circumstances strongly recommended in the course of this work, and which, if strictly adhered to, must prove of the greatest utility.

"At present the English Settlements, on the rivers Senegal and Gambia, are remarkably unhealthy; but otherwise, the northern, or what are called the windward parts of this coast, are the most healthy, especially in places or factories near the sea. Thus, the island of Goree, the town of Sierra Leone, the fort of Dixcove, Seccondee, Cape Coast, and all the English, Dutch and Danish ports on the Gold Coast are, comparatively speaking, healthier than the country to leeward of them." (p. 56.)

"I am informed by a surgeon who practised some years at Senegal, that for several months during the dry season the country was as healthy and pleasant as any in the world; but soon after the rainy season began, a low malignant fever constantly spread itself among the Europeans." (p. 59.)

"It seemed to proceed from a poison, as it were, got into the stomach, beginning with severe retchings and often with a vomiting of bile." (p. 56.)

"In some the fever was very malignant and the patient died soon after its attack, the corpse appearing of a yellow colour, and the skin stained with livid spots or blotches."

This was probably Yellow Fever.

"An inflammatory fever is seldom observed during the season of sickness in this part of the world. The Flux (dysentery) chiefly occurs at this time, though it may sometimes make its appearance at other seasons, and is a distemper very common, and often fatal to Europeans in Guinea." (p. 60.)

"The most mortal epidemic, however, is that low malignant fever of the remitting kind, which rages only in the rainy season."

"The following is an accurate description of this fever which raged on board the "Weasel" sloop of war, during the rainy season at Gambia, in August, 1769, taken from the journal of the ingenious Mr. Robertson, Surgeon of that ship":—

"*The symptoms are arranged according as the fever appeared in a more mild or more malignant form.*

"*In its mildest form it began with a headache, a sickness at the stomach, thirst, universal uneasiness and pain, especially in the back and*

loins. The pulse is small and quick, the skin hot and dry. In the morning these complaints were greatly relieved, in the evening exasperated, which happened through the whole course of the fever.

" About the third day the violence of the symptoms increased, the tongue now becomes white and foul, the speech weak and faltering, the thirst insatiable, the pulse soft and weaker than natural.

" On the fourth day the patients lose the sensation of taste, and towards the evening become very hot and restless.

" On the third night there was a gentle moisture on the skin, likewise on this night several had profuse sweats.

" On the fifth day the weakness is increased. Hitherto the patients had not been confined to bed in the daytime.

" On the sixth frightful dreams and an incipient delirium prevent them from sleeping.

" On the seventh they grow worse, their tongues are brown, dry and chapped, the delirium is increased, with restlessness and universal uneasiness.

" On the eighth the remissions and exasperations happen as usual.

" The ninth is the worst day ; in the morning they are cool, but the symptoms soon return with increased violence.

" Their pulse, since the sixth day, has been very irregular and in general weaker than natural.

" After this day there is a perfect remission of the fever, but towards night they become a little feverish till the seventeenth. The crisis of the fever is a gentle purging.

" In the more malignant form of the fever all the symptoms are more violent ; there is from the beginning a great prostration of strength and spirits, universal uneasiness, giddiness, violent retchings, a strong, quick, and sometimes a hard pulse, a white and dry tongue, sometimes a severe purging with gripes, at other times a bad cough, a violent pain and stricture over the eyes and costiveness.

" On the second day there is no alteration for the better.

" About the third day, in the morning, there is a small remission, but in the evening they again turn ill.

" On the fourth scarce any remission could be perceived.

" When a remission happened it did not last above three hours, the patients seemed a little cooler, but their thirst was not abated, and the palms of their hands and the soles of their feet glowed with heat. Anxiety, restlessness and frightful dreams prevent them from sleeping. Their memory begins to fail. The tongue in a few is white and furred, in most dry and chopped. Bilious vomitings and frequent loose fetid stools have attacked several, but those who were costive in the beginning still remain so.

" Fifth, in the night several were delirious ; the tongues of some are become black and the teeth furred.

" Sixth, in the morning a few of them had a small remission, but all had been very ill in the night. The pain of the back and loins, giddiness, and a pain at the bottom of the orbit of the eyes are still very troublesome.

" On the seventh the delirium is more general, and in some the countenance is quite yellow, a wild look, heat of urine (not from blisters), an inclination to vomit, and loose stools, are frequent this day.

" Eighth, a few after severe bilious vomitings and purgings, which stain like saffron, had purple blotches on the face and neck. In one patient a swelling of the parotid gland appeared. Delirium, stupor, cold sweats, convulsive tremors and catchings, twitchings of the tendons, and involuntary discharge of urine and fæces are frequent this day. The pulse is very irregular.

" Ninth, all the bad symptoms continued. The blotches rose above the skin, and soon disappeared; the patients thought themselves better, while they remained on the skin. A bleeding at the nose occurred in one of them, which also tinged yellow.

" Tenth, a few had a slight remission.

" Eleventh, the dangerous symptoms continued; a large effusion of blood under the skin appeared on one patient, on the right side of the face and neck, a little before his death.

" Thirteenth, their countenances were much more yellow, and they were seized with a purging, but not attended with gripes. One of them had a gentle and universal perspiration. He was afterwards cooler and his complaints were relieved. Among others, the bad symptoms still remained; one was seized with faintings.

" Fourteenth, the purging was attended with gripes; the patients continued cooler, but very weak, and the bad symptoms still prevailed, with the subsultus tendinum.

" Fifteenth, the bad symptoms continued; the swelling of the parotid gland in one patient was opened. Those who had the purging and yellow countenance were better: one had the piles.

" Sixteenth and seventeenth, all continued better except one man.

" Eighteenth, a man who, for two days, had appeared to be in a very dangerous state, fell into a sound sleep, followed by an equable perspiration, which proved a happy crisis.

" In one patient the fever continued till the twenty-first day, but it had been very mild during its whole course.

" As to the critical days and symptoms that were most dangerous in this fever.

" On the third day in the evening a perfect remission was procured in one case.

" In another case a remission of thirty hours was obtained on the fifth day in the morning; but the fever afterwards returned for twelve hours with increased violence.

" On the eighth day four died, and in one a swelling of the parotid gland formed. In the mildest state of the fever, an imperfect crisis happened on this day.

" One person died on the tenth, and on the eleventh, three.

" On the thirteenth one died, and many were seized with purgings, which proved a favourable crisis. In one, an equable perspiration broke out, which was succeeded on the fourteenth by a gentle purging, and proved salutary.

" On the fourteenth also another patient died, who had had bleedings at the nose, and blotches on the neck.

" On the fifteenth, the swelling of the parotid gland was ripe for opening.

" On the eighteenth, the unexpected crisis happened in a very dangerous case, by means of a sound sleep and free perspiration.

" Costiveness, frequent discharges of bile, both by stool and vomiting, bleedings from the nose, blotches, a brown, rough, and husky tongue, a smacking of the lips, wildness of the countenance and despondency of mind, were in every case mortal. A cough proved fatal in two cases out of three, which third was the remarkable case that came to a crisis on the eighteenth day. An involuntary discharge of urine and fæces, except in two cases, was also followed by death ; in the first case, there was a swelling of the parotid gland ; in the second, an unexpected crisis happened on the eighteenth day. A pain either over the eyes, or deep within the orbit, faintings, drinking greedily and in large draughts, were dangerous symptoms. Upon feeling the pulse, a disagreeable sensation always remained on the fingers, especially if there was moisture on the patient's skin ; but where the perspiration proved critical, this did not occur.

" Most of these patients were vomited and purged when first taken ill. The mortality of the fever, it is supposed, was greatly lessened by the ship leaving Gambia and being at sea. The captain, who was ill of it, took ten ounces of the bark. Hence we may in some measure judge how many pounds of that remedy would have been requisite in the case of thirty or forty such patients on board even a small ship and how far the allowance made to the surgeon for medicines was adequate to this expense."

This account, though lengthy, is given in full, as it is one of the best descriptions we have met with of a severe outbreak of fever on board ship at that period.

The sudden onset with headache, pains, vertigo, pains in the orbit, the bilious vomiting, the rapid occurrence of delirium ; the slight remission on the third day, the thirst, black tongue and sordes on the teeth, purple blotches on the face and neck ; parotitis, epistaxis, twitchings of the tendons, convulsive tremors, the appearance in one case of a large effusion of blood under the skin, and the mode and time of death, are all strongly suggestive of Yellow Fever and incompatible with any other known disease.

It is interesting to compare this account with that given of the outbreak of yellow fever on the " Bloodhound " in 1862 (*vide* p. 93). From the latter it is clear that undoubted cases of Yellow Fever may occur with others which the surgeon hesitates to describe as yellow fever. Also with the record of the cases of " Remittent Fever," and " Remittent Fever with suppression of urine," on board H.M.S. " Arrogant " in 1861, and the remarks of the Captain of the Port at Benguela (*vide* p. 96).

The " Report on the Pathology Therapeutics and General Aitiology of the epidemic of Yellow Fever which prevailed at Lisbon during the latter half of the year 1857 by Dr. Robert D. Lyons, late Pathologist-in-Chief in the Crimea," contains the most masterly

description of the disease in all its aspects which we have found anywhere. It is almost impossible to read of the infinite variety in which yellow fever may present itself in a single epidemic without becoming convinced that the disease which occurred in the "Weasel" was really Yellow Fever.

> "The clinical phenomena which characterise disease, whether endemic or epidemic, seldom observe a constant and invariable relation to each other. And hence it is that while in a given epidemic, in a given locality, at a given time, one set of phenomena will be prominent, if time, place or other circumstances be changed, the disease will present in salient relief another train of symptoms with perhaps a totally different clinical *cachet*, displaying another order of phenomena and being wanting in those which were described as all but essential to it in its former phase."

Chronological Account of Yellow Fever in the Ships of the Navy.

1823 to 1843.

Anyone who is desirous of realising the amount of suffering and loss of life amongst the men of the British Navy engaged on the West African coast in the suppression of the slave trade during the period covered by the above dates may be advised to read the "Report on the Climate and Principal Diseases of the African Station," by Alexander Bryson, M.D., Surgeon, R.N. (1847). It was prepared at the special request of the First Lord of the Admiralty from the official records, and is a page of history which no one, and least of all a medical man, can read unmoved. The devotion to duty of the Naval surgeons is beyond praise, but the medical treatment to which men seriously ill with "fever" were submitted was such as must have intensified their sufferings and deprived some of those who might possibly have survived if left to Nature, of any chance of recovery. The records shew that one surgeon after another learned that the pernicious teaching which he had received at home as to the proper treatment of "fever" was, at any rate, not applicable to the fevers of the West Coast of Africa; but before he had time to revise his methods by the light of experience, he was himself carried off by the disease and replaced by another fresh from "the schools."

Their "sheet-anchors" (appropriate term), were bleeding, often from the temporal artery, and the administration of mercury with the object of inducing ptyalism (salivation); the few who survived this treatment suffered terribly during convalescence from mercurial poisoning, with a horribly fœtid condition of the mouth and ulceration of the gums. The deadly nature of these fevers and the "heroic" treatment which was thought to be necessary have a very distinct bearing on the enquiry upon which the Commission is engaged. For the ordinary intermittent fever of the coast, as the following extract proves, quinine prophylaxis was as adequate then as it is to-day.

> "The 'North Star' arrived on the station from England in July, 1826, and whilst at Sierra Leone in August, the effects of the climate became manifest by the occurrence of a few cases of fever. On the 7th of the latter month twenty of the crew were employed in boats and on shore embarking provisions, they had wine and bark as directed by the public instructions with the exception of Lieutenant Boultbee, who conducted this service; he declined taking the prophylactic dose prescribed to the men and it is not a little singular that he was the only one of the whole party who suffered from fever. Several other cases of fever occurred both in this and the following month, but it is not stated whether the parties had been on shore or not: one proved fatal."(33 p. 218,219.)
>
> "The 'Hydra' subsequently, until November 1844, was employed pretty generally along the whole coast and continued healthy. During the latter month and December, fever however again made its appearance on board and seemed to assume two forms, 'one being mild and the other malignant'; the former was the more general, and occurred among men who had not been out of the ship, particularly amongst the stokers; the latter, few in number, occurred in the gig's crew, who were exposed to concentrated malaria for a period of forty-eight hours in the river Sherbro; of the four men, two had severe attacks, and one died; the third suffered to a less degree but had a lingering recovery; the fourth had feverish and dyspeptic symptoms for some days; the commander of the ship who was also in the boat being the only one of the party who escaped * * * * * * About the same time the pinnace and cutter were detached to watch the Turtle Islands, where they remained a fortnight; nevertheless not a man suffered in consequence. Bark and wine in the prescribed portions were sent with them and duly administered during the whole time. This is another instance wherein bark seems decidedly to have acted as a preventive of fever." (33, p. 167.)

It is possible, however, that there may have been infected Stegomyia in the river Sherbro and not near the Turtle Islands.

Constantly throughout this work a statement occurs of which the following is an example:—

> "The same ship (the 'Atholl') again suffered from fever after the rainy season, and a few days subsequently to her leaving Sierra Leone

where the men unfortunately had liberty to go on shore. They committed great irregularities to which the sickness was chiefly to be attributed. There were altogether forty cases of fever and three deaths." (p. 43.)

The years 1823 to 1825 were marked by a severe epidemic throughout the European settlements on the Coast, and a great influx of Europeans in consequence of the Ashantee war and a concentration of the squadron at Cape Coast Castle. This epidemic was almost certainly one of yellow fever, as "black vomit" is mentioned and all the typical symptoms of the disease as they were then known.

"The 'Bann' contracted the fearful scourge which swept off nearly one third of her crew in little more than two months at Sierra Leone." (33, p. 45.)

Other ships affected at the same time are mentioned and the following significant statement shews that in some ships the disease was Malaria, whilst in one other at least it was Yellow Fever.

"It however does not appear to have assumed a contagious form in any vessel but the 'Bann.' The total number of cases on board the 'Bann' was 99 and the mortality 34."

The fever was carried by the officers and crew of the "Bann" to the island of Ascension, where it caused an epidemic of yellow fever with 28 cases, and 15 deaths. The case of the "Bann" was warmly discussed at the time by those who favoured and those who opposed the theory of the specific and also of the contagious nature of yellow fever.

The following account of an outbreak of fever on the "Sybille" in 1827 is one of interest. The infection was apparently acquired at Fernando Po in June, 1827.

"The disease was evidently yellow fever and in the greatest degree of intensity. With two exceptions it was of the continued kind—the stage of excitement short. In the worst cases it terminated fatally between the third and sixth day, most frequently on the fifth. Death was preceded in a great number of cases by black vomit, often accompanied by a dingy or livid hue of countenance. Yellowness of the eyes and skin was very common before death, it varied from a pale lemon colour to a dark orange hue. An officer who died on the eleventh day of a relapse had previously suffered from yellow fever in the West Indies." (33, p. 53.)

The "Sybille" was again infected in January, 1830, at Princess Island from her tender, which had arrived from Sierra Leone, and had lost 23 of her crew from fever. In this outbreak there were 87 cases and 26 deaths, "with the usual symptoms of the most malignant

yellow fever." The fever broke out again in March at St. Helena, when there were 22 cases and six deaths. (33, p. 55.)

> "The disease throughout was considered by the surgeons as non-contagious, but by the officers and men as highly so. The Commodore, from humane motives, prohibited all Europeans, with the exception of himself and the medical officers, from visiting the sick. Dr. M'Kechnie mentions, 'that the frequent deaths produced such depressing effects, that at meal hours, when smoking was allowed, but more particularly in the evening, the men used to congregate together with despair depicted in their faces, to learn from one another who had gone to the doctor, or who was likely to die during the night.' The same gentleman has also kindly furnished the following incident, which deserves to be placed upon record :—
>
> "To dispel as much as possible the state of general mental depression, and to convince the officers and the ship's company that the disease was not contagious, Dr. M'Kinnal directed me to collect some black vomit from the first patient who was attacked with that fatal symptom : accordingly I collected about a pint of it from a man named Riley, I think, about two hours before he died. Shortly after this the doctor came up to the starboard side of the half deck, when I told him what I had done. He then went down to the gun-room, and about half-past twelve o'clock (the men being then at dinner), returned with a wine glass. Mr. Green, the officer of the forenoon watch, was then going below, when he called him over, and filling out a glassful of the black vomit, asked him if he would like to have some of it ; being answered in the negative, he then said, 'Very well, here is your health, Green,' and drank it off. There were no other persons actually present, but there were others on the deck at the time, and it became the theme of conversation all over the ship during the afternoon. Dr. M'Kinnal immediately afterwards went on the quarter-deck, and walked until two o'clock, to prevent its being supposed that he had resorted to any means of counteracting its effects. This took place in February, 1830, when the ship was cruising off Lagos, about one hundred and eighty miles from the land.
>
> "A more deliberate act of cool moral courage can hardly be conceived : but it is evident he had observed the fatal tendency of fear upon all around him. The sick being deprived of the kind offices and friendly consolation of their mess-mates, lost all hope of recovery from the moment they were seized : while the healthy, from brooding over the little probability they had of escaping, and from daily witnessing the mortal remains of some of their shipmates committed to the deep, were rendered peculiarly susceptible of the morbid poison, whether it were of a personal or of a local nature ; it was, therefore, above all things, desirable to restore confidence by some means or other, and there was certainly none so likely to produce that effect as the revolting measure Dr. M'Kinnal imposed upon himself. It is almost unnecessary to add, that it did not impair his appetite for dinner, nor did he suffer any inconvenience from it afterwards."

It was very natural that the officers and men should have regarded the disease as contagious ; whether it was so or not really mattered

very little to them, as it was certainly being conveyed from the sick to the healthy. Now, the explanation is of course simple, the ship was carrying infected Stegomyia. The name of the man whose act is here recorded deserves to be remembered.

The history of the "Eden" is of great interest, as it illustrates the effect of the administration of quinine in mitigating the severity of the attacks in a certain variety of fever, even when, as was at that period the practice, the drug was given only during a remission.

The "Eden" arrived at Sierra Leone on the 2nd of September, 1827, and sailed for Fernando Po on the 4th October. In April, 1828, whilst she was still at Fernando Po "fever became more general and six deaths resulted"; "the disease was contracted either at the hospital by the patients whilst under treatment or on shore by the carpenters and armourers employed there." "With regard to treatment it is observed that it varied from the practice followed on first arriving at Fernando Po and the results have been much more satisfactory, for latterly *two* out of three have recovered." Calomel was only given as a purgative, free bleeding was still employed and cold wet cloths were applied to the shaven head. * * * * * * "upon a marked remission being observed ten grains of the sulphate of quinine are immediately given. This in some cases has entirely prevented a return of fever and in others (the majority) rendered the disease milder and more manageable, smaller doses of quinine only increase the febrile symptoms." (33, p. 59.)

The fact that marked remissions occurred in some cases suggests that in such cases the disease was probably not yellow fever.

Between the 1st May, 1829, and the 1st December of that year the "Eden" lost 110 men, of whom 50 died on board and 50 on shore at Clarence Cove. Thirteen were natives of Africa, all the others were Europeans. (p. 64.)

The symptoms of this disease are described as follows:—

> "In some cases the symptoms in the stage of invasion were rapidly developed, in others more slowly and in an insidious manner. In the course of twelve or fourteen hours there was generally a remission of the symptoms, followed sooner or later by the next and last stage characterised by prostration of strength, remission of pain, the skin being covered with a clammy moisture or dry and below the normal temperature, pulse natural or flagging, or quick, small and weak: irritability of stomach, hiccough, yellowness of the eyes, frequent but ineffectual calls to stool and mental anxiety. As the disease advanced

> the debility increased; the eyes became more yellow, bloodshot and glassy; the skin also became of a yellow tinge and covered with a cold perspiration, with sordes on the teeth, chapped lips and hurried respiration, vomiting of black matter (black vomit), sometimes delirium and convulsions, at others coma and insensibilty to surrounding objects closed the scene. All the deaths occurred between the third and ninth day of the disease, but the majority on the fourth or fifth." (p. 66.)

A febrile disease accompanied by black vomit, usually ending fatally on the fourth or fifth day, could only, so far as is known, have been Yellow Fever. The words "black vomit" and the brackets are in the original.

Evidence such as that here given could be multiplied indefinitely, but as the object of this retrospect is only to prove, so far as is possible from the records, that in addition to pernicious or malignant malaria and various other diseases, Yellow Fever was present in the ships on the coast during these years, it is unnecessary to do so.

The following table gives the deaths from disease from 1825–1844 and the ratio of deaths per 1,000, from disease in the ships on the West African Station.

Date.	Deaths from disease.	Ratio of deaths from disease per 1,000 mean strength.	
1825	41	61·8	
1826	57	54·7	
1827	40	41·9	
1828	81	84·6	Eden, Hecla and Sybille (p. 92.)
1829	202	255·1	
1830	72	107·9	
1831	22	28·0	
1832	18	35·1	
1833	12	21·4	
1834	18	29·0	
1835	19	23·3	
1836	16	16·6	
1837	105	128·8	
1838	115	129·9	
1839	55	69·6	
1840	32	37·4	
1841	68	63·6	
1842	43	32·3	
1843	23	18·2	
1844	43	25·1	

Total deaths 1,082. Average ratio of deaths from disease per 1,000 seamen, 63·2.

1856.

"In a mean force of 1,680 men there were only seven deaths from fever"—"How are we to account for this improvement?" "By a wise and humane regulation the deadly practice of sending boats away on detached service to watch or intercept slavers has been interdicted."

"Prize crews are no longer turned adrift to wander through the streets of Sierra Leone; the orgies of 'The Barn' have ceased, and last, though not least, the introduction of quinine wine as a preventive of fever has not only reduced the number of febrile attacks but has lessened the severity of those that do occur, and thus the mortality has been reduced to a level which does not materially exceed the death rate from fever on some of the more healthy stations."

"There has been a great change in the medical treatment of febrile disease; the so-called active measures which were in vogue but a few years since have given place to others of a more rational character." . . . . "If these changes have had no effect in reducing the mortality they at all events have lessened the sufferings and misery entailed on patients who though they survived the fever lingered long in a state of debility from the effects of blood-letting and mercury." (33, p. 115.)

No deaths are returned from Yellow Fever in 1856.

1857 and 1858.

No deaths are returned from Yellow Fever in these years, but there are reports of some very suspicious cases on board the "Hecate" at Loanda in 1858.

1859.

One hundred and eleven cases of Yellow Fever with fifty-five deaths are reported from the squadron in this year. The infection occurred at Sierra Leone.

"It is much to be regretted that owing to the accidental introduction of Yellow Fever into one ship, the 'Trident,' more men were lost in two months from that fatal malady than during the three previous years in the whole squadron from all kinds of fevers."

The "Trident" was infected at Sierra Leone. The crew consisted of:—

Europeans	110	Cases 109. Deaths 44.
Africans	33	
	143	

1862.

The "Bloodhound" was infected in August at Benin. The ship was at Fernando Po from September 4th to the 10th, where the disease prevailed and had "carried off more than one-third of the entire purely Spanish population of the Island." Between September 15th and October 16th thirty cases of fever occurred on board, of which eleven were returned as Yellow Fever, with seven deaths. The medical officer states that only those were classed as Yellow Fever "in whom the symptoms were unmistakeable." They all died with black vomit.

The details of some of these cases and the complete medical history of the "Bloodhound" are given on p. 90 in the description of the epidemic of 1862.

1860 to 1863.

In 1860 there were three cases, all of which proved fatal. No cases are reported in 1861. In 1862 eleven cases occurred with seven deaths. In the year 1863 the squadron is said to have been free from Yellow Fever.

1864.

The history of this year is interesting. No Yellow Fever is returned, but two fatal cases with black vomit occurred on the "Hankey." The infection took place at Lagos, where "bilious fever was raging on shore, where out of forty-two Europeans twelve died in six weeks." The surgeon saw three cases on shore, "death took place in all three cases within 36 hours of the appearance of the disease. There existed intense prostration from the commencement, deep yellow skin and at last black vomit." The failure to recognize this "bilious fever" at Lagos as Yellow Fever may have been responsible for the occurrences of the following years.

1865.

Sixty-five cases of Yellow Fever appear in the returns of the squadron for 1865, of which thirty-four had a fatal termination.

1866.

In 1866 there were thirty cases of Yellow Fever, with twenty-five deaths.

The report for 1866 contains a synopsis by Assistant-Surgeon Fleetwood Buckle, R.N., of notes of forty cases of Yellow Fever in the epidemic of 1865–1866. The infection was acquired at Sierra Leone from the store-ship "Isis." The ships concerned were the "Bristol," the "Espoir" and the "Isis."

1867 to 1873.

Two fatal cases of Yellow Fever occurred in 1867, and one on the "Dido" at Fernando Po in 1871. In 1873 a seaman infected at Cape Coast Castle was landed moribund at Ascension.

1874 to 1912.

No case of Yellow Fever is reported in the returns of the Health of the Navy from the West African Station during these years.

This concludes the record of Yellow Fever in the ships of the West African Squadron up to the date of the appointment of the Commission.

Continued Fever, Remittent Fever, and Intermittent Fever in the Ships of the Navy on the West African Station.

1856 to 1867.

During these years it appears from the returns that 6,381 cases of "continued fever" and "remittent fever" occurred in the crews of the ships on the West African Station, of which 108 proved fatal. During the same period there were 1,464 cases of intermittent fever, with only

three deaths, one in each of the years '65, '66 and '77. Intermittent fever is a recognized synonym for malaria, but the nature of the diseases classed as "continued fever" and "remittent fever" and grouped as one, is by no means clear. That such a disease as malaria should be responsible for only three deaths in twelve years amongst crews often totalling 1,680 men is a very remarkable circumstance, and suggests an enquiry into the nature of the fevers termed "continued" and "remittent."

(III) YELLOW FEVER IN THE COLONIES, BOTH BRITISH AND FOREIGN, ON THE WEST COAST OF AFRICA.

We are now free to consider the history of the various Colonies on the West African Coast in relation to Yellow Fever. This subject has been dealt with at length by Augustin, Bérenger-Féraud, Boyce and other writers, but it cannot be omitted here, if it is true, as already suggested, that a knowledge of the past is necessary to a right understanding of the occurrence of the disease in the various Colonies in recent times.

In any attempt to determine whether a febrile disease, of which the diagnosis is often attended with great difficulty, has appeared in a certain region, it is necessary to set up an arbitrary standard and to accept no evidence as proof of its presence which does not attain to the degree of certainty afforded by its most severe manifestations. This plan has been adopted by the Commission in regard to individual cases, and the same standard and the same plan have been followed in dealing with the accounts of the epidemics reported to have occurred in the various Colonies.

It is most important to remember with regard to these accounts that in no single instance, so far as we have observed, do they

deal with an epidemic which was confined to the natives. It is the occurrence of cases of Yellow Fever amongst the whites which leads to a conviction that the disease is present, and as a rule the evil day of announcement is postponed as long as possible.

The records therefore which follow may possibly indicate the years in which the disease has been epidemic amongst the Europeans, but it can hardly be claimed that they constitute a full and true account of Yellow Fever in the Colonies on the West Coast of Africa.

The occurrence of epidemics confined to natives is considered in Section B of this Report. (*vide* p. 136.)

(*a*) SIERRA LEONE.

Sierra Leone has a most evil reputation as regards Yellow Fever during almost the whole of the nineteenth century; indeed it was probably involved in the epidemic of 1778, described by Schotte, of which an account has already been given (p. 9).

"Sierra Leone Fever" probably included a variety of diseases, but it is certain that one of them was Yellow Fever.

1807 to 1884.

There are two papers amongst the records of the Colonial Office of great importance, not only as regards Yellow Fever in Sierra Leone, but also, incidentally, as throwing light upon the whole subject of Yellow Fever, and the attitude towards it of the medical mind in West Africa at that date, viz.: a despatch from the Governor to the Secretary of State, dated 30th July, 1884, enclosing the report of a Medical Board ordered by the Governor to consider the question of the special unhealthiness of a certain quarter of Freetown, and the general prevalence of fever of a dangerous type.

The following extracts from these papers contain all that is relevant to the enquiry upon which the Commission is engaged :—

From the Governor to the Secretary of State.

My Lord, 30*th July*, 1884.

During the months of May and June, the season of heavy rains sets in on this portion of the African Coast, after an almost uninterrupted period of drought of about five months' duration. Experience has shown that during the early portion of this rainy season, the malarious influences of the soil, which are at all times powerful, show a marked increase in activity and virulence. Cases of malarious fever become more than usually numerous and the disease itself, in many instances, assumes a more than ordinarily severe form. The history of Sierra Leone shows that, at intervals, seasons have recurred which have been marked by exceptional unhealthiness and by the development of the ordinary malarious fever into fevers of a most malignant type.

The present season has, as your Lordship will have learnt from recent correspondence, been marked in this manner. During the month of May last and the early part of June, a form of fever which was described by the Acting Colonial Surgeon as *typho-malarial fever** became prevalent. Europeans and especially Europeans who had recently arrived at Sierra Leone appeared to be more subject than others to the attacks of this disease. It proved fatal in many cases. The malignant symptoms of this fever became more marked from day to day. On the 27th of June, the Acting Colonial Surgeon described it as "*a pernicious remittent fever on the borderland of yellow fever.*" At the same time, one of the private practitioners in Freetown expressed his opinion that the fever in question had already assumed the form of *yellow fever of a mild type*; and the Senior Military Medical Officer reported the death from *yellow fever* of a soldier of the Second West India Regiment. On the 28th of June, a European died of the disease described by the Acting Colonial Surgeon as "*Black Vomit.*" On the 2nd July, two deaths of Europeans were attributed by the same officer to *Yellow Fever*. On the 6th July, another European died of yellow fever. The disease seems then to have begun to assume a less virulent type. Several cases of yellow fever were reported, but recovery was made in all instances except one, which ended fatally on the 16th instant. On the 12th July, the Acting Colonial Surgeon informed me that all cases of fever seemed to be becoming amenable to treatment. The final opinion with regard to the nature of the disease, which was given on the 17th instant by the Acting Colonial Surgeon, on his own behalf and on that of the other practitioners in Freetown was, that it was *a mild type of yellow fever, of a non-contagious nature.* A remarkable feature in the course of the progress of this disease is that, as it assumed a more virulent form its prevalence became more and more restricted to persons of European birth, till at the point at which it reached its worst stage and was admitted to be yellow fever, the natives seemed to have complete immunity from its attacks. With

* The words in italics are so in the original document.

the exception of the case of a soldier of the regiment in the garrison here, a West Indian negro, the cause of whose death is, as I have already mentioned, stated to have been yellow fever, there has not been a single authenticated case of that disease among the negro population.

"A considerable number of cases of serious illness resulting in death in the case of four Europeans having occurred during the latter part of May and the first fortnight of June, within a narrow area in the central and best quarter of Freetown, I appointed a Medical Board, composed of the Acting Colonial Surgeon, the Senior Military Medical Officer, and Dr. Cole, a private practitioner, to enquire into the causes of the special unhealthiness of the quarter in question, and of the general prevalence of fever of a dangerous type. I enclose a copy of the report. It emphasizes in a marked manner what is probably the chief cause of the development of the ordinary malarious fever into fever of a malignant type, such as typho-malarial and yellow fever, and that is, the existence of most unwholesome arrangements in Freetown for the disposal of human *excreta*. * * * * *

(Signed) A. E. HAVELOCK,
Governor.

(*Enclosure*).—The proceedings of a Medical Board ordered by His Excellency Sir Arthur Havelock, K.C.M.G., to assemble for the purpose of investigating and reporting upon the causes which have originated the Malignant Fever now so fatal in Freetown, particularly that part of it known as Westmoreland Street, Rawdon Street and Howe Street, and other localities.

The Board having assembled beg to lay the following report before His Excellency the Governor in Chief for the information of the Secretary of State for the Colonies.

Definition.

The character of the Fever which has caused such extensive sickness and mortality amongst the natives and Europeans living in Freetown, and more especially in that limited area known as Westmoreland, Rawdon and Howe Streets, resembles Yellow Fever or that form of pernicious Remittent Fever of a malignant destructive Type having as its characteristics yellowness of the skin and conjunctivæ with dark coloured and very offensive alvine evacuations—dark coloured urine containing blood casts and very obvious albumen—a quick pulse and a persistently high temperature ranging from 102° to 105° Fahrenheit. Vomiting often persistent and very difficult to control, dark in colour and containing a large quantity of bile in some cases with distinctly Black vomit.

Duration of this form of pernicious Remittent Fever may be said to be from five to seven days—but in malignant cases four to five days. * *

The fevers occurring in these insanitary areas, limited though they may fortunately be, are always of a severe and malignant type. Individuals whether Native or European who contract Fever in these infected quarters of Freetown have its severity modified in them by prompt and immediate removal to healthier and higher situations. * * *

Intemperance.

Intemperance has always been brought forward and to it has been ascribed one of the causes of death during these Epidemics of Fever occurring so frequently in Freetown.†

It is an easy mode of disposing of a sore point more particularly when the death rate is highest amongst Europeans, and affords a feeling of self-glorification to temperate survivors. As a rule persons of intemperate habits possess iron constitutions and stand the climate well—whereas their more temperate companions do not stand the climate and are constantly down with Remittent Fever.

No person coming from a temperate climate to reside on the West Coast of Africa or in Freetown should do so until he has arrived at the age of 22 years and is of temperate habits and his constitution unimpaired. He should be physically and mentally strong and his character formed so as to resist the temptations which may surround him.

On every occasion that Origin Typho-malarial Enteric or Pernicious Remittent or Yellow Fever has appeared in Freetown epidemically it has nearly always been of sporadic origin, the undoubted product of Freetown itself, as all attempts to trace it to a non-sporadic origin have totally failed, except when brought here by a sailing vessel once from Rio Janeiro in 1872. The prevalence of this severe form of Typho-malarial Fever or Yellow Fever now so fatal among the European and native residents and many still ill with fever in the undrained insanitary areas of the town may be a warning of the approach of its more deadly sister Malignant Remittent Paludal or Yellow Fever.

History.

There may be stated to be three forms of Febrile disease usually met with on the West Coast of Africa, viz., Intermittent Fever or Ague, Remittent Fever, Enteric or Typho-malarial Fever and Pernicious Malignant or Yellow Fever.

Though the characters of these Fevers when fully developed have been freely and frequently described and showing a distinctness of type one from the other, yet so numerous are the connecting links which bind them together that much experience and careful investigation is required before absolutely and positively declaring the type to be of the Yellow Fever character or that modified form of it, viz., Typho-Malarial Fever. This Typho-Malarial or Fæco-Malarial Fever has always had seasons of Exacerbation. During some years assuming a mild form, at others a most severe, the mortality increasing with the severity of the type.

The earlier years of the existence of this Colony have been marked by seasons of extreme unhealthiness especially so in 1807, 1809, 1812, 1815 and 1819. In 1823 Yellow Fever was epidemic commencing in

† The paragraphs here placed side by side follow each other in the original. They suggest compromise and collaboration.

the earlier part of the year, the so-called healthy or "dry season," and running on through the early rains and ending with the "heavy rains." In 1825 Yellow Fever again become epidemic, and out of a known 902 persons attacked with that Fever 263 succumbed.

In 1829 during the months of April and May, Sierra Leone was again visited, and Yellow Fever then confined itself principally (as in the present instance May and June 1884) to the lower levels of the town. This epidemic was, however, stated to be most prevalent during the blowing of the Westerly winds and the falling of the heavy rain. It is recorded that out of 150 Europeans attacked with this Fever, 11 (?) perished.

In 1837 Yellow Fever commenced amongst the Europeans in the month of April, but many very suspicious cases of Endemic, Remittent, or the so-called African Fever occurred during the month of January, and two cases died having distinct black vomit. In March Yellow Fever declared itself amongst the Europeans in Freetown, and the first case occurring amongst the troops was on the 11th day of May, 1837. The disease is distinctly stated to have declined with the maturity of the rains and gradually decreased with the saturation of the ground and the atmosphere with moisture until it finally ceased by almost imperceptible and indefinable lines, merging again with the ordinary Endemic Remittent from which nearly all cases recovered. In October the disease again broke out but not in so malignant a form, and finally disappeared in December.

In 1838 Yellow Fever appeared in February and ended in March. In 1839 a severe form of Remittent Fever caused the death of six officers at Tower Hill—during the months of July, August and September every man of the Royal African Corps suffered, and the mortality amongst that Corps is stated to have been appalling. There were seven officers of the Royal Navy and 13 seaman attacked with Yellow Fever, and all died.

In 1845 Yellow Fever got amongst the crews of Her Majesty's squadron at anchor in the Roquelle River—the Eclair sailed from here on the 23rd of July and 60 of her crew perished from Yellow Fever. One case died in September from Malignant Remittent fever.

In 1847 Yellow Fever was epidemic in Freetown during June, July and August, and the "rainy season" was noted for great heat with little rain, only 38·45 inches falling, followed during the rains by days of extreme heat.

In 1859 there was no rain till April, May and June, which was then recorded as very slight. Yellow Fever was epidemic in Freetown and carried off 106 Europeans during this year.

In 1865 Yellow Fever again appeared and was epidemic in Freetown.

In 1866 Yellow Fever was again prevalent during the first quarter of the year there was no rain. Between the month of April and the 2nd of October, 100 Europeans had died of Yellow Fever.

In 1872 the fevers appear to have been of a malignant type during the months commencing May and ending in December.

In December there were 9 persons attacked with Yellow Fever, six died. The average death rate for this year has been rated at 250 per 1,000 amongst Europeans. But this appalling mortality does not indicate all the victims, as others died on shipboard trying to escape from the Colony.

1873 was unhealthy.

In 1877 there was considerable sickness from fever in Freetown. The year 1882 was not very healthy and was marked by cloudy and rainy weather for 72 days in the year only, and a total rainfall of 40·73 inches, being less than any on record during the past 32 years in Freetown * * * * * *

The Epidemic of 1884 *in Freetown.*

The extreme mortality occurring in Freetown during the months of May and June and an increase of sickness prevailing is mainly due to defective sanitation and almost total disregard for the disposal of excreta. * * * * * *

The extreme sick rate and mortality from fever amongst the "native population" occurring during the months of May and June in Freetown, and falling upon a great number of the inhabitants and attacking many persons at the same time with Fever pain in the bowels, bleeding from the gums, and vomiting in some cases black in colour has been a disease taking the form of the so-called "Sierra Leone Fever" and more severe in type than has been experienced for some years in this city.

The death rate since January has been estimated from the "burial records" as about 35 per 1,000, or 4 per cent. of the entire population. The Registrar General's return shows for May and June alone no less than 19 deaths amongst the resident natives, and this is the more remarkable since very few of these have been authenticated by "Medical Certificate," and the people have been left to make a report themselves as to the "cause of death," according to their own judgment, thereby proving the endemic of a fever by exposing a very obvious knowledge of its more fatal symptoms. We do not consider at present that there is a diminution of sickness, although we have reasonable grounds for believing that the advent of the "heavy rains" and by the adoption of Sanitary measures at once, so as to thoroughly remove the accumulated filth and thoroughly cleanse the town, that the general health may progressively improve * * * * * *

(Signed) ROBERT SMITH,

President.

An Appendix, headed "Mortality," "contains the names of the fatal cases occurring amongst Europeans and natives who died from Pernicious Remittent Enteric or Typho-Malarial Fever and Yellow Fever, residing in Rawdon Street, Westmoreland Street and Howe Street, also in other localities, with a brief history of their illness during the months of May and June."

An account follows of twelve cases numbered consecutively. It must suffice here to classify them on the basis adopted by the Commission.

Cases 1, 3, 6, 7, 9, would be classified as "Yellow Fever." Case 5 "Probably Yellow Fever." Case 2 "Possibly Yellow Fever." Cases 8 and 10 Enteric Fever. Case 4 (?) Enteric Fever. Cases 11 and 12 "evidence insufficient for classification."

It is easy with our present knowledge to deride the fantastic nomenclature adopted and the ignorance manifested in this document, but there are extenuating circumstances which may be realized by reference to p. 14 of this Report.

These papers are important and informing. It is clear that anyone who wished to arrive by easy stages at a diagnosis of "yellow fever of a mild type" would have every facility for doing so, and from another description* of the same epidemic it appears that twenty deaths amongst the Europeans within a short period would justify such a conclusion.

It will be observed that in the report just quoted there are periods of varying duration during which no mention is made of the presence of Yellow Fever in Sierra Leone, viz.:—

1830 to 1836.	1848 to 1858.	1867 to 1871.
1840 to 1845.	1860 to 1864.	1878 to 1881.

All these are inclusive.

It would be of great interest to determine whether the disease was really absent during these periods, but it is very unlikely that the most diligent search amongst the records would bring to light evidence of a convincing character.

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* J. S. Lamprey, "British Medical Journal," 1885, Vol. 2, p. 594.

But a belief that a disease is habitually present in a given country by no means connotes a belief that it is invariably to be found in all its towns and villages. Measles is a *maladie habituelle* in Great Britain, but it is not present everywhere and at all times.

In the list given by Augustin (p. 311), which is based upon the work of Bérenger-Féraud, it is seen that the years in which it is not suggested that the disease was present are almost precisely similar to the above.

Nevertheless, scattered through the pages of Bérenger-Féraud and Augustin, there are accusations against the British Authorities of having wilfully suppressed the fact of the existence of Yellow Fever at Sierra Leone and elsewhere in various years. That very often they did not know the truth is certain, but, having tested these statements by the aid of the Naval records and the history of the Colony as regards Yellow Fever given in the Report from which we have quoted, and also from other official records, we are of opinion that, so far as official records are concerned, the case as regards Sierra Leone entirely breaks down.

These charges are reduced to the years 1868, for which Bérenger-Féraud and Augustin give no authority; 1864 which is dealt with below; and 1878, which is discussed on p. 52 of this report. The statement relating to the year 1864 is as follows:—

> "Yellow Fever did not 'officially' prevail in 1863 and we find no record of any cases. In 1864 an outbreak took place, the facts of which would no doubt have been suppressed, but a merchant vessel brought a case from Freetown to Falmouth, England, and the facts could not be hidden from the English public. The case, which proved fatal, caused much agitation in England, and the whole African coast was quarantined until the advent of the cold weather." (7, p. 324.)

This statement is based upon the following in Bérenger-Féraud (6, p. 141.)

> "EUROPE—Un navire contaminé à Sierra Leone apporta un case mortel de fièvre jaune à Falmouth, en Angleterre, et à la suite de ce fait on mit en suspicion toutes les colonies Anglaises de la côte d'Afrique."

No authority for this statement is given. We have searched the Annual Register and Palmer's Index to *The Times* without finding

any mention of this case, and no record of such an occurrence can be found in the Department of the Medical Officer of the Local Government Board, where it would certainly have been known. Lest it should be thought that this refers to the Swansea epidemic, which occurred in the following year, 1865, it may be mentioned that the "Hecla," the ship which carried the infection, sailed from Cuba, and touched at no port on the homeward voyage from Havana to Swansea.

Bérenger-Féraud in commenting upon the Swansea outbreak observes that "some authors state that it was brought from St. Mary, Bathurst" (i.e., Gambia). "Donnet says that it was from Havana." In the exhaustive and classical description of this incident by Dr. (afterwards Sir) George Buchanan, which was published in the eighth Report of the Medical Officer of the Privy Council for 1865 (p. 442, et seq.), the whole of the facts are minutely described, and it is absolutely proved, indeed there was no suggestion to the contrary, that the ship did not touch at any port on the homeward voyage to Swansea.

1862.

A despatch from the Governor informs the Secretary of State that the Director of Public Works died from an attack of African Fever on July 29th.

1865–1866.

In 1865 and 1866 there was a serious outbreak of Yellow Fever in the squadron and the infection is said to have been acquired at Sierra Leone from the store-ship "Isis," which was permanently in that port. In both these years Yellow Fever was epidemic at Freetown.

1872.

Bérenger-Féraud states that a Sister of Charity from Sierra Leone informed him that several persons had died in Freetown with black vomit.

1878.

In the report of the Board it is stated that the fevers in this year appear to have been of a malignant type.

Dupont (Archiv de Médécine Navale) states that Yellow Fever was raging in Sierra Leone on July 5th, "but this was absolutely denied by M. le Jemble, who applied to the English Colonial Office, and was shown the reports showing that in 1877 and 1878 there was no Yellow Fever either at Sierra Leone or the Gambia." Bérenger-Féraud refuses to accept these statements.

The question as regards the Gambia is discussed on p. 52 of this report.

1892.

The Colonial Surgeon at Sierra Leone reports twelve deaths amongst Europeans.

4 landed for burial from steamers in transit.
6 from "climatic fever" including three from the military.
1 influenza.
1 intemperance.

12

1893.

There was an epidemic of cholera raging at St. Louis, Senegal and in the Gambia and French Gambia; "fortunately the disease was not introduced into Sierra Leone." Four deaths occurred amongst the Europeans from "pernicious Malarial Fever."

1894.

"The public health during the year was most unsatisfactory; a good deal of sickness was prevalent amongst the natives and the European residents." Particularly during February, May, June, July and August when 'Malarial Fever of a pernicious type' was prevalent. During the latter half of the year diarrhœa (of a dysenteric type), bronchitis, and small-pox were very general." (Blue Book Report.)

Europeans, 16 deaths (including 1 case on board a steamer in port and 3 cases that died within 36 hours after landing in Freetown from the rivers).

13 *Bilious remittent hæmorrhagic fever.*
1 Convulsions.
1 Hepatic congestion.
1 died on his way to Freetown from Hinterland from Malarial Fever.

16

One would like to know more as to the nature of the cases described as "Bilious remittent hæmorrhagic fever."

1895.

"General health fairly good in 1895 as compared with the previous year."

"There were 6 deaths amongst the Europeans, but a considerable number of serious cases were invalided."

1896.

There were 11 deaths amongst the Europeans; 2 from Remittent Fever and 5 from Malarial Fever. Six European officials died and 6 were invalided.

1897.

There was a large amount of sickness amongst the Europeans and natives; 19 deaths occurred amongst the Europeans.

Remittent Fever	4
Remittent Malaria	3
Bilious Remittent	3
Bilious Malaria	1
Malaria	5
Blackwater	1
Hæmaturia	1
Suicide	1
	19

The recurrence in 1897 of the nomenclature of 1884, or of terms almost as unscientific, is highly suggestive of a desire to escape from the use of the words "Yellow Fever."

1900.

Seven deaths from Malarial Fever among Europeans (three at sea landed for burial).

" Yellow Fever was notified in Senegal in the early part of the year, and later on the Gambia was also declared infected. Fortunately the disease was not introduced here."

1901.

Isolated cases of Yellow Fever are mentioned as having occurred in Senegal. Quarantine declared. A list is given of the European deaths at Sierra Leone from 1886-1901 (i.e., 16 years).

Totals.

Landed for burial	36
Resident in Freetown, climatic causes ...	85
Otherwise	42

In 1894 and 1897 there were 13 deaths of Europeans in each year.

1902.

The registered deaths from fever in Freetown from 1897 to 1902 are given as follows :—

1897	41
1898	64
1899	55
1900	40
1901	42
1902	49

There were three deaths among the Europeans from Remittent Fever in 1902.

1903.

Deaths from fever 121. Three deaths of Europeans from Remittent Fever. One from Malarial cachexia. " Deaths from climatic disease among the Europeans in Freetown during 1902 and 1903 were the lowest number recorded for a very lengthened period."

1904.

Six deaths from Malarial Fever amongst Europeans. "Health of the general European staff exceptionally good." "Yellow Fever reported at Grand Bassam previous to the beginning of the year (1904)."

1905.

"Only three deaths of Europeans from Malaria."

1906.

"Only three deaths of Europeans from climatic causes."

1907.

"202 deaths from Malarial Fever amongst all classes." Two deaths from Remittent Fever amongst Europeans.

"The improvement in the health of the Europeans is to a large extent due to residence at Hill Station, where for the past three years a large number of the European officials on duty at headquarters reside."

1908.

Deaths from Malarial Fever 150. Deaths of Europeans from Malarial Fever 3.

1910.

The epidemic of this year is analysed on p. 110.

(*b*) SENEGAMBIA.

Senegal.

The medical history of Senegal is one long story of epidemics of Yellow Fever, beginning with that of 1778, of which an account has already been given (p. 8). The disastrous results to the French expedition which recaptured St. Louis in the following year have also been mentioned.

In the following table the number of cases and the mortality is given for each year. The information upon which it is based is

from Béranger-Féraud's work. It is impossible within the necessary limits of this report to analyse these numerous epidemics.

	Cases.	Deaths.	Locality or Town.
1779	—	180	St. Louis.
1828	34 on the Bordelaise	(?)	Goree-Dakar.
1829	—	14	Goree-Dakar.
1830	144	85	Goree-Dakar.
1830	600	328	St. Louis.
1837	160	46	Goree-Dakar.
1837	12	(?)	St. Louis.
1859	244	162	Goree.
1859	41	11	St. Louis.
1866	249	110	Goree.
1866	(?)	14	Gunboat "Surprise" in harbour at Dakar.
1867	Many cases and deaths	—	Rufisque.
1872	4	4	Goree-Dakar.
1878	(?)	373	Goree-Dakar.
1878	(?)	176	Logo Expedition.
1878	(?)	200	St. Louis.
1880	(?)	(?)	St. Louis.
1881	524	425	St. Louis.
1881	10	10	Makana.
1881	21	13	Bop-Diarra.
1881	16	14	Goree-Dakar.
1881	362	181	Unclassified.
1881	102	57	On vessels.
1882	27	15	Goree.
1882	40	30	Dakar.
1882	2	2	Rufisque.
1882	21	18	S.S. "Albatross."
	4	4	Carabane.
	142	76	Dakar.
	22	20	Goree.
	1	0	Mehke.
1900	1	1	N. Dande.
	18	15	Rufisque.
	218	102	St. Louis.
	7	4	Thies.
	3	3	Tivaouane.
Total in 1900	416	225	

1901.

"The disease did not become epidemic for the simple reason that those who had fled in 1900 wisely remained in France." "There were ten cases and five deaths."

1904.

Dakar was declared to be infected with Yellow Fever.

1905.

On May 31st, 1905, an engineer employed at the waterworks at Dakar died of Yellow Fever. A panic ensued and "a general exodus took place." Energetic measures were taken and only one other case occurred. The information is based upon the report of Mr. Strickland, American Consul (U. S. Public Health reports 1905: vol. 20, p. 1473), and Dr. Ribot (Annales d'Hygiène et de Médécine Coloniale; Paris, 1907 : vol. 10, p. 79).

> "The chief health officer of Goree purchased two immense woven-wire cages which had been used by Consul Strickland during his sojourn in Senegal, one to sleep in and the other to enclose his writing table and book-cases. The largest cage was capable of accommodating two single beds, a chair and a table, while the smallest could contain a bed, a chair and a table. The cages were mounted in the hospital and all cases of suspicious fever were placed therein. Our representative says that he has used such cages since 1877, and attributes his immunity from the diseases incidental to the climate to this precautionary measure."
>
> (7 p. 306.)

Consul Strickland and "our representative" were clearly in advance of their times, and set an example which may be commended to the notice of such officials on the West Coast of Africa at the present day as object to the mosquito-proofing of their bungalows.

1906.

Yellow Fever appeared at Bamaku in Upper Senegal and at points along the Kayes-Niger Railway. The first case is said to have occurred at Ségou in the Soudan. There were 21 deaths.

The disease was reported by the British Consul-General at Dakar as present in September, October and November in the Upper Senegal and Niger Territories.

1910.

In October, in the Upper Senegal and Niger, seven deaths took place in the vicinity of Kayes, Dinguira and Satadougou. Three of these cases occurred at Dinguira and two in the district of Satadougou. As no medical officer was present at the time it was not possible to determine the nature of the disease. The sixth death took place at Kayes on November 5th, and was again classed as "Malaria," but on the same day one of the European Mission ladies from Dinguira died of Yellow Fever at the hospital at Kayes. After this stringent precautions were taken in the Upper Senegal and Niger, and no fresh outbreak occurred.

1911.

There was an outbreak of Yellow Fever at Dakar and Rufisque in the early part of the year, necessitating the temporary transference of several medical officers for duty at those places.

1912.

In January, February and March, cases continued to occur, and in September, October and November Yellow Fever again appeared among Europeans at the following places in Senegal :—

On the Dakar-Saint Louis Railway.

	Cases	Deaths
Louaga	6 ...	3
Sakal	1 ...	—
Kelle	2 ...	2
Tivaouane	3 ...	3
Thiès	3 ...	3
Dakar	10 ...	7
	25	18

On the Thiès-Kayes Railway.

	Cases.	Deaths.
Khombole	1 ...	1
Diourbel	5 ...	4
Kaffrine	1 ...	1
Birkelane	1 ...	1
	8	7

Total ...	Cases	33	
	Deaths	25	Case mortality, 75·7%

At Dakar six out of the eight cases which occurred during the month of November were fatal.

Five of these appeared at different points on the railway line and were brought to Dakar for isolation in the lazaretto. Three other cases occurred amongst the railway staff at Dakar itself. Dakar was quarantined until December 14th.

(*c*) GAMBIA.

The incidence of Yellow Fever in the Gambia must have been affected by the custom of leaving the Colony during the unhealthy season which has apparently always prevailed, and does so to this day amongst those European inhabitants whose position enables them to go away : business is then almost suspended and a general exodus takes place.

For an epidemic of Yellow Fever to occur amongst a white population the presence of a certain number of non-immunes is necessary, and when the other factors are favourable for the appearance of the disease, and this is lacking, the result must be influenced.

1778.

It will be remembered that this is the earliest date as to which the evidence is regarded as adequate to prove the presence of Yellow Fever in West Africa. The Gambia is said to have been infected from Sierra Leone.

1825.

The disease is stated to have been again imported from Sierra Leone. Of a detachment of 108 men who were landed in 1825, 74 died of " Remittent Fever " within four months.

1828.

Yellow Fever is stated by Bérenger-Féraud to have been present in the Gambia in the years 1828, 1837, 1859, 1860, 1865 and 1866.

1837.

The disease was brought from Sierra Leone on H.M.S. "Curlew." That ship lost 16 men whilst at Bathurst, and there were many cases on shore.

Two doctors died, and at the end of June, 1837, the authorities at the Gambia applied to the French at Goree–Dakar for medical assistance, owing to the presence of Yellow Fever in the Gambia. A doctor was sent, and returned on July 21st with the report that the disease had subsided at Bathurst, but he advised that strict quarantine should be maintained. In August a coaster arrived at Goree–Dakar from Bathurst with three Europeans on board; two, who were sick, were allowed to land; all died from Yellow Fever. The disease spread to the town, and out of a white population of 160 there were 80 cases and 46 deaths.

1838.

It is stated in the Blue Book Report for 1849 that "the years 1837 and 1838 were fearfully unhealthy."

1839.

See under 1862.

1841–42.

Four cases of Yellow Fever are said to have occurred amongst the garrison, of which two proved fatal.

1845 to 1849.

In the Blue Book Report for 1849, it is stated that for the five years ending 1849 the total European deaths numbered 23, of which 12 occurred amongst sailors, and 11 amongst residents. There were three cases in which fever proved fatal in the first year of residence. The average strength of the European officers of all departments and non-commissioned officers during these years was 14.

The mortality amongst the military during this period was 10 (14·28 %); all the deaths were more or less due to climate, five occurred in the first year of residence. Amongst sailors and casual visitors only 12 deaths occurred in the five years, the number visiting Bathurst every year being little short of 1,200.

1859.

In the Blue Book for 1859 reference is made to the "lamentable epidemic in August and September." "Last September only six Europeans were alive, some of these were convalescent, there was one military officer fit for duty and 100 worn out black soldiers." "Such an epidemic as that of last year has not been known for 22 years" (i.e. since 1837, q. v.).

1860.

A despatch dated 6th September, reports the death of Staff-Assistant Surgeon B——— on July 21st, of Staff-Assistant Surgeon T——— on August 7th, and of Staff-Assistant Surgeon C——— on August 24th; "these three officers yielded to fever of a bad type after five days' illness at McCarthy's Island."

This outbreak is referred to in a despatch dated 20th August, 1866, describing an epidemic of Yellow Fever as follows:—

> "Remembering the fatality to all who occupied the same dwelling at McCarthy's Island during the epidemic there in August, 1860. * * * * * * I deemed it prudent to close Government House (Bathurst) for a short period, taking up temporary quarters on board the 'Dover.'"

Having regard (*a*) to the intervals between the onset of the illness in these cases, (*b*) to the fact that they all occurred in the same house and (*c*) all proved fatal in five days, there can be little or no doubt that the disease was Yellow Fever.

The following paragraph occurs in the despatch of September 6th, 1860:—

> "4. I have great pleasure in reporting that the Europeans in Bathurst have this year been free from a fatal epidemic, although they have nearly all suffered from a fever of a milder kind, generally called Coast Fever."

1862.

"It would be satisfactory to record a conviction that the stone buildings, well appointed houses, civilised comforts, and improved drainage had lessened the coast fever in the Island of St Mary's, but it is not so, and until the marsh situated to windward of the town is drained, I fear the mournful statistics will still place Gambia almost out of the pale of life insurance companies."

"During the winter, spring and summer, the upstairs ward of the Colonial Hospital devoted to European sailors, chiefly of the French nation, is empty; whereas now in August, whilst I am writing, it is full of cases in every stage of fever." * * * * * * The writer refers to "the saying 'that the Gambia is the finest climate in the world for nine months in the year, but the worst for three.'"

In a despatch sending home the Blue Book for 1862, the following appears:—

> "On the completion of this work" (draining a marsh) "the capitalist will no longer dread a residence in Bathurst, River Gambia, and the vacuum caused by the epidemic of yellow fever in 1839 will, I trust, be filled up."
>
> "While I write within the last week two European members of this Society have died from the Gambia or marsh fever. They were of temperate, steady habits, one was a youth in a mercantile house and the other * * * was remarkable for the regularity of his daily habits."
>
> "In Government House two members of the garrison were given over by their medical attendants but youth triumphed, and yet there is no epidemic of yellow or virulent fever, it is but our annual visitation."

1864.

It is stated that "the sanitary condition of Bathurst was never more satisfactory."

1865.

From the report it appears that from 1859 to 1866† the births number 1,018 and the deaths 2,272.

"1,254 deaths in excess of births speaks very unfavourably."

"In the rains the Europeans die and in the cold weather the Africans."

1866.

It is stated (Cedont, Archives de Médécine Navale, Paris, 1868, vol. 9, p. 334) that a coasting vessel, the "Marie Antoinette," arrived at Goree from Bathurst, where Yellow Fever was known by the authorities at Goree to be present, and through false representations was admitted to pratique.

The town of Goree was infected, and an epidemic followed, in which there were 249 cases and 110 deaths.

† This year is included in the report, the covering letter of which is dated December 10th, 1866.

A despatch, dated 20th August, 1866, from the Administrator to the Secretary of State, begins as follows :—

"With the deepest regret I have to report that this settlement has been, within the last month, visited by an Epidemic of Yellow Fever."

Fatal cases continued to occur until October 7th.

On November 14th the Governor-in-Chief at Sierra Leone informed the Secretary of State that he had received a despatch from the Administrator of the Gambia announcing "the disappearance of the Epidemic and a favourable change in the climate."

The following deaths were reported :—

1. A partner and two clerks in a French mercantile house.
2. An Assistant Surgeon in the Army.
3. The Private Secretary to the Governor.
4. The wives of three officials, and one child.
5. The Principal Medical Officer.
6. A Captain in the Mercantile Marine.
7. A German clerk.
8. A German missionary.
9. The brother of the Queen's Advocate.
10. A Civil Engineer.
11. The Deputy Commissary General.
12. The Captain of a French merchant vessel.

Mention is made of three European convalescents from the disease.

The following extract is from one of the despatches received during the course of the epidemic :—

"Since the 7th inst. (October) the settlement has been free of fever of a bad type, but the intermittent coast fever has attacked the Garrison in some violence; all the officers are in the sick list, but they are doing well; the Hospital likewise is crowded but only one soldier has died."

1872.

In the year 1872 there was a severe epidemic of Yellow Fever in the Gambia. Bérenger-Féraud states that the official records of the

Colony are a blank concerning this outbreak, but on reference to the Blue Book Report for 1872 the following appears under "Hospital":—

"The number of patients admitted into the Hospital shews an increase in (? on) 1871. The prevailing diseases being Yellow Fever and small-pox."

1878.

The same statement is made by Bérenger-Féraud with regard to an epidemic in 1878, on the authority of Dupont.

On August 8th, 1878, the Editor of the *African Times* addressed a letter to the Secretary of State to inform him that the French newspapers reported an outbreak of Yellow Fever at Senegal. He suggests that it may spread to the British Colonies, and that it may be thought advisable to warn them. The letter contains this statement:—"When the Europeans have Yellow Fever the natives have small-pox of a most virulent character. Many thousands have thus perished in a single outbreak." Also that "African fever and small-pox are very prevalent at Lagos this year." *

It was decided to warn all the Colonies immediately. It is, however, clear that the Government of the Gambia were already aware of this outbreak, as on reference to the despatches we find that on August 12th, 1878, the following public notice was issued:—

> "In consequence of an Epidemic of Yellow Fever having broken out at Goree, the public, and especially the inhabitants of Bathurst, are earnestly warned and enjoined to adopt, both individually and collectively, every precaution to guard against the introduction of this destructive disease into, or its occurrence within, the Settlement.
>
> "In furtherance of these objects, the utmost care should be observed by all, and every one in keeping clean the houses, out-yards, yards, and lots and the streets and drains thereto adjoining.
>
> "All refuse and offensive matter should be destroyed by being burnt, or rendered inocuous by being buried, and the frequent use of lime is strongly recommended.
>
> "By means of the strict system of quarantine which has already been put into operation and through the willing, earnest and intelligent co-operation with the Government of the inhabitants at Bathurst it is to be hoped that such a calamity as the visitation of an epidemic of Yellow Fever may be providentially avoided."

* Dr Rowe (afterwards Sir Samuel Rowe, K.C.M.G.), Governor of the West Africa Settlements, was of opinion that "the deadly West African Fever is very little different from Yellow Fever."

On August 15th the following Public Notice was issued :—

"In consequence of the occurrence of an Epidemic of Yellow Fever at Goree all boats or vessels arriving at Bathurst from any part of the Coast situated between Booniadoo Point and St. Louis, both places inclusive, that is between Latitudes 13° 36′ N. and 16° 2′ N. shall be placed in quarantine. Boats or vessels arriving at Bathurst from the River Cazamance or its vicinity shall also be put into quarantine."

In a despatch dated August 9th, 1878, the Administrator of the Gambia reports that the S.S. "Kinsambo" had arrived at Bathurst from Goree without any bill of health, and that "fever, presumably Yellow Fever, is raging at Goree."

"I have received no notification on the subject of the existence of fever at Goree from the French Authorities nor from the French Consular Agent at Bathurst, of which latter I made enquiries."

"As I write I am informed that several deaths at Goree from the fever there prevalent have recently occurred."

In a despatch dated August 19th, 1878, the following occurs :—

"The fever first appeared at Goree on or about the 13th ultimo.

"The number of deaths up to the 8th instant, which is the latest date up to which we have any news, amounted to 25, all of the victims being Europeans."

"Amongst those who died were the judge, two doctors, a dispenser and four Sisters of Mercy."

"The disease is supposed to have arisen spontaneously.

"A Goree correspondent of one of the French houses at Bathurst stated that the symptoms attending the disease were not of a similar nature to those characterising Yellow Fever. I saw it, however, stated in the *Moniteur du Sènègal* that the disease was Yellow Fever.

"The French Authorities have established a *cordon sanitaire* round Goree."

In a despatch from the Governor to the Secretary of State, dated 20th August, 1878, the following occurs:—

"I have not received any official intelligence from the French authorities, but I have been able to gather the following information from some of the French merchants here as to the mortality which took place at Goree and Dakar since the 8th instant."

"Although I have not received any communication from the French authorities I have requested the French Consular Agent at Bathurst to convey to them the expression of my deep regret at the calamity which has overtaken their Settlement and of my warm sympathy with them in their trouble and affliction.

From the above it is clear that although Yellow Fever was "raging" in Senegal, the Governor of the Gambia had received no official notice

of its presence. So far therefore from the French Authorities having cause for complaint as Bérenger-Féraud maintains, the exact opposite was the case.

In a despatch dated October 21st, 1878, reference is made to the "continued immunity of the Colony from epidemic disease. The latest accounts from the French Settlements are bad. The last death occurred on September 18th."

At a later period of the year, however, although the nature of the disease was not recognised, it is extremely probable that Yellow Fever spread to the Gambia.

Extract from Blue Book Report of 1878.

"The year towards its close became so unhealthy that an unusually high rate of mortality occurred amongst the European residents of Bathurst. Out of a small European community averaging between 50 and 60 persons for the year, including the floating population of ships, 13 persons died, of which number 10 died during the last quarter of the year."

"Of the resident European community averaging 33 persons for the year, 7 died, amongst whom were the Rev. F. Renown, Father Superior of the Catholic Mission, and who had not long before arrived at Bathurst; a Sister of Mercy named Sister St. Clare * * The Rev. Mr. Lamb * * and the Chief Magistrate, Mr. John Carr, Junior." "But although this Colony had to deplore the loss of several lives the neighbouring French Settlements had to mourn the deaths of an appalling number of their white inhabitants, who were carried off by the Yellow Fever, which raged as a widespread and severe epidemic throughout the French possessions adjoining the Gambia."

In a despatch dated 26th December, 1878, it is stated :—

"This Settlement remains free from the epidemic. Since December 3rd there have been no deaths amongst the Europeans and only three cases, of which one has recovered entirely and two are convalescent."

"I regret to inform you that Yellow Fever has spread to Cazamance, a French Setttlement six miles south of Bathurst. The last death at Cazamance occurred on November 13th.

"I have no official report of the number of cases and of deaths at Cazamance, but from private sources I learn that the Yellow Fever at this place was of a less virulent type than that which scourged Goree, Senegal and Joal. From this I am led to hope that the pestilence which has been prevalent in this region is on the decline.

"It is worthy of note that concurrently with the existence of Yellow Fever 45 miles to the north and 60 miles to the south of this place

we have been visited with a 'Malarial Fever'† of extraordinary malignance and of startling fatality.

"Quarantine regulations continue to be strictly enforced."

It is more than probable that the "malarial fever" was Yellow Fever.

1884.

It is stated that "the Colony during the year remained gratefully free from any epidemic or contagious disease, although Freetown was subjected to what was alleged to have been the presence of Yellow Fever."

1891.

In the report for this year one death of a European is returned as having been due to "bilious hæmaturic fever," a disease which does not find a place in the nomenclature of the Royal College of Physicians.

1895.

No deaths in hospital from climatic causes.

No deaths amongst officials either European or native.

One death of non-official European from "bilious hæmaturic fever," and one from cardiac failure occurring during an ordinary attack of "Remittent Fever."

The former had previously suffered during the year from an attack of the same type of Malarial Fever.

Twenty-two cases of malarial fevers," including three cases of the hæmaturic type" amongst the non-official Europeans.

The writer refers to the influence of the annual exodus of Europeans in June and their return in November on the sick and death rates, "thus escaping the evil effects of the deadly period intervening between those months."

1896.

Health of the European population fairly good.

The report refers to the death of a Government official, a Roman Catholic priest and a French clerk, from "Fever."

† The inverted commas are in the original.

One death of a European official from Bilious Remittent Fever.

Two deaths amongst non-official Europeans from "bilious hæmaturic fever" and "malignant remittent (hyperpyrexia) fever."

"The malignant form of malarial fever was more common than usual."

1897.

"The Colony first saw a year pass without a death amongst the Europeans."

The number of attacks of fever were up to the average, but no case assumed a malignant type.

Thirteen European officials were admitted to hospital for Remittent Fever, four for Intermittent Fever and one for Tropical Fever.

Twenty native officials were under treatment for malarial fevers.

"Malignant and other varieties of malarial fever were particularly prevalent amongst the natives during the rainy season."

1898.

The deaths in 1898 exceeded those in 1897 by 74, which is accounted for "because the year was more unhealthy and not to any special causes, which I suppose must be accepted as correct."

"Towards the end of the last quarter the sick rate reached its nighest point, malarial fever cases being then numerous and severer in character."

1899.

A case of "pernicious Remittent Fever with hyperpyrexia" occurred, in which the temperature on the second day reached 107·8 F. Recovery followed.

1898.

Three Europeans died : not more than 25 Europeans in residence during the rainy season.

Four deaths from Blackwater Fever.

1899.

Thirty-seven cases of Remittent Fever amongst the non-official Europeans and three cases of hæmoglobinuric fever ; all of the latter recovered.

In one case of "pernicious remittent fever with hyperpyrexia" (T. 107·8°) which recovered, "Quinine by the mouth had no effect upon the temperature." It was then given hypodermically. The temperature was reduced on several occasions by cold bathing. The patient was an alcoholic subject; the nature of the case is somewhat doubtful.

Cases such as the above suggest the idea that in Yellow Fever, as in rheumatic fever, the virus may, under certain conditions not understood, affect the heat regulating centres to an unusual degree.

1900.

An epidemic of Yellow Fever occurred in this year, of which the following edited description is given by Dr. Chichester, who attended the cases as Acting Senior Medical Officer.

(*a*) *Period of suspicious cases.*

"Case No. 1.—On 23rd May a Syrian was admitted into the hospital under the impression that he was suffering from influenza then prevalent in the town. He complained of fever, pain and headache. On the next morning he was very restless, semi-unconscious, had yellow tinging of conjunctivæ, and the urine was albuminous. He was removed to a hut erected for native smallpox patients, where he died that evening, having vomited just before death 'coffee ground' looking matter. All precautions were taken as if it had been a case of yellow fever. It was reported as death from fever 'of a doubtful nature.'"

"Case No. 2.—Taken ill on June 2nd was an inmate of the same house in which the first case had occurred. He was attended by a native qualified practitioner who certified that he died of remittent fever. The practitioner in question stated that it was an undoubted case of malaria, but I am inclined to think that it must have been a case of yellow fever. His death occurred on 7th June."

(*b*) *Presence of the disease recognised.*

"Case No. 3.—Also came from the same house. He was attended by the doctor above-mentioned, and I only heard of his being ill on 9th June. Little definite information was obtainable at the time, except

that he had headache and fever. No previous history could be obtained ; the urine had not been examined. No malarial parasites were found. The next day the case looked very suspicious. He was in a semi-comatose condition, the conjunctivæ were slightly tinged, the urine was nearly suppressed and the small quantity drawn off was highly albuminous ; liver and spleen were not enlarged ; tongue was covered with a white fur and red round the edges. This looked to me very like yellow fever, and the question in my mind was, Was I sufficiently sure to have the place put in quarantine ?

"The patient died that night, and a post-mortem next morning removed all doubt. It was declared to be a case of yellow fever."

(*c*) *Course of the Epidemic.*

The house was closed and watched, and those not attacked were placed in quarantine on the other side of the river.

"Case No. 4.—Also from the house in Russell Street ; died from yellow fever in the hut on 12th June, having been removed thereto that morning."

"Case No. 5.—A young French clerk living some 150 yards from the house in Russell Street. Seen on 15th June, when he had been ill for some days. An undoubted case of yellow fever. He died on the 16th of hæmorrhage due to the rupture of a blood vessel in the stomach walls".

"Case No. 6.—An Englishman about forty-five years of age, who had been many years on the coast. He had been in very bad health for some time previously but only sought advice after he had had yellow fever for four days. Under treatment he improved a little but died of heart failure on the 19th."

"Case No. 7.—This case occurred on 16th June at the Telegraph Station. It was a mild case and ended in recovery."

"Case No. 8.—A lay brother at the Catholic Mission was taken suddenly ill on June 27th. An exceedingly severe case of yellow fever. He died within thirty-six hours from the time of onset."

C.[1]—*Apparent disappearance and recrudescence of the disease.*

"Case No. 9.—A long time elapsed before the occurrence of another case. The patient was a clerk in one of the companies. The source of infection was not traced. He was taken to the old Military Hospital on 4th August and died on the 6th.

"No other cases appeared at this period,

"The mortality was heavy—8 cases out of 9 died. More than half of the European population left in the early part of the epidemic."

C².—*Second reappearance of the disease.*

"Case No. 10. A clerk in the employ of one of the European houses, arrived in Bathurst on 11th October. He came from Mandina Bar, a town on the banks of the river some thirty miles distant, through which passes much traffic from Cazamance, Carraban and the surrounding country. Cazamance and Carraban are towns in French territory in which yellow fever has appeared, and which are no doubt still infected.

"On 13th October he was taken suddenly ill with fever, very severe pains in head, loins, and limbs, vomiting though not severe. The headache pains lasted all the next day and on into the third day. The vomiting then ceased for nearly twenty-four hours, and the pain decreased. Temperature 103·4° : face a little flushed, eyes watery, pulse rapid. Tongue clean. No tinging of skin or conjunctivæ.

October 16th, 12 per cent. albumin in urine and day by day the percentage increased, until on the sixth day it amounted to over 60 per cent. ; urine not measured but the amount much diminished. A few plasmodia found at the first examination, but none later. Quinine seems to have caused their disappearance, but it had no effect on the temperature which, from October 15th up to the day of his death, ranged between 102·4° and 103·8°, except when on the sixth day it when up to 104°. On each day he was given 6 g. of quinine hypodermically.

"On October 17th the eyes were more suffused and beginning to assume a yellow tint.

"On the 18th the skin began to assume a yellowish tint, but it did not become marked. The *pulse rate was at no time in proportion to the temperature, and on the fourth day began to lessen to* 84.76 *and* 72.

"He died on the evening of the eighth day of his illness.

"Delirium was not present till the last twenty-four hours. After the cessation of the initial pains *he constantly expressed himself as feeling quite well.* I have noticed this in nearly all the cases of yellow fever I have attended.

"*A limited post-mortem examination* was made. Stomach coats softened and swollen, blood vessels prominent, some mucus of a chocolate colour was present. No coffee-ground matter was found. The small intestines presented similar appearances. Spleen not enlarged. Liver slightly enlarged. hyperæmic. Post-mortem staining of the body was very marked."

"Case No. 11.—Another case is at present under treatment, a European belonging to the same firm. It is up to the present a mild case ; but I have little doubt that it also is a case of yellow fever, and that it was contracted at Madina Bar whither he had gone to take an inventory of the stock after the death of the man, of whose case I have just given the history."

COMMENTARY.

1. In his report on the epidemic, Dr. Chichester states that "it is now some 34 years since the disease has appeared here."

Reference to the preceding pages, however, shews that in 1872 Yellow Fever was certainly present in the Colony, and probably also in 1878.

2. No source of infection was discovered. "There appears to have been no communication by sea to account for it."

3. The following passage occurs in the report :—"Perhaps, and not improbably, in this case mosquitoes were the agents responsible for the Yellow Fever spreading from its original centre." * * * "It is worthy of note that all the cases (with one exception) occurred in the front street of the town, the street most infested with mosquitoes, and in people who slept without mosquito nets or with nets in a bad state of repair." The Report is dated 13th October, 1900.

The American Yellow Fever Commission which established the mosquito transference of Yellow Fever published its first report at the Annual Congress of the American Public Health Association held at Indianapolis on October 22–26, 1900.

4. "Yellow Fever (?)" is mentioned amongst the diseases of the Europeans in the official Medical Report of the Gambia for the year 1900.

The Senior Medical Officer, who was at the time absent on leave, expresses a doubt as to the disease prevalent in June and July having been Yellow Fever; he is "more inclined to consider it malarial in origin." The discrepancy between this opinion and the facts as shewn in the report of the outbreak by Dr. Chichester here given is a matter of very great importance. It is to be particularly noted that with a change in the observer temporarily in charge "Yellow Fever" immediately appears in a place where "bilious remittent fever," "bilious hæmaturic fever" and "malignant remittent (hyperpyrexia) fever" had recently been present.

1901.

One death of a Commissioner whilst travelling from "Bilious Remittent Fever" and one death from Blackwater Fever.

One death from pernicious Malarial Fever took place in port : the disease was contracted outside the Colony. The expedition from the Liverpool School of Tropical Medicine, under the late Dr. Dutton, visited the Colony in this year and made valuable recommendations.

1902.

Two deaths of Europeans during the year. Only nine cases of fever amongst the Europeans. This improvement was probably the result of the anti-mosquito work suggested by Dr. Dutton.

1903.

One death of a member of the French Catholic mission recently arrived from Senegal, from a severe attack of " Bilious Remittent Fever ". Death rate amongst the natives was high ; this was attributed to an exceptional rainfall.

1904.

The public health was very satisfactory. There was no epidemic disease. There were no serious cases of illness among the European population, and no one was invalided.

1905.

" No serious illness amongst thirty-five European Officials ".

Remittent Fever, eleven cases.

One death in hospital from " Malignant Fever with Hyperpyrexia."

1906.

One case of Remittent Fever, ending in malarial cachexia, and one of Malignant Remittent Fever with hyperpyrexia. " In the latter case quinine was not for some reason assimilated, though given by the mouth in large doses, the liver being at the same time acting freely, the hyperpyrexia could only be subdued by ice-packs and intra-muscular injections of quinine produced an immediate beneficial effect on the course of the fever, causing an uninterrupted convalescence to set in."

In the case of a similar nature previously reported in detail (1899) it was clear that the ice-packs and not the quinine caused the fall of temperature. The exact nature of these cases is doubtful.

1,075 more cases treated at the hospital, "due to appreciation by the public of the improved facilities for the treatment of the sick."

1907.

Deaths of children under five years of age equal to 32·62 per cent. of all the deaths registered during the year.

One death of a European from "Malignant Malarial Fever."

1908.

A table is given shewing the number of Europeans who died in the Colony from climatic causes for each year since 1899.

	Climatic.
1899	—
1900	7
1901	4
1902	1
1903	4
1904	—
1905	2
1906	1
1907	1
1908	2
1909	3*

Table shewing the number of cases of illness and invalidings and deaths among Europeans and the number resident in the Colony :—

	1901.	1902.	1903.	1904.	1905.	1906.	1907.	1908.	1909.†
Resident	85	98	105	100	114	232	128	107	151
Treated	89	26	47	42	43	49	42	27	53
Died	4	2	2	0	2	2	2	7	4
Invalided	3	2	2	0	1	3	2	3	3
Malarial cases	54	11	15	24	22	21	287	30	38

1909.

"Of the 151 Europeans who have resided in the Colony during the year not one, so far as I can gather, slept at night time outside a

* From report of that year. † From the report of that year.

mosquito house or net; protection at night time being now regarded as essential. The question of providing mosquito proof accommodation in Government quarters for the use of officers in the day-time is now under consideration."

"The health of the European residents in the Colony was fairly good, although four died as the result of malarial infection."

1910.

"Fortunately, although Yellow Fever is said to be endemic, no suspicion of such a case has occurred in the Gambia during the past four years; this is somewhat remarkable considering that the stegomyia is the most numerous of all mosquitoes in Bathurst."

"The health of the Europeans has been extremely good during the year."

1911.

The epidemic at Bathurst in this year is analysed on p. 121.

"Three deaths occurred amongst the European officials—two being members of the Royal Engineering Surveying Department on their first tour of service, and the third an engineer who had been in the Government service for many years."

1912.

"The general health of Bathurst and the Protectorate was satisfactory."

"Every European now lives in a protected room."

Death Rate per 1,000 of the population, 1901 to 1912, calculated on the census of 1911 :—

1901	...	...	28·53
1902	...	...	30·60
1903	...	...	38·53
1904	...	...	31·01
1905	...	...	28·58
1906	...	...	27·27
1907	...	...	29·33
1908	...	...	29·41
1909	...	...	25·08
1910	...	...	29·26
1911	...	...	24·19
1912	...	...	25·53

(*d*) PORTUGUESE GUINEA.

1910–11.

The Bissagos Archipelago.

Boulama.

An outbreak of Yellow Fever occurred at Boulama in December, 1910, and lasted until June, 1911. "Twenty-six Europeans and a few natives died." The presence of the disease was subsequently confirmed; quarantine was declared against the Port of Boulama and was continued until July 1st, 1911.

In December, 1911, a European engineer was reported to have died from Yellow Fever on a vessel at Boulama.

At Bissau Island and Boulama it is stated that cases of Yellow Fever have occurred which did not come under official notice. In May, 1913, "there were several people sick with fever at Bissau under rather suspicious circumstances," and "it was not unlikely that they were suffering from Yellow Fever." It appears that "epidemics are constantly occurring" at Bissau.

Is it possible that this Island may be what Bérenger-Féraud calls "un foyer générateur"? Yellow Fever ("Bulam Fever") was at Boulama in 1793.

The close attention of the Government of Portuguese Guinea should certainly be given to the sanitary condition of the Colony and the Islands, as they may be a source of danger to other Colonies on the West Coast.

(*e*) FRENCH GUINEA.

The chief town of French Guinea is Conakry. Yellow Fever is reported to have occurred there in 1901.

(*f*) SOUDAN.

A country in Central Africa south of the desert of Sahara and extending from the Atlantic Ocean to the Red Sea. There is a railway from Kayes on the River Senegal to Kulikoro on the River Niger.

1828.

Yellow Fever is said to have broken out at Christmas at Sangarrah, " 30 days journey north east from Medina " ; whole villages are said to have been depopulated on the road from Kayes to Kita.

1829.

The epidemic of Yellow Fever in Sierra Leone in this year is said to have spread from Sangarrah.

1862 to 1865.

There is a good reason to believe that the epidemic at Khartoum about this period was Yellow Fever and not plague. (*vide* p. 103.)

1878.

A French force was sent from St. Louis in Senegal where Yellow Fever was epidemic to Bakel on the Upper Senegal River 350 miles from St. Louis, and out of 317 Europeans 180 died of Yellow Fever. At Medina 12 deaths occurred amongst the few white inhabitants. This is said to have been the first appearance of the disease in the French Soudan.

1879.

A few cases occurred in this year.

1880.

Yellow Fever was present amongst the labourers building the rail-road from Kayes to Kita.

1881 to 1882.

A French column is said to have spread Yellow Fever wherever it stopped.

The chief victims were Chinese and Moroccans employed on the railroad.

1883 to 1885.

In these years a serious mortality occurred amongst the French troops from "Typhoid Fever."

1885 to 1886.

"Typhoid Fever" became rare, but "Continued Fever" decimated the troops from November to February.

1886 to 1887.

"Typho-malarial Fever" appeared.

1887 to 1888.

"Typho-malarial Fever" continued, but was of a less severe type. In discussing the nature of these epidemics it is mentioned* that "the errors in diagnosis" were due to the absence of "black vomit" in more than half the cases, owing to the fact that the patients died before there had been time for the appearance of this symptom. Epistaxis and tarry stools were, however, noted in some of these cases. The conclusion is arrived at, that under various names the disease throughout was really Yellow Fever and that there has been an annual epidemic from 1878 to 1888.

1891.

In October caravans from Medina to Kita and from Kayes to Niore and Bafoulabe suffered severely from Yellow Fever. 56 deaths of Europeans were reported.

1892.

Bakel, Kita and Bafoulabe were infected during this year.

*Historique de la Fièvre Jaune au Soudan Francais par M. le Dr. Primet (1893). (T.I. p. 433.)

1897.

Fourteen deaths occurred on the Kayes-Kita railroad from Yellow Fever and five elsewhere.

The digging of the soil along the line of the Kayes-Kita railroad, "where are interred thousands of yellow fever victims" (!!), is given as the active cause of the epidemic of 1897.

Augustin, who is rarely at a loss for a suggestion as to how Yellow Fever may possibly have been imported into any place where it appears, remarks, "How the fever was imported into the Soudan in 1897 will therefore remain hidden behind the mists of conjecture." Is it not possible that it may have been there previously?

1901 to 1902.

Outbreaks occurred in both these years along the railroad and at Kayes.

1906.

There was an epidemic between Segou and Kayes in which 20 deaths occurred amongst 32 patients attacked. Four "suspected cases" also proved fatal.

1907.

From November 1st to 30th 34 cases with 16 deaths were reported from "the same localities visited by previous epidemics."

1908.

Yellow Fever was epidemic in this year, according to Augustin.

(*g*) LIBERIA.

We learn from the Inspector-General of Hygiene that no cases of Yellow Fever have been observed on the coast or for 30 miles inland.

(*h*) IVORY COAST.

The chief towns of the Ivory Coast, a French possession, are Grand Bassam, Assinie and Dabou.

1852.

The mortality among the French troops at Grand Bassam from Yellow Fever in this year is stated to have been over 50 per cent.

1857.

In February of this year the disease appeared at Grand Bassam and continued until April, when it died out, but was revived on the arrival from France of many non-immunes, and a considerable number of deaths occurred amongst them and amongst the inhabitants who had escaped the disease during the earlier period of the epidemic. Twenty-two deaths occurred amongst the 66 white inhabitants. The mortality amongst the natives is not known. The disease was carried to Dabou by two men, both of whom died there.

1862.

The epidemic in this year is described on p. 100.

1863.

The case which occurred in 1863 is mentioned in the account of the 1862 epidemic.

1899.

An outbreak of Yellow Fever occurred in April and May, and the disease reappeared in July and August. Amongst the 40 white inhabitants at Grand Bassam there were 33 cases and 29 deaths. There was no evidence of importation of the virus. There was also an epidemic of plague amongst the natives, preceded by a great mortality amongst the rats.

1902.

A severe epidemic occurred in this year. At Grand Bassam there were 13 cases with 11 deaths. At Abidjah one case was introduced from Grand Bassam. At Eloca one case, which was fatal, also came from Grand Bassam. No evidence that the disease was imported could be obtained.

1903.

The outbreak in January began amongst the Syrians and continued during that month. There were no cases during February, but the disease reappeared in March, when several fatal cases occurred amongst the Europeans. The decision was then taken to remove the white inhabitants from Grand Bassam in small batches of two and three to neighbouring places, the result being that the disease was spread and new foci appeared.

The following summary of the epidemic is given :—

	Cases.	Deaths.
Grand Bassam	10 ...	7
Adjeo	1 ...	1
Imperie	2 ...	2
Arriounna	1 ...	1
Schucider	1 ...	1
	15	12

1904 to 1905.

The disease re-appeared, and is said by Augustin, on evidence that can only be described as fantastic, to have been imported.

His own conclusion is as follows :—

"This circuitous mode of infection may seem a little far-fetched, but it is plausible and in the absence of proof to the contrary is just as good as any other theory."

1910.

In October a native was admitted to hospital at Grand Bassam for fever which was classified as "malaria." Seven days later a

native, who had been living in close proximity to the first was attacked with the same symptoms. Another native, who had recently arrived from Sierra Leone, was subsequently attacked.

Although these cases were officially entered as "malarial fever," they were, nevertheless, treated as suspected cases, and the usual precautions were taken. All these patients recovered.

1911.

It is said that there was no epidemic on the Ivory Coast in this year.

(*i*) GOLD COAST.

The chief towns of the Gold Coast Colony are Cape Coast, Elmina, Accra, Seccondee, Saltpond and Winnebah, all of which are situated on the Coast, and Quittah.

1819 to 1824.

It is very probable that in the years 1819 and 1821 Yellow Fever was present on the Gold Coast, and practically certain that it was so in 1824. The disease of that year was called "bilious remittent fever," a term the exact significance of which has yet to be decided, but as death usually occurred on the third, fifth or seventh day, and the patients were as "yellow as an orange," its true nature is hardly doubtful; 217 deaths are reported, chiefly amongst the regiments in garrison (Blue Book Reports).

1853.

It is recorded that "fever and dysentery have proved fatal to many during the year, particularly the white residents."

1855.

This year was "fully an average unhealthy one if not more than that."

In letters from the Clerk of the Court at Annaboo to the Medical Magistrate it is stated that "the people are dying here somewhat like fowls," and later "I have the same report to give of the people as in my last letter." The nature of this disease is not stated; the "people" were natives.

1856.

It is stated that there was "much sickness; many of the military officers were invalided home; two died here and one on passage; the wife of another died here." The nature of the diseases is not mentioned.

1862.

The Acting-Governor on the 6th of August reports the death of Mr. Joseph Moseley, the Chief Justice.

"The cause of his death was the same terrible cause which, without a single note for preparation, has carried off so many Europeans before him—fever."

There is no other disease than Yellow Fever known on the West Coast of Africa of which the above statement could have been made.

In August an official threatened with dysentery, and having already suffered from fever, was granted "leave to proceed for a few weeks to sea in the mail steamer 'Athenian,' on board of which he had come from Accra and on board of which he was then lying sick."

1867.

"In this year the European population suffered very much from losses by sickness."

1885.

"The Europeans suffered particularly from malarial fevers of various types of severity, grave cases of intermittent and remittent fevers placing the patients' lives in extreme peril came under my care, the symptoms of which were uncontrollable vomiting of dark green matter mixed with blood, rapid discoloration of the skin and dark coloured urine which was temporarily albuminous. In one case there was marked intestinal hæmorrhage." (Report of the Colonial Surgeon.)

1886

Three cases of Blackwater fever proved fatal and two cases of "remittent of another type."

In this year at Accra "the health of the European officials in the last quarter was unsatisfactory, and one death occurred from 'hæmorrhagic malarial fever,' also a Venetian coral seller died from 'hæmorrhagic malarial fever.'"

1888.

The death rate amongst the resident Europeans at Quittah was 40 per cent. and there was much sickness.

"The deaths were chiefly due to the adynamic form of malarial fever complicated with hæmoglobinuria, which has of late been so common on the coast."

Deaths also occurred from "ardent remittent fever," and there was one case of "sporadic yellow fever."

Of five officers at Quittah, one died from "pernicious malarial fever," one was invalided for the same disease, and three had attacks of "remittent fever" of varying intensity.

1893.

ACCRA. "General health very bad amongst all classes, one European official died from bilious remittent fever, nine were invalided and many cases of illness occurred."

CAPE COAST. "In the second quarter almost all the resident European population suffered from severe forms of remittent fever."

ELMINA. "General health could not have been more unsatisfactory. * * * * Four of the five traders exhibited grave and complicated forms of fever. The prevalent diseases were remittent fever of a serious type—intermittent fever * * * *"

QUITTA. "The incidence of disease was so excessive that among the community there was a state which I venture to call 'fever panic.'"

1894.

ACCRA. "In the last two months of the year there were several cases of a severe type of remittent fever."

ADA. "Health very unsatisfactory. Two cases of malignant remittent fever."

CAPE COAST. "Malignant remittent fevers common."

CHAMA. "Unsatisfactory."

ELMINA. "Good until November. All officials except one ill with fever."

QUITTAH. "Three Europeans ill with malarial fever, one of the so-called bilious, the other of the remittent type."

"May and June, 60 per cent. of the non-officials on the sick-list."

SALTPOND. "Health fairly good."

1895.

"General health of Colony extremely bad; the endemic fever assuming a pseudo-epidemic form of a malignant type closely approaching in its clinical manifestations the Vomito Negro or Yellow Fever of the West Indies. The death rate was enormous amongst Europeans, and the excitement induced thereby amounted almost to a panic and served to intensify the fatal tendencies of the prevailing fever in the latter part of the year."

"The disease was *practically* limited to Axim, Chama, Elmina, Cape Coast, Saltpond and Accra, but with varying intensity at each of these places."

ACCRA. *In August malignant fever at this station. This disease in the opinion of the medical officer "is of the same type as has during the last few years appeared occasionally at Sierra Leone, Bonny, Lagos and other places on the West coast of Africa."

CAPE COAST. "Remittent fever of a very pernicious nature with a tendency to hyperpyrexia, suppression of urine and amaurosis."

CHAMA. The health of the Europeans during the first quarter "could not be imagined worse."

* Three deaths from this fever occurred among the officers of the African Direct Telegraph Company.

ELMINA. Unusual prevalence of malarial fever. "Of ten officials eight suffered from more or less violent fever, of whom three died and two were invalided."

SALTPOND. Health most unsatisfactory. "One official died from remittent fever complicated with suppression of urine."

1896.

"General health shows little or no improvement on that of 1895."

High death rate due to the fact that "the epidemic of the malignant type of fever which prevailed during the last half of 1895 continued during the first four months of the year, the period in which the greater number of deaths occurred."

European mortality.	Among officials per 1,000.	Non-officials per 1,000.
Accra	22·72	60·97
Axim	nil.	7·76
Cape Coast ...	307·	89·29
Chama	250·	nil.
Elmina	200·	nil.
Saltpond	250·	142·8

1896.

"Little or no improvement on 1895."

	Deaths of officials.	Non-officials.
1895	15	23
1896	11	30

Fifty-eight Europeans were invalided as in 1895.

"An epidemic of a malignant type of fever was prevalent during the first four months of the year, the period in which the greater number of deaths occurred."

"The health of the native population was also unsatisfactory."

1895 to 1906.

Sir Rubert Boyce* gives extracts from the case books at (1) Elmina, (2) Quittah, (3) Saltpond, (4) Axim, (5) Cape Coast, (6) Accra, (7) Tarquah.

These cases on the basis adopted by the Commission would be classified thus :—

(1) ELMINA.

March, 1895	...	"Yellow fever."
April, 1895	...	"Yellow fever."
January, 1902	...	"Yellow fever."

(2) QUITTAH.

1894	...	...	"Yellow fever."

(3) SALTPOND.

1895	...	...	"Yellow fever."
1897	...	...	"Probably yellow fever.'
1898	...	...	"Possibly yellow fever."

(4) AXIM.

1905	...	...	"Details insufficient for classification."

(5) CAPE COAST.

1895	...	...	"Probably yellow fever" (two cases).
1901	...	...	A series of cases, "possibly yellow fever."
1902	...	...	"Yellow fever" (two cases), "probably yellow fever" (two cases).
1903	...	...	"Yellow fever" (case diagnosed as yellow fever by Dr. Rome Hall). "Negative" particulars not given. Five cases diagnosed as yellow fever by Dr. G. L. Barker.

* (8 pp. 75-76.)

(6) ACCRA.

April, 1899	...	"Possibly yellow fever."
April, 1904	...	"Yellow fever."
June, 1905	...	"Yellow fever."
July, 1905	...	"Probably yellow fever."
February, 1906	...	"Yellow fever."

(7) TARQUAH DISTRICT (Mantrain).

1902	... ...	(8 cases.) "Negative" details insufficient for classification.

See pp. 115, 119 and 124 for analyses of the epidemics of 1910 1911 and 1912.

(*j*) TOGOLAND.

1905.

In Appendix H. to the Report on certain outbreaks of Yellow Fever in 1910-1911 (Colonial Office) there is an interesting report, of which the following is an extract, on Yellow Fever in Togoland in 1905, by Dr. G. E. H. Le Fanu, of the West African Medical Staff. This is stated to have been the first record of the disease in that Colony.

In 1895 the Government was removed from Anecho to Lome, in consequence of the "very high rate of mortality amongst the European population. This was at the time attributed to severe malaria, but there is a strong probability that the disease was Yellow Fever."

"Up to 1905 there had been no European deaths in Anecho for two and a half years, but between January 27th and February 2nd, three Europeans died." Two of these were members of the Catholic Mission. The first, a Catholic brother, died with apoplectiform symptoms and high fever, after scarcely one day's illness. The second, a Catholic sister, died on February 2nd, "with jaundice and black vomit"; neither of them was medically attended. Light was

thrown upon these cases by the death, on January 31st, of a young merchant who had resided in the Colony for a period of four years. He died on the third day of his illness "with symptoms which at first suggested an attack of renal colic. He showed some improvement soon after the onset of his illness, but on the third day a remarkable slowing of the pulse, with high temperature, jaundice and black vomit revealed its true nature."

"On February 10th, a Father of the Catholic Mission was attacked and exhibited similar serious symptoms. He embarked on a homeward bound steamer, but was obliged to land at Lome, where he died on February 14th. A few days later another local merchant was attacked by the disease. He recovered.

"On March 23rd, a young merchant, who came from Grand Popo, in Dahomey, was brought into hospital unconscious, and died on the same day at midnight. He had been in the tropics four months. The cause of death was Yellow Fever.

"On April 19th, the Mother Superior of the Convent of Agoué in Dahomey, who was visiting Anecho, was attacked by Yellow Fever, which she had contracted in Agoué, and died after a few days. She had been in the tropics for twenty years. A sister from the same Convent, who came to Anecho to nurse the Mother Superior, also died of the disease. Her illness lasted eight days, and jaundice became very pronounced, the skin turning almost a brown colour.

"In April also, a convalescent from Yellow Fever, who came from Grand Popo, was put under treatment in the quarantine station at Hilakofi.

"Before the outbreak of Yellow Fever in Anecho. cases of Yellow Fever had occurred in Dahomey. At the beginning of the year Togo and Dahomey were visited by the French steamship 'Tibet,' which had come from the French ports in North Africa. Two members of the ship's company, one of them the surgeon, died on the voyage with symptoms of Yellow Fever, and the entire crew were placed in quarantine in Dahomey for five days.

"In April cases of Yellow Fever were still occurring in Agoué and Grand Popo. In the latter place all Europeans were finally removed to a neighbouring village, where they were kept for some time. After their return, no further cases occurred.

"At the Convent at Agoué, the two remaining sisters (two had died in Anecho) also died of Yellow Fever. No cases were observed amongst the natives in Anecho."

The above is taken from the Annual Report for Togoland 1905–06, "Blätter und Briefe," by Dr. Külz. Dr. Külz mentions that possibly other but slight cases suggestive of Yellow Fever occurred in the Catholic mission at Anecho.

At a later period of 1905, Dr. Sunder, observed two fatal cases in natives in the district of Lomeland.

1906.

Yellow Fever appeared in January at Badja on the Lome-Palime Railway, 43 km. to the north of Lome, where six Europeans were attacked, of whom four died in a little more than a week. Another case ending in recovery occurred at Badja shortly afterwards.

In August a case infected at Tovega, to the north of Badja, ended fatally.

1907.

In March of this year Dr. M—— died of Yellow Fever at Palime. He had been infected in Anecho and died shortly after being transferred to Palime. Four cases in natives, of which one was fatal, occurred later at Anecho.

1910.

In January a case occurred at Anecho in a native: he recovered.

In August an epidemic occurred at Anima in the Trans-Kara region, 60 km. to the north of Sokodé. From July 26th–July 30th, twenty-five deaths and thirty other cases of illness were said to have occurred. A medical officer was despatched and thought the report exaggerated. He saw one fatal case of Yellow Fever, and two slight cases, which recovered. He concluded that the epidemic had probably been one of Yellow Fever. Two suspicious fatal cases in natives occurred at Sansane-Mangu in September.

A prisoner at Misahohe in June of this year died of Yellow Fever and pulmonary tuberculosis. A suspicious death also occurred in a European at Sokodé in September.

The Commission have considered the reports of 29 of these cases and have classified them as "Yellow Fever."

Dr. Le Fanu remarks on the high rate of mortality (66·6 per cent.), especially amongst the Europeans (85 per cent.), and the diffusion of the cases over the Colony.

In 1905 Dr. Külz was unable to discover cases amongst the natives, but in 1906 two were observed: four in 1907, four in 1910 and one in 1911.

We have prepared the following table to illustrate the extension of the disease as shown by these cases and the time it took to travel from the coast, assuming that it did so travel, which, of course, is not proved. Sansane-Mangu, Anima and Sokodé may have been infected from the interior.

Year.	Month.	Locality.	Distance from Coast.	Period from appearance in 1905.	Infection possibly carried.
1905	January...	Anecho ...	—	—	—
	February	Lome ...	30 miles	14 days ...	By rail.
	April ...	Anecho ..	—	—	From Agoué, in Dahomey.
1906	April ..	Lomeland	30 miles	—	By rail.
	April ...	Badja ..	57 miles	16 months	From Lome.
	August ...	Tovega ...	? (North of Badja)	—	—
1907	March ...	Palime ...	110 miles	2 years and 2 months	Rail from Anecho to Palime via Lome.
1910	August ...	Anima ...	257 miles	5 years and 7 months	Rail to Ackampe, Lome-Sokodé.
1911	June ...	Misahohe	—	—	Sokodé-Anima.

(*k*) DAHOMEY.

1905.

There are no records of the occurrence of Yellow Fever in Dahomey previous to 1905; but very little is known of the sanitary conditions prevailing there prior to that date.

In January of 1905 the disease appeared at Agoué, Ouidah and Grand Popo, and in six weeks from that date there were 13 cases with 10 deaths. The remaining Europeans, 14 in number, then left for France.

1906.

The disease reappeared at Ouidah in April and continued until June; out of 15 cases known to have occurred 12 ended fatally.

Locality.	Cases.	Deaths.
Kotonou	1 ...	1
Grand Popo	3 ...	1
Ouidah	7 ...	6
Togo	4 ...	4
	15	12

Cases were also reported from Porto Novo and Kaonu (? Kotonou).

1907.

The disease reappeared in January of this year.

(*l*) NIGERIA.

Southern Province.

The Administration of Lagos was taken over by the British Government in 1861. The chief towns of Southern Nigeria are Lagos, Forcados, Burutu, New Calabar, Bonny, Opobo, Calabar, Warri and Sapele.

Lagos.

1864.

On reference to p. 28, it will be seen that two fatal cases occurred on the "Hankey" with black vomit. The infection took place at Lagos. They were not returned as Yellow Fever, but the Surgeon of the "Hankey" reported that "at Lagos bilious fever was raging on shore, where out of forty-two Europeans twelve died within six weeks." He saw three cases on shore, all of which died with black vomit within 36 hours of the onset of the disease.

Bérenger-Féraud states (p. 141) that Yellow Fever was present at Lagos in 1864.

1894.

It is stated* that ten non-natives, nearly all of whom were Syrians, died in January. Several had hæmaturia and black vomit. Death occurred from the fourth to the sixth day. They were regarded as cases of "bilious remittent fever." The same writer states that during the year 31 Europeans died out of 150 resident.

1905.

The mortality amongst Europeans from Malarial Fever and Blackwater Fever during the years stated is given as follows :—

	Malarial Fever.	Blackwater Fever.
1897	11	2
1898	4	0
1899	12	3
1900	10	7

The European population is given as about 233, including ships in port.

1901	6	4
1902	4	5
1903	5	2
1904	6	2
1905	6	2
1906	5	4

1906.

Mortality from Malaria in Lagos and Ebute Metta :—

	Natives.	Europeans.	Total.
1905 ...	705 ...	5	710
1906 ...	542 ...	5	547

It is mentioned that an isolated case of Yellow Fever was reported from Dakar in September and one from Grand Popo in January.

1907.

No deaths occurred among the European officials from Malaria or Blackwater Fever.

Amongst the other Europeans, and white Asiatics, there was one death from Malaria : none from Blackwater Fever.

* Dr. G. Rome Hall, "British Medical Journal," 1911, 2, 1263.

Benin.

Benin now forms part of the Southern Province of Nigeria. It has a long history as regards Yellow Fever.

1828.

The disease is said to have been imported from Sierra Leone by the ship "La Bordelaise."

1862.

Benin shared in the epidemic of Yellow Fever which affected almost the whole of this part of the Coast.

Calabar.

1862.

Calabar was involved in the epidemic of Yellow Fever which "ravaged the whole African coast from the Congo to Sierra Leone," (*vide* p. 84).

1905.

"Many of the residents now realise the fact that a very narrow margin separates the slight fever from the malignant one, the former being as a rule a milder type of the latter, and they send at once for a medical man when they become ill instead of waiting to see what will happen."

Warri.

1906.

Four cases of Hæmoglobinuric fever occurred in persons of German nationality in the employment of one commercial firm.

Bonny.

1862.

It is stated that in 1862 an epidemic of Yellow Fever almost decimated Bonny and Wa, as fatal among the blacks as among the few white settlers of the Colony (Augustin). Two thirds of the inhabitants are said to have perished. Of 140 Europeans 70 were attacked in one month. Between April 4th and May 5th there were

62 deaths among the crews of vessels at Bonny. A complete account of this epidemic will be found on reference to p. 84, taken from the admirable report of Assistant-Surgeon W. J. Eames, R.N., H.M. Sloop "Bloodhound."

1891.

An epidemic is said to have occurred in this year of which details are not available.

CENTRAL PROVINCE.

1908.

"Mosquito nets are used by practically all the European community, and are becoming popular amongst the natives."

(IV) HEALTH CONDITIONS IN THE WEST AFRICAN COLONIES DURING 1862, A YEAR OF EXCEPTIONAL PREVALENCE OF YELLOW FEVER.

It appeared possible that a study of the health conditions in all the Colonies during a year in which there was a widely-spread epidemic of Yellow Fever might throw light, not only on the origin of the epidemic, but also on the mode of spread of the disease from one Colony to another, if it should prove that it depended for its wide distribution upon such transference.

It might also incidentally reveal the fact that during such a year, in Colonies in which Yellow Fever had not been officially notified, fevers had occurred to which certain names had been given which are known to be often applied to diseases closely resembling and probably identical with Yellow Fever.

Observation of the conditions immediately preceding and following such a wide-spread epidemic prevalence might also give results of interest.

The year 1862 has been selected because the disease is stated to have been present then in a larger number of Colonies and Islands than in any other year, viz: Angola, Benin, Bonny, Calabar, Canary Islands, Cape Verde Islands, Congo Coast, Fernando Po, Gold Coast, Ivory Coast and Sierra Leone.

Cape Verde Islands.

It is stated, but no authority is given, that the fever was brought on this occasion to the African Coast by some trading vessels plying between the Cape Verde Islands and Bonny.

Those islands were infected in 1862, but at what period of the year is not known. The epidemic there "was not very severe."

The earliest mention of the disease in West Africa in this year is at

Bonny.

"The epidemic of 1862 almost decimated Bonny, and was almost as fatal among the blacks as among the few white settlers of the Colony. Two thirds of the inhabitants of Bonny are said to have perished. Out of a population of 140 Europeans 70 were attacked in the space of a month. In one day as many as twenty bodies were taken out of the same house. The mortality in the shipping was heavy. The bark "Phrenologist" lost its captain, pilot, first mate and two sailors. The ship "Gran Bonny" lost four men.

"Between *April 4th and May 5th* there were 62 deaths among the crews of vessels at Bonny. (7, p. 167.)

"*Early in May* the fever broke out among the natives huddled in the towns and hamlets located along the banks of the Bonny River and spread rapidly to the officers and white portions of the crews of the palm oil vessels in the river * * * * * *. The contagion then successively attacked the crews of vessels lying at anchor in the numerous rivers flowing into the Gulf of Biafra, more especially the Old and New Calabar and Brass rivers. * * * * * *

"The epidemic, although of a vicious and generally fatal type, was of short duration, disappearing from all the rivers and bordering villages by the *end of June*."

Calabar.

Bérenger-Féraud states that Yellow Fever was in activity in 1862, but no particulars are given. It is suggested that it was "no doubt imported into Calabar by the palm-oil vessels trading along the coast." (7, p. 177.)

Fernando Po.

Fernando Po, a Spanish possession, forms one of a group of four islands in the Bight of Biafra, 20 miles off the coast of Guinea.

> "*In the early days of July*, 1862, yellow fever broke out amongst the Spanish population. The disease was first observed in one of two convict hulks in Clarence Bay and spread rapidly to the convicts and sailors in the other hulk, whence it attacked the soldiers composing the small garrison and the mechanics on shore.
>
> "In a very short time 76 out of 200, composing the entire purely Spanish population, were carried away by the disease. A remarkable phase of this epidemic is that it was confined exclusively to the Spaniards of unmixed blood, and did not attack the coloured Cuban settlers *(Emancipados)*, although the latter nursed the sick and visited freely all the foci of infection. This proves conclusively that the disease was the genuine West Indian yellow fever for the *Emancipados*, who evidently had experienced an attack in their own country, escaped unscathed." (7, p. 221.)

The source of importation is disputed. Some stated that "the inter-colonial mail steamer 'Retriever' brought the disease from Bonny, others that it was brought by the English ship 'Ferrol' from Havana." The "Ferrol" is stated by Augustin to have left Havana with 200 *emancipados* on board on *June 10th*, 1862. (7, p. 221.)

We have to thank the courteous Secretary of Lloyd's for the following information :—

"The 'Ferrol' was a Spanish ship and not British as stated. The only entry in 1862 or 1863 of the arrival of that ship at Fernando Po is on the 12th February 1863."

We know that there was Yellow Fever at Fernando Po when the "Bloodhound" arrived there on July 27th, 1862.

The Niger, Benin River, Brass River, Lagos, Fernando Po and Batanga.

Much light is thrown upon the nature and extent of the epidemic of 1862, and on the conditions preceding it, by the admirable account given by Assistant-Surgeon William J. Eames, R.N., in charge of H.M. Sloop "Bloodhound," of the fevers affecting the crew of that ship in 1860–61, 1861–62 and 1862–63.

ABSTRACT FROM THE JOURNAL OF H.M. SLOOP "BLOODHOUND," WEST COAST OF AFRICA.

MR. WILLIAM J. EAMES, *Assistant-Surgeon in Charge.*

Between the 25th July, 1860, and 30th June, 1861.

"With regard to the movements of the ship * * * * * * since our arrival on the coast a larger amount of river service has fallen to our share than to that of any other ship in the Bights division, this may be owing to the advantages which the ship is supposed to possess over any other for such service, a lighter draught, better ventilation, and being a paddle steamer which is considered to be better suited than the screw for this description of work, however that may be, it necessarily follows that the company of a ship so engaged are proportionately more exposed to the deleterious influences of the climate than that of a cruiser which has the advantage of being constantly at sea.

"I find that out of 222 cases which have been placed on the sick list during this time 106 or nearly one half are cases of Remittent Fever * * * * * (Note.—The Ship's Company numbered 68). Of these cases of Remittent Fever the larger number were attacked after leaving the River Niger in November last (Note—i.e. November, 1860. 'Febris' December, 1860, cases 48; January, 1861, cases 15; from December 6th to 16th, there were 40 cases of 'Fever' on board the ship). Since then although cases occasionally appear the disease has never assumed the form of an epidemic. The character of this Fever is as far as I have been able to judge similar in all its symptoms save one, to what is known as the Fever of the Mediterranean, the exception I allude to is the almost constant sequence of Articular Rheumatism in the latter disease, which as far as my experience goes is absent in this.

"The similarity of the two fevers consists first in the manner of attack. The patient complains for a few days perhaps of a feeling of general lassitude, disinclination for food, a sensation of cold, dull aching pains in loins and back; this if taken in time may pass off, but more frequently, about the third day, a distinct rigor takes place, followed by sweating. The tongue in these cases is sometimes covered with a brownish fur, but more frequently presents a white appearance and the pulse indicates that the circulation is disturbed. By the administration of proper remedies in five or six days the patient may be sufficiently well to return to duty, or complain perhaps of nothing more than slight debility. In unfavourable cases, however, the abdominal viscera in both fevers appear to be alike susceptible of becoming engaged, and in both the same symptoms indicative of this change exist. The tongue presents a red centre and tip, the edges being covered with a white fur. Pain is referred to the epigastrium, sometimes so severe as to prevent the slightest pressure being exercised without considerable increase of

it. Vomiting and diarrhœa are usually present in this stage. With regard to the origin or cause of this fever, I do not feel competent to give an opinion. No doubt much is attributed to Malaria, but what is Malaria? To ascribe a cause for producing an effect, it is necessary to know first what that cause is, and with regard to malaria so many authorities differ as to what it is * * * * * * that one is obliged to confess nothing yet is satisfactorily known on the subject. Experience proves that an influence exists in the rivers of Africa and on some parts of the coast which is not felt at a certain distance from land; that when the European constitution is exposed to this influence a certain train of symptoms follows, but farther than this I cannot see the present state of our knowledge warrants us to go. *We do not yet know whether it may be one or many causes which contribute to produce the same result.* An opinion prevails to a large extent amongst European residents here, that like some eruptive fevers, one attack renders a return of the disease very improbable, and that to become acclimatised it is necessary to have one attack. With regard to the first of these opinions, I need scarcely say that, over and over again, it has been proved within my own experience to be a fallacy. By referring to the sick list the names of many men will be seen entered some six or seven times for the same disease. With regard to the second I have not such good data to form an opinion on, but I think it highly improbable that anyone could be very long exposed to the influences of the climate without being the subject of an attack. The prophylactic influence of quinine in the fevers incident to this coast has been so well established that comment is unnecessary, although it does not secure perfect immunity from the disease there can be no question that by strictly attending to its use the chances of contracting the disease are very much lessened, and when it does appear the symptoms are generally of a mitigated character. Connected with this subject, however, a circumstance came under my observation lately which affords room for speculation as to how far and under what circumstances quinine operates in securing immunity from the disease, or rendering it when it does appear less fatal.

"Of the ships' and boats' crews comprising the *expedition lately undertaken against Porto Novo*" (Note.—In Dahomey, close to the frontier of Southern Nigeria; June, 1861), "some were exposed the whole time in boats, others were on board ship under cover. To all the same amount of quinine was given daily, almost all were engaged in precisely the same duties. Fever prevailed amongst all after our return, but in a ratio least expected. Amongst the men of the 'Arrogant' who, with the exception of ourselves, were better provided for than any other, the disease assumed a most virulent form. I cannot say the number attacked out of a force of about 150 which were sent, but up to the 30th June, during a space of 25 days, six deaths had taken place, the disease *carrying them off with alarming rapidity*. Amongst the boat's crew of 'Alecto' and 'Espoir', who were constantly in their boats and frequently in wet clothes, fever existed to a very limited extent and of a mild form, whilst amongst this ship's company 11 cases were placed on the sick list up to the 2nd June, the aggregate days of sickness amongst them being only 43,

or scarcely 4 days for each man, and this appears still more strange when it is remembered that immediately on our leaving the Lagoon we proceeded up the Brass River, where we remained six days. Quinine having been administered without any intermission from the date of entering Lagos, this would seem to argue that at least the medicine does not lose its prophylactic properties in any degree by a long continued administration of it. The only cause that I can assign for the large percentage of cases amongst the crew of the 'Arrogant,' is that the ship (one hired for the occasion) *when brought to Lagos* contained a quantity of green wood for fuel, which was removed, and the ship thoroughly cleansed preparatory to the embarkation of the men, some morbific influence may have, however, still remained."

This refers to a hired paddle-wheel steamer, which carried some of the men of the "Arrogant." That vessel was a ship of the Navy. The question is discussed on p. 100.

"The next class of diseases, viz., of the abdominal viscera have been with only one or two exceptions of a comparatively mild character, consisting chiefly of cholera, colic and diarrhœa. On our passage out after touching at Madeira a few cases of the former disease appeared. I attributed its appearance to the use of water which was taken on board at that Island. It yielded to the usual remedies and since then only a few sporadic cases have presented themselves (*Vide* infra)

"Ulcer, which to a large extent has prevailed lately, adds considerably to the number of sick for the 12 months. It only appeared lately during the time the ship was in the Victoria Lagoon. Unfortunately having got aground, where we remained fourteen days, we were subjected to great annoyance from mosquitoes. The bites from these insects being scratched took on the character of an ulcer.

"I am glad to say that during the year no deaths have happened on board. During this period 18 gallons of rum were used for the purpose of administering quinine."

The possibility of a ship harbouring at the same time the virus of two distinct diseases must not be overlooked. The case narrated below from the Journal of the "Bloodhound" is clearly one of cholera.

"A.D., æt 39, Captain's steward.—Placed on sick list on the forenoon 8th August complaining of vomiting, purging and prostration; pulse weak and slow. Tongued furred; evacuations watery. Treated with opium gr.i every 2 hours, at 12.30 p.m. became much worse, pulse scarcely perceptible, severe cramps in abdomen and calves of both legs and in a state of collapse. Treatment, sinapisms to calves, gr. 2 opii, &c. This treatment was continued for some hours, when the symptoms gradually yielded. This case is a type of many that presented themselves amongst the ship's company after leaving Madeira."

JOURNAL OF THE "BLOODHOUND."

1st July, 1861, *to* 30*th June*, 1862.

MR. W. J. EAMES, *Assistant-Surgeon in Charge.*

GENERAL REMARKS.

" During the past twelve months, from 1st July, 1861, to 30th June. 1862, the health of the ship's company has been satisfactory, the total days sickness for the year being 1,181, an average of 15½ for each man. No deaths have occurred from disease. The diseases attributable to climatic influences have borne the proportion of almost one-third to those which are incidental to other stations. With regard to fevers, the disease which calls for especial attention here, I have little to add to what was mentioned in my last report. As far as I can speak from personal experience there has not been any alteration in symptoms, but from all the accounts which have reached us, *the rivers seem to have suffered in more than an ordinary degree, the river Bonny in particular. The epidemic made its appearance in March*, 1862, *and raged with unabated violence for three months ; out of* 163 *white inhabitants* 130 *died in that time. It was equally fatal amongst the natives.* I have made all the enquiries in my power, and believe from the symptoms described, that the disease must have been the *true black vomit, from the first period of attack it generally ran to a fatal termination in* 48 *hours or less.* There was no medical man in the river, consequently the patients had not the benefit of any treatment, which may account for such a large mortality. The residents account for *this visitation, a thing so unprecedented*, from the fact of there being no regular rains last year and the irregularity of the breezes for some time previously. Scarcely any sea breeze prevailed. The land breeze before reaching the town must pass over an extensive swamp and arrives loaded with poisonous exhalations, the loss of the breeze blowing off the sea acting as an antidote to this, was most severely felt, and the present epidemic, or something of the sort, was predicted. After the experience I have gained in the last two years, I am inclined to think that the fevers incidental to this Coast have been divided in a manner too arbitrary for any practical use. We are called upon to believe that the disease engendered in the Niger is invariably followed by dysentery, a sequence that has not once come under my notice, although after leaving that river 68 cases were under treatment. The only instance I have met of dysentery as a sequence to Coast fever was in the case of a man now under treatment, who contracted the disease at Lagos.

" The difference between these fevers exists, in my opinion, in the degree of intensity, and being complicated with a disordered state of some viscera, particularly the liver. I have always noticed the most troublesome cases to exist with this complication, indicated by bilious vomiting, pain in right hypochondrium, and at a later period, by the conjunctivæ and sometimes the skin becoming tinged, and although unable to speak from personal experience, *I believe from all I can*

*learn Yellow Fever to be the same disease intensified to a great degree, in fact on more than one occasion I have noticed this bilious remittent fever to assume a character which would almost justify its being classed under that denomination.** As for drawing a defined line between the Remittent and Intermittent type, I think it is scarcely practicable, as on many occasions I have seen the one merge into the other, and for all practical purposes such a distinction is of little value, the same treatment being applicable to both. After having given Dr. Livingstone's pill a fair trial I do not think that it is * * * * * * superior in any way to any other purgative administered in combination with quinine. The treatment I usually adopt now is * * * * * * calomel 2 grains with 8 of quinine in two pills, at the expiration of 8 hours a draught composed of sulphate of magnesia, 2 dr. dilute sulphuric acid, ½ dr. 4 grains quinine and 2 oz. of water. This routine I occasionally vary according as other treatment may be indicated.

"Ulcers have not been so numerous as formerly. This can be accounted for by the small amount of river service which we have lately performed. Almost all these ulcers were caused by mosquito bites, which having been irritated quickly assumed that character."

JOURNAL OF H.M. SLOOP "BLOODHOUND."

MR. W. J. EAMES, *Assistant-Surgeon in Charge.*

Between the 1st July, 1862, and 30th June, 1863.

GENERAL REMARKS.

"In writing a statement of the different diseases which have prevailed on board during the past year * * * * * * by classifying the diseases into those affecting the different cavities, a pretty correct idea may be formed how much may be attributed to climatic influence and how much may be considered as incidental to this in common with other parts of the world. I find that during the 12 months, 163 cases have been under treatment, of these 153 have been discharged to duty well, 7 have died, 3 have been sent to hospital. Remittent fever forms a large proportion. 58 cases appear on the sick list * * * * * Yellow fever, although shewing a small number as having been attacked, furnishes the only cases of mortality which have occurred on board. I should premise by stating that at the time my report of this epidemic was written, I was only recovering from a very severe attack of fever, which rendered me unable for some days to attend to the duties which were demanded of me then more than ever, as it was during the time the greatest amount of sickness prevailed that I was attacked myself. However, with the exception of four days, during two of which I was delirious, I was able with assistance to get on deck and visit the patients. I only discharged myself from the list the day on which the ship arrived at Ascension in order that I might be able to attend to various duties which it was necessary should be performed. This disease, occupying

* The italics are not in the original.

as it does from the great mortality attending upon it the most prominent position, demands the first notice. Perhaps it will be as well to commence my report by giving a statement of the movements of the ship from the time the *first visit was made to Fernando Po* immediately *before leaving for the River Benin.* On our arrival at Fernando Po, on the 27th July, with H.M. Consul on board, a demand was made for our services through the Consul to proceed to the Benin, in order to obtain redress for some outrages that had been committed by the Natives. *We left for this river on 1st August,* consequently the duration of *our stay at Fernando Po on this occasion was five days.* I have made every enquiry both from English and Spanish residents, as well as the most intelligent natives of the place, and they all agree in their statement that, although great sickness and mortality existed at this time on board the convict hulks and shipping lying at anchor at Clarence Bay, it had not extended to the shore. With these ships and hulks we had no communication whatever. As the coaling depôt off which H.M. ships anchor is in another Bay (Maidstone) distant some mile or mile and half, at this time the ship was perfectly healthy. The disease prevailing at Fernando Po was *stated by the Medical Authorities to be Yellow Fever.* During this visit none of the the white ship's company with the exception of stewards and officers held any communication with the shore. Arriving *off the River Benin* on the night *of the 3rd August* we came to an anchor, and the following morning entered the river, where we *remained till 27th August, 23 days.* It is much to be regretted that no medical man was in the river whose opinion as to the nature of this disease, which had made such havoc amongst the residents, could be depended on, but from the statement made to me by a resident there, a Mr. Henry, who had studied medicine. I have no doubt the disease was *the same that had depopulated all the other rivers in the Bights—Yellow Fever.* His wife had died a month before, the symptoms he described were those of this disease, a few days after, a trading agent died with symptoms exactly similar. During our stay in this river the rains were prevalent, lasting sometimes for days without cessation. The river was swollen, and detached masses of floating vegetation separated from the banks were constantly coming down and fouling the ship, frequently causing her to drag. To clear these away necessitated a fresh exposure of the ship's company, and frequently their clothes were wet through once and twice in the twenty-four hours. Quinine was administered daily till the supply was exhausted, which happened a day or two before we left the river. All that could be procured in the river was purchased, but could not be given daily, as the stock at Fernando Po was finished, consequently I could not replenish there. *It will be seen that towards the latter part of August remittent fever became rather prevalent. Leaving the river on the 27th of August, we proceeded to Lagos,* where the Consul communicated with the Governor of that place. No unusual sickness was prevalent there at the time; leaving this, *we steamed to Fernando Po* in company with H.M.S. 'Brisk' and arrived *on 4th September.* At this time the sickness prevailing amongst the shipping had disappeared. There was none on the island. Only the usual communication with the shore took place, stewards and officers landing.

We remained *at Fernando Po* till 10th September, from whence we proceeded to *Batanga, a small village about* 50 *miles south of Cameroons;* it was while lying off this place on the 15th September that the first case of yellow fever appeared, 18 *days after leaving the river* (i.e. the river Benin), but it must be borne in mind that this man was complaining for two days before he applied for treatment, *notwithstanding this the time that elapsed between leaving and the appearance of the disease appears long.* Yet after having made all the enquiries in my power both from the stewards who landed with this man, and also from residents at Fernando Po as to disease being prevalent, I have not been able to trace the slightest evidence that would warrant an assumption that he contracted the disease by infection at that place.

"As I stated before, the 'Brisk' whose white men were employed daily on shore coaling, escaped without a case. To what then is the outbreak to be attributed? I confess I feel myself at loss to form anything but an opinion, which may possibly be an erroneous one, but I believe the germs of the disease to have been planted in the river. Why they should have remained so long dormant is the only unsatisfactory link in the evidence that has caused me to form this opinion. I regret that no clearer causes can be shown, as to its introduction into the ship, but it has not been owing to any want of exertion on my part to obtain every information, as every enquiry I could think of has been made. After the first case (which proved fatal) occurred we *stood out to sea and cruised for five days,* but finding this did not check the disease, we *started at once for Ascension,* calling at Fernando Po for coal, where we remained for 30 hours. On the passage across eight more cases appeared of whom five died. *Many cases of severe remittent fever were under treatment, but none were classed as yellow fever, except those in whom the symptoms were unmistakable.*"

The value of this record is greatly enhanced by the scientific caution shown in not at once concluding that all the cases were necessarily examples of one and the same disease. Probably there were many mild cases of Yellow Fever amongst them. If this excellent man had not been himself attacked he would doubtless have given equally good clinical records of some of these cases. The arrangements made for the accommodation of the sick consisted of a spar lashed fore and aft on one side of the forecastle, between which and the ship's side hammocks were slung, and attendants told off, who relieved each other twice a watch; the awning was kept spread, over which were placed tarpaulins, so that a constant supply of fresh air was always present; the treatment employed will be seen by reference to the cases which are given. The last case which appeared was in lat. 3′ S., long. 3′ 8″ W., and the disease had entirely disappeared before the arrival of the ship at Ascension.

REPORT OF CASES OF YELLOW FEVER ON H.M. SLOOP "BLOODHOUND."

"YELLOW FEVER. (1.)—J. P., æt 21, Lieutenant Commanding's Steward, presented himself on the evening of the 15th September, 1862, complaining of frontal headache, pain in loins and general lassitude, has been unwell for the last two days; constant irritability of stomach, pulse very small and quick, bowels confined, had cal. gr. v., rhubarb gr. x., quinine gr. v. On the following morning much worse, medicine had acted, tongue dry and covered with sordes, had quinine gr. iij every two hours with hydrocyanic acid and morphia in effervescence and essence of beef. At 4.0 p.m. he was still becoming worse, matter ejected from stomach thin and almost black, skin and conjunctivæ tinged, calomel gr. i was added to each dose of quinine and a small blister applied to epigastrium. On the 17th was seen at 4.0 a.m., he was suffering from cramp in legs and arms. Pulse scarcely perceptible. Tongue almost black. Ordered brandy and hot water every half hour. Castor oil ʒi and to continue as before. At 8.0 p.m. delirium set in. No urine had passed for 24 hours, bowels not opened, and evidently appears to be sinking; blister applied to nape of neck; ordered champagne, to have croton oil ℥ i. at once. At 2.0 a.m. on the 18th was called and found him in articulo mortis, applied hot water and friction to extremities and epigastrium, but without benefit. He expired at 2¼ a.m.

"YELLOW FEVER (2.)—J. B., 25, A.B., was placed on sick list on the 18th September, 1862, complaining of the usual symptoms of fever. He expressed himself "as having very little the matter." Pulse was not much accelerated, tongue looked clean; had quinine gr. iij, calomel gr. i three times and Dover's powder gr. x at night. The following day was worse, vomiting set in, tongue much furred, pulse quick; to continue the same. 20th, little change. Bowels confined, for which a mercurial purgative was given, and the same treatment continued with wine ʒiv. and at 8.0 p.m. castor oil ʒi. On the 21st the bowels were not opened. Tongue looked black, an enema of castor oil and turpentine was given which acted very slightly, and the same treatment as before. 22nd, much worse. Wanders, hiccough has set in and vomiting of a black ink-like fluid. Pulse small and slow; skin and conjunctivæ tinged. At 4.0 p.m. enema was repeated. A small quantity of black fœcal matter came away. Slight subsultus, perfectly insensible. 6.0 p.m. gradually sinking, tossing about and appears in great pain, low muttering delirium, vomiting almost constantly, ejected apparently without effort. Died at 8.50 p.m.

"YELLOW FEVER (3).—E. S., æt 25, A.B., was placed on the sick list on the 21st September, 1862, complaining of headache, pains in the back and other febrile symptoms. Treatment was commenced by the administration of quinine gr. v. calomel gr. iv. rhubarb powder ʒi. which was repeated in the afternoon. On the 22nd pulse quick, tongue looking black and covered with sordes. He appeared drowsy and difficult to rouse, although sensible when spoken to; a blister was applied to nape of neck and quinine gr. iv. calomel gr. ij. thrice a day. 23rd, motions quite black. Appears somewhat better. At 2 p.m. he became

suddenly worse, throwing his arms about and moaning, talks incoherently. Sol. of muriate of morphia ℥ 4 in wine was given, which had the effect of procuring four hours sleep, after which he awoke better. 24th, had castor oil ʒi. at 6 a.m. which acted at once, has had vomiting, skin and conjunctivæ yellow, but seems better; to continue as before. 25th, vomiting less urgent, bowels acting regularly, tongue cleaning, decidedly better. Same treatment continued from this date, he convalesced without any relapse, and on 20th October was discharged to duty well.

"Yellow Fever (4).—J. P., æt 24, stoker, was placed on the sick list on October 1st. He was seized on the previous evening with the premonitory symptoms of fever, headache, lassitude and pain in loins. Tongue slightly furred, pulse rapid. On the 1st he appeared better, the bowels had acted. Quinine gr. v. calomel gr. i. was ordered thrice a day.

"2nd. Tongue getting brown, pulse slow and labouring. When seen at 4 p.m. his bowels had been very loose, having had ten or twelve motions since the morning. Vomiting had set in. Matter ejected being a watery black-looking fluid. To continue quinine and wine during the night.

"3rd. Very much worse, delirious and was with great difficulty prevented from throwing himself out of his hammock. Eyes suffused. Tongue quite black and hanging out of his mouth, lips and teeth covered with sordes, skin tinged, vomiting almost incessant, head shaved and a blister applied to nape of neck. Some brandy and water was ordered, but could only with great difficulty be given. He died at 11.40 the same day.

"Yellow Fever (5).—W. C., æt 36, stoker, was placed under treatment on October 1st. Frontal headache which he complained of as being almost unbearable. Tongue not much furred, pulse slightly accelerated. Quinine gr. v. jalap and calomel was given. 2nd, tongue looking very black, has had vomiting (black), pulse slow and labouring. Appears stupid. 3rd, much worse, appears to be sinking; vomiting constant. Extremities cold. Hot water was applied to feet and abdomen, and a tablespoonful of brandy and water every quarter hour. He died at 10 a.m. on the same day."

ITINERARY OF H.M. SLOOP "BLOODHOUND."

From July, 1862, to September, 1862.

Arrived Fernando Po ...	...	27th July.
Left „ ...	...	1st August.
Arrived Benin River ...	...	3rd August.
Left „ ...	...	27th August.
Arrived Lagos	...	?
Left „	...	?

Arrived Fernando Po	4th September.
Left „	10th September.
Arrived Batanga	? 13th September.
Lying off Batanga	15th September.
Left Batanga	? 18th September.
Cruising at sea	? 19th to 24th September.
Arrived Fernando Po	?
Left „	"30 hours later."
Arrived Ascension	?

As the first case of Yellow Fever appeared on September 15th, "eighteen days after leaving the (Benin) River," the infection may have been acquired in the Benin River, if recently infected stegomyia were then taken on board, but it is specially to be noted that the first case occurred in a man who had in September landed with the stewards at Fernando Po, a place where Yellow Fever had been epidemic in July, but which was said to be free from the disease at the date of the second visit of the "Bloodhound" in September. Wherever the infection was acquired it was certainly not at Sierra Leone, as stated by Augustin (p. 323).

A good illustration of the inaccuracy of this author is afforded by his method of dealing with this incident. "In the Statistical Report of the Health of the Navy of 1862 it is stated that the squadron on the West Coast of Africa suffered from Yellow Fever. Although Sierra Leone is not directly incriminated, the infection was no doubt contracted there. Eleven cases occurred on board the 'Bloodhound,' seven of which died."

He does not state that all the cases in the squadron occurred on the "Bloodhound"; takes no trouble to ascertain, by a comparison of dates, where the infection probably occurred, and suggests that it must have been at a place at which the ship did not touch during the time that the disease prevailed on board. There is indeed no reference in the Journal to any visit to Sierra Leone in the year 1862.

CASES OF "REMITTENT FEVER" ON BOARD H.M.S. "ARROGANT" IN 1861.

Abstracts from the Journal of Dr. Hart Gimlette,

Surgeon, Royal Navy.

The disease was acquired in the Lagoon of Porto Novo between April 22nd and 28th, 1861, in the expedition against that place. The cases are those referred to by Assistant-Surgeon Eames in the Journal of the "Bloodhound."

Strength of the expedition from the "Arrogant."		Cases.	Deaths.
Officers and Seamen ...	104	41 ...	6
Marines	60		
	164		

Case 1.—"*Remittent Fever.*"

P. H., æt 22 Onset May 6th.

May 6th. Giddiness, frontal headache, pains in loins.
May 7th. Rigors, thirst, frontal headache. P. 80.
May 8th. Languid expression, denies any feeling of weakness.
May 9th. Restless, constantly getting out of bed.
May 10th. Tongue brown dry. P. 84.
May 11th. Stomach irritable: refuses food, restless, delirious.
May 12th. Suddenly became insensible. Died at 10.15 a.m. "Apparently from pressure on brain."

Autopsy—Head opened; results nil.

Case No. 2.—"*Remittent Fever.*"

T. G., æt 24, exposed to malaria in launch in the Lagoon of Porto Novo from April 22nd to 28th, 1861. Has been taking sulphate of quinine gr.iv every morning since the 22nd. Onset May 7th. Lassitude, weakness, pain in head, vomiting, tongue foul. Pulse 82.

May 8th.—Face flushed, pulse 84, eyes suffused, thirst, but not much headache.

May 9th.—Restless. Inclined to vomit.

May 10th.—Sickness continues. Vomited a bilious coloured fluid. Delirium. Pain in head greatly increased, tongue dry and brown. Symptoms of coma appeared in the evening. Pulse 94, weak and compressible.

May 11th.—Very restless and delirious, perspired freely and passed a large quantity of urine during the night. Stomach irritable.

May 12th.—Delirium continues, tries to get out of bed. Vomited. 2.0 a m. very violent. Died 1.40 p.m.

CASE 3. "*Remittent Fever attended with suppression of Urine.*"

G. I., æt 21, one of crew of launch. Exposed thirteen days previously at Porto Novo. Onset 8th May. Rigors, vomiting, headache, thirst, lassitude, weakness. Pulse 98.

May 9th. Heavy, difficult to rouse, delirious, tongue brown, pulse 100. Not passed water all day, but bladder not distended.

May 10th. Delirious, fell out of hammock, breathing stertorous. One ounce of urine drawn off by catheter "ammoniacal." Died 1.15 p.m.

CASE 4. "*Remittent Fever.*"

J. Mc.A. æt 26. Exposed April 22–28 in Lagoon of Porto Novo. Onset May 7th. Headache, giddiness, lassitude. Has been suffering more or less since 30th April; has taken vini quinæ ʒi during the whole period. Pulse 65. Feels chilly.

May 9th. Slight rigor, pain in head, increased, worse about forehead.

May 10th. Pulse 74. Slept badly, vomited two or three times. Urine scanty.

May 11th. Headache worse, drowsy, wanders. Pulse 86.

May 12th. Stomach irritable.

May 14th. Better.

May 16th. Deaf, headache returned.

May 25th. Convalescing.

June 7th. "A paroxysm of ague."

June 12th. At Ascension: recovered slowly.

CASE 5.—"*Remittent Fever.*"

W. P., æt 24. Exposed 22–28 April, at Porto Novo. Onset 8th May. Frontal headache, debility, rigors. Pulse 68. Has taken gr. iv. quinine regularly each morning since the 22nd April.

May 9th. Headache increased, cold, shivering, thirst. Pulse 84. Vomiting.

May 11th. Headache less. Vomiting.

May 12th. Restless night. Passed water freely.

May 15th. Comfortable, cardiac failure after getting up to night chair. Death 12.40 p.m.

CASE 6.—"*Remittent Fever.*"

J. K., æt 30. Same history as previous cases. Has taken gr. iv. quinine daily for 14 days. Onset on 10th day from forcing of barrier at Porto Novo. Rigors, frontal headache, anorexia, thirst, eyes dull and suffused. Pulse 84, irregular.

May 9th.—Much worse, headache, vertigo, rigor. Drowsy, in evening. Vomiting. Urine fair proportion, high coloured.

May 10th.—Violently delirious. Now comatose.

May 11th.—Comatose. Pulse 94. Very violent in night.

May 12th.—Sordes on teeth. Restless. Died 3.40 p.m.

CASE 7.—"*Remittent Fever.*"

I. H., æt 24. Same previous history. Onset 10th day after return to ship. Rigors, general pains, lassitude. Pulse 80. Vertigo. Quinine gr. iv. daily since 22nd April.

May 10th. Restless, headache, urine scanty.
May 11th. Restless, rigor, pains in back, deaf.
May 12th. Vomiting.
May 13th. Better until 2 p.m. then vomiting.
May 14th. Improving.
May 17th. Stronger. Pulse 90.
May 30th. Discharged to duty.

NOTES BY DR. H. GIMLETTE.—"In this man's case the early symptoms appeared to follow nearly the same course as in Case 45" (Case 6) "but without any particular plan of treatment a favourable change took place in this one, with a manifest remission of the head symptoms, although the pulse was not reduced for some time, but in the other the disease increased in severity and terminated fatality on the 4th day unchecked by the means employed. Both men were equally exposed to malaria, got wet at the barrier, were in the same boat and both took quinine as prophylactic for 16 and 17 days."

The above cases are the first seven recorded, the others are almost precisely similar in character; all the men were attacked about the same date and all had taken quinine regularly since April 22nd.

CASE 8. A similar case to last, recovered.

CASE 9. Recovered.

CASE 10. Recovered after a long illness.

CASE 11. Recovered after a long illness.

CASE 12. Recovered after a long illness.

CASE 13. Recovered after a long illness—violent delirium.

CASE 14. Recovered after a long illness.

CASE 15. Died from syncope after a period of improvement.

CASE 16. Occurred on 7th July at St. Thomas. Death on 17th July.

In recording the cases more attention was paid to noting minute details of treatment than to giving an accurate clinical description of the symptoms.

For example, the character of the vomited matter is only once mentioned, and the same remark applies to the presence of jaundice.

The following paragraph in the general remarks is important:—

"Two men who acted as nurses contracted this fever, who had not been absent from the ship, but at the same time another man was attacked who had no communication with the sick. The patients were isolated and kept on one side of main deck, and though Remittent Fever is not considered contagious, the idea of infection, etc., which most people entertain, is of great advantage to the patient on board ship in procuring him rest and quiet."

In the General Remarks of Dr. Gimlette in the Journal of the "Arrogant" for 1862 the following statements occur :—

Remittent Fever.—1862.

"A lad aged 16 was attacked without exposure of any kind, shewed symptoms of coma on the fourth day, without much previous headache ; became rapidly insensible and died off Lagos on the 8th day, his symptoms resembling in many points those of the men who suffered last year from fever after the attack on Port Novo."

"Remittent was complicated with dysentery amongst the Portuguese residents at Benguela and Pernicious Fever (so called) prevailed at Mossamedes, the most southern division of the province of Angola, which town * * * * * * had been used as a Sanatorium by the Portuguese troops until the latter portion of '61 and beginning of '62, when the malignant form of fever visited the province and decimated its inhabitants. As the 'Arrogant' did not call at Little Fish Bay, I was not able to ascertain the particular symptoms which marked the attacks, but all agreed that the disease was rapid in its progress and it was not styled Yellow Fever by the Portuguese practitioners.

"An intelligent officer, Captain of the Port at Benguela, who had been employed for fourteen years in the country, informed me that he had observed the same kind of sickness during his residence and that at one period it was termed Remittent, next Typhoid, and lastly Yellow Fever, without his observing much difference in its appearance."

Commentary on the Cases of Remittent Fever on the "Arrogant," 1861.

These cases are of great importance as illustrating the nature of the disease then termed "Remittent Fever." A review of the whole of the circumstances and of the clinical history of the cases, of which

abstracts are given, can, we think, lead to no other conclusion than that the disease was Yellow Fever. The suggestion of Dr. Eames that "some morbific influence may have remained" on the hired launch which carried some of the men of the "Arrogant" during the expedition is discussed by Dr. Gimlette, but rejected. The boat was, it is true, so foul that the men who cleaned out the hold were made sick by the horrible odour, but they were not attacked by the disease. The launch had come from Bonny, where in the following year there was a very severe epidemic, and might have harboured infected stegomyia elsewhere than in the hold, but from a consideration of the dates it appears to be more probable that the disease was acquired at Porto Novo. As cases appeared on the "Arrogant" in men who had not been out of the ship, infected mosquitoes must have been taken on board when the men returned from the expedition.

The conclusion at which the Captain of the Port at Benguela had obviously arrived as the result of fourteen years' experience in the country shews that, although not a medical man, he was possessed of much clinical acumen.

Ivory Coast.

Grand Bassam.

On the 16th November, 1862, the French despatch boat "l'Archer," which is said to have been *infected at St. Paul de Loanda* by communicating with the ship "Dialmath," arrived at Grand Bassam and landed one white and ten native sailors. The white sailor was taken ill on the 17th and died on the 20th, with unmistakable symptoms of Yellow Fever. None of the blacks, who were put on shore at the same time, contracted the disease.

"The fever did not spread immediately to the mainland, but soon broke out on the vessel. On November 26th the second steersman was stricken. The fever spread rapidly, five deaths occurring between November 28th and December 5th." Dr. Sarouille,* from whose

* Sarouille. Thèses de Paris, 1869, No. 150, p. 41, quoted by Augustin.

report the facts were obtained, was himself attacked. "On December 7th the Commandant, thinking that 'l'Archer' had been infected at Grand Bassam, took on board all the white inhabitants of the port who could be spared and sailed for Dabou. But the disease continued to appear on board, and by the time the vessel reached Dabou, December 12th, three more sailors had succumbed. The men who were taken on board at Grand Bassam were landed at Dabou, and strange as it may seem not a single case developed among them, the disease being confined to the sailors. This immunity can only be explained on the ground that the landsmen slept on deck, where the infected mosquitoes had no access, while the sailors were compelled in the performance of their duties to remain below decks most of the time, where they were unprotected from the bites of mosquitoes." (7, p. 233). It is surely more likely that only the seamen's quarters were harbouring the infected mosquitoes. On December 12th only three of the original crew remained alive. Subsequently the captain died, so that out of ten attacked only one recovered.

Cases began to appear at Grand Bassam shortly after the death on November 20th of the sailor landed from "l'Archer." Out of a white population of eighteen there were twelve cases and six deaths.

Assinie is situated on the coast about 30 miles east of Grand Bassam. "The European population at Assinie in 1862 consisted of the governor, the resident surgeon and three soldiers. *About the 10th December* two of the soldiers were taken ill and both died a few days later. The governor and the surgeon were then successively attacked, the latter dying on the 27th. The former recovered. The natives of the villages contiguous to Assinie suffered severely, but in the town proper there were only four deaths among the blacks, making a total mortality of eight." (7, p. 234.)

"Sporadic cases of Yellow Fever occurred at Grand Bassam and Assinie in 1863, but almost entirely among the natives. We find the record of only one death among the Europeans at Grand Bassam, an agent sent by a French commercial house to establish a factory at this post. He arrived at the 'unhealthy season' and remained three months on board a vessel in the harbour. During the month of

February, thinking all danger was past, he went on shore. Fifteen days later he was stricken with Yellow Fever and died eight days after the onset of the malady." *

Lagos.

It is interesting to note that although at Lagos in 1862 "no unusual disease was prevailing," yet in 1864 "bilious remittent fever" was raging and many were dying after a short illness with black vomit (*vide* p. 27). Was this an aftermath of the epidemic of 1862?

Angola.

1860, 1861, 1862.

St. Paul de Loanda.

St. Paul de Loanda is the capital of Angola on the Congo Coast. Angola is said to have been for a long period the radiating point of the slave trade. It is stated by Béranger-Féraud, but he does not cite his authority, that a severe outbreak of Yellow Fever occurred there in 1860, and that it was again visited by the disease in 1862, but the period of the year is not given.

Benguela and Mossamedes.

We know from the journal of the "Arrogant" that there was a disease at Benguela and Mossamedes in 1861 and 1862 of such a malignant type that it "decimated the inhabitants" of the province of Angola. There cannot be any doubt that this disease was Yellow Fever.

* Sarouille. Thèses de Paris, 1869, No. 150, p. 41, quoted by Augustin.

"THE ALBERT NYANZA AND THE SOURCES OF THE NILE."

By (Sir) Samuel W. Baker.

Sir Samuel Baker, on his arrival at Khartoum in 1865, when he had long been given up for lost, writes as follows (Vol. II., p. 340) :—

"The plague or a malignant typhus had run riot in Khartoum, out of 4,000 black troops only a remnant below 400 remained alive. This frightful malady that had visited our boat had revelled in the filth and crowded alleys of the Soudan capital.

"For some two days two or three of our men had been complaining of severe headache, giddiness and violent pains in the spine and between the shoulders. I had been anxious when at Gondokoro concerning the vessel, as many persons had died on board of the plague during the voyage from Khartoum. The men assured me that the most fatal symptom was violent bleeding from the nose, in such cases no one had been known to recover. One of the boatmen, who had been ailing for some days, suddenly went to the side of the vessel and hung his head over the river: his nose was bleeding! Another of my men, Yaseen, was ill; his uncle, my vakeel, came to me with a report that his nose was bleeding violently. Several other men fell ill; they lay helplessly about the deck in low muttering delirium, their eyes as yellow as orange peel. In two or three days the vessel was so horribly offensive as to be unbearable *the plague had broken out*! * * * * * * Yaseen died; he was one who had bled at the nose * * * * * * Mahommed died; he had bled at the nose * * * * * * Several men were ill, but the dreaded symptom had not appeared * * * * * * All night we could hear the sick muttering and raving in delirium, but from years of association with the disagreeables we had no fear of the infection. One morning the boy Saat came to me with his head bound up and complained of severe pain in the back and limbs, with all the usual symptoms of plague; in the afternoon I saw him leaning over the ship's side, his nose was bleeding violently! At night he was delirious. On the following morning he was raving and on the vessel stopping to collect firewood he threw himself into the river to cool the burning fever that consumed him. His eyes were suffused with blood, which, blended with a yellow as deep as the yolk of egg, gave a horrible appearance to his face, which was already so drawn and changed as to be hardly recognised * * * * * * Saat grew worse * * * * * * He never slept, but night and day he muttered in delirium, breaking the monotony of his malady by occasionally howling like a wild animal * * * * * * as morning dawned a change had taken place, the burning fever had left him and although raised blotches had broken out upon his chest and various parts of his body he appeared much better * * * * * * His pulse was very weak and his skin cold * * * * * * He is dead!

This disease was certainly not plague. It is to be remembered that Sir Samuel Baker was not a medical man, but the description which he gives of the cases coming under his own immediate observation is strongly suggestive of Yellow Fever and that the boat was carrying Stegomyia previously infected at Khartoum.

EAST AFRICA PROTECTORATE.

The following extract from a communication sent to the Governor of the East Africa Protectorate describes a fatal case of fever in a young European, which presents many of the characters of Yellow Fever.

It will be observed that it occurred in the course of an epidemic in which the disease proved fatal to many natives (*vide* p. 135.)

22nd December, 1913.

"With reference to your request for particulars regarding the death of our son, I beg to intimate that he was a perfectly sound and healthy young man, I am sorry that I am unable to give his exact temperature during the course of the disease as I had no clinical thermometer with me at the time, but from past experience I believe that during the first severe attack the temperature was about 107. In all my life in Africa I never was conscious of feeling with the hand so high a temperature in a human body. The heat of the body was not so high in the second exacerbation and lessened considerably as the time of departure approached. There was considerable suffusion of biliary secretion and jaundice was present in a marked degree, but I was not aware of any albuminuria being present.

"Bleeding from the nose continued at intervals during the course of the disease, and frontal headache was exceedingly severe and acute as long as consciousness remained. There were a great many cases of severe bilious remittent fever among the natives and numerous deaths from same in the district in which my son was stricken with the disease.

"The initial symptoms, which came on with alarming suddenness, were pains in the stomach and in the lower limbs, and immediately a feeling of coldness and shivering, while the face turned yellow. These symptoms were followed by an alarming hot stage with severe bleeding from the nose, frequent vomiting of yellowish and green matter and terrific frontal headache, and the patient soon passed into delirium. The hot stage prevailed without any diminution for a period of 8 hours, during which the temperature was probably 107°, after which the temperature gradually lowered for a period of 4 hours until it reached about 102°, during which a little sleep was obtained. After this the

patient was conscious, but in a very weak state for the space of 6 hours, during which time his speech was perfectly coherent, but he was not inclined to speak much. He refused to be carried home from the camp where he was, and insisted upon riding his pony a distance of 12 miles. After the sixth hour of lowered temperature the second exacerbation came on while he was at home, and although his temperature rose high yet it did not on this occasion reach above 105°, as far as I could judge. Delirium soon set in, and shortly afterwards the power of speech was lost and never regained.

"Twenty minutes before death, however, evident consciousness returned. His illness lasted 36 hours. After death the body was of a distinctly yellowish hue and blood oozed from the nostrils and also very slightly from the mouth.

"This disease has been known throughout Ukamba for a long period of time, and few years pass by without a few cases, and these generally come in the 'nunduni' or cloudy season of June and July. Never before in the memory of the oldest men have there been so many cases and so many deaths as this year. Their name for the disease is 'Kiathi' or 'Ndetema wa Nyonggo' (bilious fever) and they assert that during the course of the disease there is hæmorrhage from the internal organs, a greatly enlarged gall bladder (which sometimes bursts) and that after death, blood oftentimes oozes from the mouth, nose, ears and anus. Few patients recover, and their recovery is very slow, sometimes covering two years, while others never get strong again."

In the opinion of the Commission there can be little doubt that this is the same disease as that from which (Sir) Samuel Baker's men died in 1865.

Health of the Ships of the Navy on the West African Station in 1862.

	Admissions.	Deaths.
Continued Fever and Remittent Fever	675 ...	11
Intermittent Fever	140 ...	0
	815	11
Yellow Fever	cases 11 ; deaths 7	

The cases of Yellow Fever all occurred on the "Bloodhound."

Health of the Black Troops serving in Western Africa in 1862.

	Average Strength.		Admissions to Hosp.		Deaths.
Sierra Leone	317	...	252	...	9
The Gambia	209	...	254	...	4
Lagos ...	105	...	198	...	3
The Gold Coast	313	...	144	...	9

Sierra Leone.

"The admissions into hospital at Sierra Leone though somewhat above the average, have been greatly below the numbers in 1861. At the Gambia there has been a great increase in the admissions, but a decrease, to the extent of one half, in the deaths; and on the Gold Coast the admissions have been much under the average, while the deaths have been above it and greatly in excess of those in 1861."

Lagos.

"At Lagos the admissions were extremely high, amounting to twice the average proportion at the Gambia, but the deaths corresponded closely with the ratio at Sierra Leone and on the Gold Coast."

The Gambia.

One death occurred at the Gambia and one at the Gold Coast from remittent fever: none at either Sierra Leone or Lagos.

No death occurred among the European non-commissioned officers at any of the stations.

Commentary on the Epidemic of 1862.

It is evident that about the year 1862 Yellow Fever was a widely spread disease in Africa. It by no means follows, however, that because it was present in a great many centres fifty years ago it is to be found in those places to-day; nevertheless it ceases to be surprising that from time to time it should re-appear in one or more of them or

in new centres. Like other transmissible diseases it requires for its continued presence certain conditions, some of which may fail and so lead to its disappearance, and this in a given centre may be either temporary or permanent.

So far as these records go there is no evidence to show that it was imported into any African settlement from the West Indies or elsewhere in the year 1862, and we have the statement of the Medical Board whose report (1884) is given on page 34, that whenever it appeared in Sierra Leone (except in 1872) it was "the undoubted product of Freetown itself."

Like some other diseases it certainly spreads along the lines of human travel, but these records do not shew that in 1862 it was carried from one Colony to another. Also, like other insect-borne diseases, it requires for its continued extension the presence of its intermediary host, and so far as our present knowledge goes it is only by the destruction of the carrier that we can hope to wipe out the disease.

(v) ANALYSIS OF THE WEST AFRICAN EPIDEMICS OF 1910, 1911 AND 1912.

A report on the epidemics of Yellow Fever in 1910 and 1911, the work of Dr. A. E. Horn and Dr. T. F. G. Mayer, of the West African Medical Staff, successively attached to the Colonial Office, has already been published. The Commission have gone carefully through the records of the cases, and also of those which occurred in 1912, and have classified them on the basis which they have adopted throughout, viz. :—

Yellow Fever.
Probable Yellow Fever.
Possible Yellow Fever.
Negative.

In the last class are included cases in which the evidence did not attain to the arbitrary standard which, as already explained, the

Commission have fixed in order to secure the utmost possible degree of certainty, and also those, comparatively few in number, in which the diagnosis was thought to be wrong. In this analysis these two classes are differentiated. The inverted commas in the following analyses, e.g., "Yellow Fever," indicate the diagnosis of the cases arrived at by the Commission from a study of the records.

A general survey of the position as regards Yellow Fever in West Africa immediately preceding and at the time of the first outbreak in May, 1910, at Freetown, may be useful as an introduction to an analysis of these epidemics.

It is unlikely that a knowledge of the past history of the West Coast in relation to this disease, such as now appears in the Retrospect forming part of this report, was then present to the minds of many of those concerned.

The memory of the long history of epidemics at Sierra Leone, and elsewhere, had been buried in a happy oblivion, and much of the information on the subject now available has been obtained since that date.

On this as on other occasions no evidence was obtained, although careful search was made, that the disease had been introduced by an infected ship from the West Indies or some non-African Port, and this remains true of all the outbreaks which have occurred since 1910 in the British Colonies on the coast.

Sir Rubert Boyce states that "in 1908 a Syrian died at Freetown with symptoms which the Medical Officer who was in attendance regarded at the time as due to gastric ulcer. He now thinks that it might very well have been a case of Yellow Fever."

Also that "in 1909 a fatal case occurred, which in the light of recent experience the Medical Officers who were in attendance now conclude was Yellow Fever." This was diagnosed as phosphorus poisoning.

We have not verified these statements as regards the opinions of the individuals concerned, but the frequency with which the Syrians, who live in the native quarters of the towns, are the first to be obviously attacked in an epidemic renders any doubtful case occurring among them doubly suspicious. Whether a patient had or had not taken phosphorus should not have been a matter of doubt.

As this enquiry has proceeded it has become evident that in the year 1910 the disease was present at various places, distributed over a very wide area in West Africa.

Distribution of Yellow Fever in West Africa in 1910.

In January there was Yellow Fever at Anecho on the coast of Togoland.

In a report by Dr. Coghill, one of the Investigators appointed by the Commission, it is stated that a disease, which from the description given was undoubtedly Yellow Fever, " was brought south from Senegal " in March, 1910, Wagadugu being the chief centre of infection. From thence it was carried " west through the Wangara country—many dying on the way." In April it appeared at Leo, near the northern boundary of the Northern territories. In May it was at Gwong, south of Tumu, at Duluboi in July and at the end of that month at Kankillanbassie.

The period of suspicious cases in the Freetown epidemic extends from April 7th to May 16th. The case which occurred on April 7th has been classified by the Commission as " Yellow Fever." The last case occurred on September 22nd, 1910.

The first case in the Seccondee epidemic classified as Yellow Fever occurred on April 12th, although a fatal case of " possible Yellow Fever " occurred on March 24th.

A case of " probable Yellow Fever " occurred at Axim on July 6th, and another at Sawmills on July 18th.

At Lagos a case similarly classified occurred on July 27th, and another on August 5th.

In August there were cases at Anima in Togoland, 257 miles from the coast.

On October 18th seven deaths took place near Kayes, Dinguira and Setadougou, in Upper Senegal. In October three doubtful cases are recorded at Grand Bassam. In December there was an outbreak of Yellow Fever at Boulama, in Portuguese Guinea.

It is obvious therefore that in the year 1910 Yellow Fever was a disease widely distributed in West Africa, and that its appearance in the British Colonies in that year is by no means astonishing.

The Course of Yellow Fever Epidemics.

The following extract from a paper by Dr. Kohnke* on "The Sanitary Prevention of Yellow Fever," may be commended to the notice of those who are disposed to criticise medical action in relation to epidemics of Yellow Fever :

> "It is my experience that early cases, not imported, are not recognised in time to prevent infection, and it is my belief that they never will be. Diagnosticians who can at all times differentiate between the very mild cases of Yellow Fever and diseases resembling it, exist mainly in the imagination of the laity."

Dr. H. D. Geddings, a distinguished member of the Marine Hospital Service, United States of America, in a paper read at the International Medical Congress at Moscow, in 1897, on "Yellow Fever from a clinical and epidemiological point of view and its relation to the Quarantine system of the United States," observes† :—

> "The first cases occurring in a locality are usually of a mild type, and generally end in recovery, and it is only later, when the foci of infection have become greater in number, the cases more virulent, and the victims begin to die with symptoms not readily to be accounted for by the common diseases prevailing in the given locality, that suspicion begins to be aroused, and by this time it is usually all too late to undo the damage that has already been done and there follows an epidemic of Yellow Fever * * * *"
>
> "There is always a melancholy sameness about epidemics of Yellow Fever, and a brief description of one will suffice with certain modifications for all. There is always a period of an unexplained malady, at first usually mild, gradually becoming more severe and finally causing deaths. The cases begin to occur in widely separated localities, but on later investigation they may usually be traced to the one original source.
>
> "Then * * * the cases become more frequent and more severe, the deaths correspondingly more numerous * * * * a panic ensues, and there is a flight from the stricken city * * * *"

SIERRA LEONE.

Analysis of the Freetown Epidemic of 1910.

(*a.*) *Period of "Suspicious Cases."*

On April 7th, 1910, a Syrian (case 1) was admitted to hospital, and died on April 17th. Case classified as "Yellow Fever." On the

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*(7.1137). †Annual Report M.H.S., 1897, p. 236.

17th, a Syrian (case 2) died suddenly at home. "Negative," as no details were obtainable.

On May 5th a Syrian, living in Kissy Street (case 3), died in hospital. "Probable Yellow Fever." This would have been certainly classed as "Yellow Fever," but no post-mortem examination was made.

On May 5th a Syrian (case 4), living in Little East Street, died at home. "Negative." No details obtainable.

On May 7th a Syrian (case 5) died in hospital. "Probably Yellow Fever." This case was only not classed as Yellow Fever because of the absence of a post-mortem examination.

On May 13th a Syrian trader (case 7) died suddenly at his home without being medically attended. "Negative"—no details.

It could not be ascertained with certainty whether all these Syrians resided in the same locality, but it was found that more than one death had taken place in the same house.

(b.) Presence of Yellow Fever Recognised.

The second period as a rule coincides with the death of one or more Europeans, and it was so in this epidemic.

On May 9th an Englishman, aet. 42 (case 6) long resident in Freetown, was taken ill and died in the nursing home on May 14th from "Yellow Fever." Post-mortem examination.

On May 16th a meeting of the Sanitary Committee was summoned to consider the action necessary in view of the fact that Yellow Fever had appeared at Freetown.

(c.) Course of the Epidemic.

On May 25th another Syrian (case 8) died in the Colonial Hospital from "Yellow Fever." He was reported to have arrived from Dakar three weeks prior to May 23rd, 1910.

Case 9 was that of a European missionary who was taken ill on May 26th and died in the Nursing Home on May 31st from "Yellow Fever." The next case occurred in a European (case 10) who died from "Yellow Fever" on June 8th, after an illness lasting five days.

Case 11 was that of a Government official who was ill from June 25th to July 15th with some fever and jaundice—"negative"; wrong diagnosis; albuminuria absent; ? Insolation.

(d) Temporary Disappearance and Recrudescence of the Disease.

It often happens that after a more or less prolonged period of activity the disease seems to have disappeared. If the town is a port, quarantine is raised after 18 days from the date of the last death or the screening of the last case, and there is a general feeling of relief. Infected stegomyia are, however, still present, and in time find their victims.

Quarantine was raised from Freetown at the end of June, all necessary anti-mosquito measures being continued.

On July 18th another death of a soldier (case 12) occurred from "Yellow Fever," and Freetown was again declared infected.

On the same date a Syrian woman (case 13) was taken ill and died on July 22nd from "Yellow Fever." Case 14 was that of a Syrian, who died suddenly, in a house a few doors from that occupied by case 13, without medical attendance. A post-mortem examination was made, and was said to have confirmed the diagnosis; but as no details either of the illness or the autopsy are given the case was classified as "negative." Case 15 was a negro, æt. 23, a clerk on the railway, who had never been out of West Africa. He was taken ill on July 27th and died from "Yellow Fever" on August 2nd.

Case 16—also that of a negro, æt. 24, who was taken ill on July 30th, admitted to Hospital on August 1st with pyrexia, Faget's sign, jaundice, epigastric tenderness and albuminuria, and was discharged well on August 5th. "Probable Yellow Fever." Case 17 was that of a European trader, æt. 24, whose illness, which commenced on August 1st, was characterised by pyrexia, pains, vomiting, albuminuria and an erythematous blush on the skin of the back and chest, a condition which was also subsequently noticed in case 31 (*vide* p. 110). On August 11th he was sufficiently recovered to be removed to a Nursing Home. "Possible Yellow Fever." Dengue could not be absolutely excluded. Case 18 occurred in a Government official, æt. 27, taken ill on August 11th with pyrexia, Faget's sign and

vomiting, a trace of albumen. "Negative." Evidence not given in sufficient detail. Case 19, a negro cook, taken ill on August 18th and discharged from hospital on August 27th, was classified "negative," as the symptoms did not in the opinion of the Commission point to Yellow Fever.

(*d.*) *Second Disappearance and Recrudescence.*

On August 20th, 18 days after the last death from Yellow Fever and the screening of the last suspected case, quarantine was again raised and the port declared free from Yellow Fever; but on August 30th the occurrence of case 20 necessitated a third declaration that the port was infected.

This patient, a negro labourer, æt. 26, was taken ill on August 25th, admitted to hospital on August 28th and died from "Yellow Fever" on August 29th.

(*e.*) *Third Disappearance and Recrudescence.*

"On September 19th it was decided that, 18 days having elapsed since the last death from Yellow Fever, ships calling at Freetown should be given a clean bill of health, but that the regulations previously instituted for the protection of shipping should continue to be enforced for a time."

It is remarked that "the wisdom of the latter decision was proved by the occurrence of another fatal case."

On September 15th a European clerk (case 21) æt. 26, who had not been out of Freetown for some time, began to ail, but continued at work; on September 19th he was seen by a medical man and was admitted to hospital, and died from "Yellow Fever" on September 22nd. This was the last case known to occur.

Commentary.

1. A knowledge of the movements of the Syrian (case 1) for (say) six weeks prior to April 17th would be of interest, but there is no reason to believe that he landed from an infected ship. There is no evidence that the disease was imported.

2. Seven deaths (cases 1, 2, 3, 4, 5, 7, 8) occurred amongst the Syrians between April 17th and May 25th.

3. Case 4, classified as "negative," because of insufficient details, died at home in the same street as a fatal case, No. 7, also "negative," and for the same reason, and in close proximity to case 3, "probable," and case 8, "Yellow Fever."

4. As just stated, case 7, "negative," died at home in close proximity to cases 3, 4 and 8.

5. On reference to the map of Freetown (appended) it will be seen that cases 1, 3, 4, 7, 8 occurred in a part of the town where the Syrian quarter overlaps the European quarter.

6. The streets and places mentioned in connection with these cases are Kissy Street (3, 7, 8), Little East Street (4 and 7), Garrison Street (6), Tower Hill Barracks (12), Fourah Bay Road (13 and 14), Henry Street (15).

The neighbourhood of Kissy Street appears to have been the "Primary Epidemic Focus."

7. The interval of 18 days which must elapse from the death of the last patient, or the screening of the last case, is made up, of course, of two periods: The first of 12 days, allowed for the incubation within the body of the mosquito, the second of six days, for the incubation within the body of the patient.

It will be observed that in this epidemic :—

	Quarantine was raised	The next case occurred	Duration of	Interval.
(1)	"At the end of June"	July 18th ...	(18+18) ...	36
(2)	August 20th	Aug. 30th ...	(18+10) ...	28
(3)	September 19th ...	Sept. 22nd ...	(18+ 4) ...	22

From the above it is clear that if the period had been double that required by the quarantine regulations (i.e., 36 days), it would have coincided with or have been immediately followed by another case on July 18th.

From a scientific point of view it is manifest that the period of 18 days is insufficient ; but having consideration for the necessities of trade some arbitrary limit must be fixed by regulation, and Science can only say that a stegomyia *may* live 310 days, and that if

infected it *may* remain so during all that time, and that the observation of Marchoux and Simond that the virus can be transmitted from the infected mosquito to the next generation *may* ultimately be confirmed.

GOLD COAST.

Analysis of the Seccondee Epidemic of 1910.

(*a.*) *Period of Suspicious Cases.*

A European, æt. 29 (case 22), arrived at Seccondee from Accra on March 10th, 1910. At Accra he had "an illness of a similar nature," marked by vomiting and diarrhœa. Yellow Fever was not recorded there until 1911. He slept in the Town Council Offices, adjoining Cosby's bungalow, from which, later, several fatal cases came. Death occurred on March 24th, with marked jaundice of a lemon colour, which increased post mortem—"Possible Yellow Fever"—albumen not noted as present. This case was diagnosed as typhoid fever.

On April 12th the wife of the manager of a mercantile firm (case 23) was taken ill and after an illness lasting 16 days, marked by headache, pyrexia, saddle-back temperature and vomiting, she recovered and sailed for England on April 28th. There is no record of albuminuria. "Yellow Fever" on epidemiological grounds.

On April 27th the husband of the above (case 24) was taken ill and died on April 30th from "Yellow Fever." On May 8th a Government Official (case 25) was taken suddenly ill and died on May 10th from "Yellow Fever." On May 9th a missionary, æt. 25 (case 26), was taken ill and died on May 14th from "Yellow Fever." On May 10th a European, æt. 45 (case 27), died from "Yellow Fever." On May 12th and 13th a letter and a telegram were received from the Medical Officer at Seccondee reporting the occurrence of these cases "which exhibited the clinical symptoms of Yellow Fever."

(*b.*) *Recognition of the presence of Yellow Fever.*

On May 13th the Port of Seccondee was declared to be infected with Yellow Fever.

On the morning of May 15th a public meeting was held in the District Commissioner's Court and the situation was explained to those present.

Commercial Town—the portion of the town bounded on the west by the Hospital Road, on the south by the sea, and on the north by the Railway Timber Siding—was declared an infected area.

(*c.*) *Course of the Epidemic.*

On May 14th a post-mortem examination was made on a Hausa (case 28), who was said to have died suddenly during the night "Yellow Fever."

On May 16th an autopsy was held on a negro (Kroo), (case 29) who had been brought to the mortuary dead. "Yellow Fever."

On May 21st a European (case 30) died in Hospital after three days' illness from "Yellow Fever."

During the night of May 19th a European (case 31), æt. about 33 years, was taken suddenly ill, and died on May 27th from "Yellow Fever." This patient had "a rash like measles on the face, the upper part of the trunk and the backs of the hands" (*Vide* case 17, p. 107.)

On May 12th a missionary arrived in Seccondee, from Accra, and visited case 26 ("Yellow Fever") in Hospital. On May 20th he was brought to the hospital (case 32) in a semi-conscious condition, and died on May 23rd from "Yellow Fever."

Case 33 occurred in a government official, who was taken ill on May 22nd and died on May 25th from "Yellow Fever."

On May 24th a negress, the wife of a native clerk (case 34) died at her home in Essikado, near Seccondee, of "Yellow Fever." This was the last case which was known to occur.

(*d.*) *Disappearance of the Disease.*

The quarantine of Seccondee was raised on June 15th, 25 days after the isolation of the last case and 19 days after the last death from Yellow Fever. No recrudescence of the disease occurred.

Commentary.

1. It is stated in the report that "In view of the subsequent events it appears to be possible that the first case that occurred was case 22" ("Possible Yellow Fever"). There was an interval of nine days between the arrival of this patient in Seccondee, from Accra, and the onset of his illness; the inference being that if it was one of Yellow Fever it was either a relapse or infection took place in Seccondee.

2. It is suggestive that 19 days after the death of this patient cases should have appeared in Cosby's Bungalow, close to where he had lodged. Cases 23, 24, 25 and 31 can be traced to Cosby's Bungalow. Two cases (26 and 32) lived in the Wesleyan Mission Bungalow. Two cases (30 and 33) were probably infected in Bissue's Hotel, and one case (27) in Rust's Bungalow.

3. All the patients had been in Seccondee for periods longer than the usual incubation period of Yellow Fever.

4. There is no evidence of the introduction of the disease from without.

5. The sketch map of Seccondee (appended) shows the position of the houses where these cases occurred.

Axim.

On July 15th the death of an unofficial European (case 36) occurred at Axim. It was regarded as a case of Yellow Fever, and active measures were at once adopted. This patient had visited Secondee about June 20–22. He returned to Axim on July 6th. This case is classified as "Probably Yellow Fever." The signs were sudden onset, marked pyrexia, saddle-back temperature chart, Faget's sign, deafness, suppression of urine, vomiting, jaundice. Total duration of illness 4 days. Post mortem: The liver was enlarged and fatty. It is not expressly stated that albuminuria was present, and there was "a growth at the pyloric end of the stomach, otherwise it was normal." No further case occurred and Axim was not placed in quarantine.

Sawmills.

A European (case 35), aged 38, was brought from Sawmills Camp, 12½ miles by rail, to Secondee, on July 18th, and died from "Yellow Fever" at the latter place on July 19th.

No other case occurred.

SOUTHERN NIGERIA, 1910.

Lagos.

(*a.*) *Period of Suspicious Cases.*

A native, aged about 30, of the Yoruba tribe (case 37), came from Ilesha to Lagos. Two days later he was taken ill and after a similar period he was brought into the hospital. Apparently the day following admission was July 27th. There was then suppression of urine, jaundice, absence of malaria parasites, and black blood-stained fluid issued from the mouth. He died after a period of unconciousness on July 27th. The post-mortem findings suggested death from an acute disease, the liver was deeply bile stained and the stomach contained dark grumous looking fluid, but there was an "area of pneumonic consolidation in the right lower lobe." "Probably Yellow Fever."

Case 38 occurred in a negro of the Kroo tribe, employed in Lagos as a labourer. The illness is stated to have begun on August 5th, on the following day he was brought to the hospital in a dying condition, He was said to have vomited blood. There was suppression of urine, blood in the stools—coffee ground material was vomited after admission. On autopsy all the viscera were deeply bile stained; sub-mucous hæmorrhage was present in the stomach and intestines. Cloudy swelling of the kidneys. There were, however, areas of pneumonic consolidation. "Probably Yellow Fever."

No further cases were reported.

GOLD COAST.

Analysis of the Accra Epidemic of 1911.

(*a.*) *Period of Suspicious Cases.*

On February 24th, a European (case 39), died after an illness of uncertain duration (possibly 32 days), chiefly marked latterly by pyrexia, intense jaundice and bilious vomiting. Fever was absent until February 19th, 5 days before death; from its appearance until then it was continuous. The liver, on autopsy, was found to be greatly contracted, of an almost uniform yellow colour and harder than normal. The diagnosis, which was "acute yellow atrophy," is confirmed by the Commission.

(*b.*) *The Presence of Yellow Fever Recognised.*

On February 19th a European merchant (case 40), who had been engaged at Swanzy's factory, Accra, died in the hospital there, two days after admission. The symptoms were anuria, urine loaded with albumen, temperature ranging between 105° and 101° F.; no malarial parasites found on two examinations. This case is classified "Negative," owing to the very few details of the illness and the absence of a post-mortem examination; but it is to be noted that the reason given for the latter omission is "the diagnosis of yellow fever being considered sufficiently certain."

Swanzy's factory was sealed and fumigated and all the usual measures were at once put into force. No further cases occurred, "and the Gold Coast appeared to be free."

(*c.*) *Recrudescence of the Disease.*

On May 23rd, the same day on which Yellow Fever was reported from the Gambia, a European merchant (case 41), æt. about 24 years, attached to the Basel Mission factory, was admitted to hospital and died the same day of "Yellow Fever."

On May 23rd another European (case 42), contact of the former case, was admitted to hospital and died on May 28th of "Yellow Fever."

The natives living in the Mission premises were removed and isolated, and on May 24th one (case 43) was found to be ill with pyrexia, albuminuria, Faget's sign, absence of malarial parasites. He had recovered by May 21st. "Probable Yellow Fever."

On May 24th another native (case 44) was similarly attacked and recovered after an illness of the same duration (7 days). "Probable Yellow Fever."

On May 25th a native clerk (case 45), living in the native town of Christiansborg, was admitted to hospital with a similar attack and recovered after 7 days' illness. "Probable Yellow Fever."

On May 25th Accra was declared to be an infected port and was declared free from infection on June 14th.

(*c.*[i]) *Second Recrudescence of the Disease.*

On June 22nd an electrical engineer, æt. 35 (case 46), who had been working in an annexe to the Post Office, "underneath which was a damp store swarming with mosquitoes," was taken ill and died on June 26th of "Yellow Fever."

(*c.*[ii]) *Third Recrudescence of the Disease.*

(*a.*) *Period of Suspicious Cases.*

On August 26th a merchant, æt. 35 years (case 47), died after an illness of eleven days' duration marked by pyrexia, Faget's sign, restlessness, delirium, and terminating in coma. The urine did not contain albumen. The stomach was injected; the skin of the face was icteric —"Negative."

No further case was reported until December 20th, when a railway clerk (case 48) died after an illness of four days' duration, marked by hyperpyrexia and albuminuria. There was a history of alcoholism. "Possible Yellow Fever."

Commentary.

1. The "Primary Epidemic Focus" was apparently the Basel Mission factory.

2. First appearance of disease, February 19th.
Second „ „ „ May 23rd.
Quarantine declared, May 25th.
Port declared free, June 14th.
Third appearance of disease, June 22nd.

Period between last case and third appearance of the disease (18 + 8) = 26 days.

3. The source of the infection was not discovered.

4. The sketch map of Accra (appended) shews the position of the houses in which the cases occurred.

Avreboo.

Avreboo is a town 9 miles inland from Axim.

The manager of a rubber estate (case 49) "situated in a very hilly but sparsely populated country," was taken ill on June 22nd, 1911, and died on June 27th from "Yellow Fever."

No other case was reported.

THE GAMBIA.

Analysis of the Bathurst Epidemic of 1911.

(*a.*) *Period of Suspicious Cases.*

On May 8th a frontier soldier came to the Hospital, Bathurst, and stated that he was suffering from Yellow Fever. His reason for this opinion was that he believed he was passing blood in his urine. He was detained in a screened ward. The urine was slightly darker in colour than normal, but no blood was found at any time, nor was there albumen at any time. After detention for 5 days he was discharged for duty.

On May 18th a European (case 50), Royal Engineers, was taken ill and died in Hospital on May 23rd from "Yellow Fever." On the same day another European, Royal Engineers, æt. 32 (case 51),

was taken ill and admitted to Hospital on May 19th. On the 20th May the case was regarded as suspicious of Yellow Fever, a view which was confirmed after the autopsy on the following day. "Yellow Fever." Case 52, a European, was admitted on May 21st. He recovered. "Probable Yellow Fever."

(*b.*) *Recognition of the Presence of the Disease.*

On May 21st the presence of the disease was notified to the neighbouring ports.

(*c.*) *Course of the Epidemic.*

On May 26th a European private servant (case 53), one of five men, who were friends, of whom two died from Yellow Fever, died in a wing of Government House. Case classified as "Negative," owing to the absence of records of the illness and no autopsy made. On May 26th an Engineer, æt. 24 (case 54), died after an illness of three days' duration, of which the only record is the temperature chart (Temp. 101°–104°F). "Probable Yellow Fever."

(*c.*[i]) *Disappearance and Recrudescence of the Disease.*

No further cases appeared for six weeks, i.e., until July 6th.

On this date the Assistant Engineer (case 55) of the Government vessels in the Harbour was infected, and died on July 13th from "Yellow Fever."

This patient was treated in a house next to houses occupied by Syrians and natives.

On July 8th or 9th, a Syrian (case 56) was taken ill and died on July 12th of "Yellow Fever."

On July 16th a European clerk, aet. 27 (case 57), living 100 yards from the house occupied by case 55, many small houses of natives, Syrians and Moroccans intervening, died on the 4th day "with most marked symptoms." "Probable Yellow Fever"; evidence insufficient.

On July 15th a Syrian (case 58), living in Russell Street, about 500 yards from the house in which case 55 lived, developed a slight attack, from which he recovered in 7 days: "Probable Yellow Fever"; evidence insufficient.

Case 59 occurred in a Roman Catholic brother, who died on July 23rd "undoubtedly of Yellow Fever." This patient had left Bathurst through fear of the epidemic and died without medical attendance at Abuko. "Possible Yellow Fever"; evidence insufficient.

A European clerk, æt. 29 (case 60), who had nursed case 57, ("Probable Yellow Fever": owing to insufficient evidence) with whom he lived, was taken ill on July 22nd.

He was found concealed (the only case so found) but screened; the intention being to take him on board a steamer which left Bathurst on the following day; he died in hospital. "Probable Yellow Fever": details insufficient.

A Syrian (case 61) was taken ill on July 24th, a few days after his arrival in the Colony, and died on July 28th of "Yellow Fever." Post-mortem examination. This patient lived in the same house as case 58, also a Syrian, who recovered and is classified as "Probable Yellow Fever" owing to insufficient evidence.

The last case in this series occurred on August 2nd. The patient (case 62) was a Bank Cashier. "Although the symptoms were mild it was undoubtedly a case of Yellow Fever and the patient recovered." "Possible Yellow Fever." No sufficient evidence given.

(*c.*[ii]) *Second Disappearance and Recrudescence of the Disease.*

No further cases occurred for a period of more than three months.

On November 11th a French clerk (case 63) who had arrived from France via Dakar, one month before his illness, was seen by a medical man and found to have fever, Temp. 103° F. and continuous vomiting. He died on November 15th from "Yellow Fever."

On November 15th a member of the same firm (case 64) was taken ill with Malarial Fever. On November 18th he was profoundly affected by the news of the death of his friend (case 63) his temperature rose to 105°. He became extremely nervous, was removed to Hospital, and on the morning of the 21st his temperature suddenly rose to 107·2° and he collapsed and died. "Possible Yellow Fever."

Analysis of the Epidemic.

1. "All five patients (cases 50, 51, 52, 53, 54) were friends and often together in the Engineer's quarters."

2. The mosquitoes in these quarters were probably infected from a mild case in a native soldier.

3. A large number of Syrians (55) in the town escaped infection.

4. No evidence was obtained in support of the suggestion that the infection was brought by the S.S. "Akassa."

5. Quaratine declared ... ... May 21st.
"Last case" died. .. .. May 26th.
Disease reappeared ... . July 6th.
Disease disappeared ... ... August 2nd.
Disease reappeared ... ... November 11th.
Disease disappeared ... ... November 21st.

6. No evidence of the source of infection was obtained.

7. The sketch map of Bathurst (appended) shews the position of the houses in which the cases occurred.

GOLD COAST.

Analysis of the Epidemics of 1912.

Accra.

(*a.*) *Period of Suspicious Cases.*

A man, æt. 39, who had stayed at Accra from April 5th to April 8th, was taken ill at Weshiang on April 10th, and died on April 13th. "Probable Yellow Fever."

Reappearance of the disease.

Christiansborg.

Case 67 was a European, æt. 35, taken ill on May 30th, and died June 4th of "Yellow Fever."

(*b.*) *Course of the Outbreak.*

A European, æt. 35, living at Accra (case 68) suffered from a mild attack lasting from June 12th to June 21st. "Probable Yellow Fever."

A young German, æt. 27 (case 69), living at the Basel Mission workshops, Christiansborg, was taken ill on June 22nd and died on June 27th from "Yellow Fever."

LABADI.

The case of a clerk (case 70) taken ill on July 19th with pyrexia headache, brightness and yellowness of the eyes, Faget's sign and albuminuria was classified as "probable Yellow Fever."

He recovered after an illness of about 4 days.

"Enquiries were instituted at Labadi into the health of the occupants of the house from which this patient came." The result being that eleven patients (cases 71–81) were discovered, some of whom were suffering from slight febrile attacks. "A control examination of 15 people was made amongst the inmates of a house about 200 yards away, only one of whom shewed a slight rise of temperature." All these cases were classified as "probable Yellow Fever." Seven of these persons shewed a rise of temperature on July 28th.

SECCONDEE.

(*a.*) *Period of Suspicious Cases.*

On May 17th Mr. E—— (case 66) was taken ill with vomiting. On the 18th he was better, but had slight conjunctival jaundice. No headache, fever or albuminuria. On the 19th jaundice rather more marked; no headache, vomiting, epigastric tenderness or pyrexia. During the 20th and 21st there was nothing special to note. He made urine in normal quantity, but with a large amount of bile in it; no albuminuria; jaundice disappearing from the eyes and face, but more marked over abdomen and legs. Temperature, taken every four hours, always 98° or 98·4° F. Patient was quiet and made no complaint of any kind. The diagnosis up to that time was Catarrhal Jaundice.

(*b.*) *Recognition of the Presence of the Disease.*

There was, so far, no feature in the above case except the jaundice to suggest that it was one of Yellow Fever, but at 4 p.m. on May 22nd the temperature suddenly rose to 101° F., then to 106° F.; he became comatose; albumen appeared in the urine; dark fluid came from the mouth, and death followed at 5.30 a.m. on May 23rd. Post-mortem appearances typical of "Yellow Fever."

A remarkable case, illustrating the impossibility for more than five days of arriving at an accurate diagnosis.

AXIM.

On December 5th a native (case 82), æt. about 35, was taken ill with pyrexia and epigastric tenderness. Later Faget's sign and albuminuria developed with prostration and jaundice. He had recovered by December 15th.

The case was classified by a majority of the Commission as "Probable Yellow Fever."

(*B*)—RACIAL IMMUNITY—CLINICAL TYPES.

The literature of Yellow Fever, which is probably more extensive than that of any other disease, contains many references to the so-called immunity of the native races. This is believed to be either partial or complete, the latter view having always been held more firmly by the laity than by medical men. It is worth while to consider, briefly, the nature of the evidence upon which these beliefs are based, as the question is one of considerable practical importance. As we have already pointed out, the records of epidemics in West Africa are confined almost entirely to the incidence of the disease amongst Europeans, and it is not until well marked, and as a rule not until fatal cases occur in non-natives, that its presence is recognised. Upon such cases the attention of the affected community is centred, and neither then, nor at any other time, have they much knowledge of the state of health of the native population. Such of the latter as are in

contact with the sick may be observed to escape, and from this it is concluded that all natives are immune. Medical men, with more extended opportunities of observation, have seen that during epidemics cases undoubtedly occur amongst the natives, but that they are usually of a mild type; hence arises the view that the natives enjoy a partial immunity.

In the despatch from the Governor of Sierra Leone quoted on p. 30 it will be remembered that the following passage occurs:—

"A remarkable feature in the course of the progress of this disease is that, as it assumed a more virulent form, its presence became more and more restricted to persons of European birth, till at the point at which it reached its worst stage, and was admitted to be Yellow Fever, the natives seemed to have complete immunity from its attacks. With the exception of the case of a soldier of the regiment in the garrison here, a West Indian negro, the cause of whose death is, as I have already mentioned, stated to have been Yellow Fever, there has not been a single authenticated case of that disease among the negro population." This may be cited as an example of the lay view, but in the medical report forwarded with the same despatch we find the following: "The prevalence of this severe form of typho-malarial fever or Yellow Fever now so fatal among Europeans and native residents * * * * ."

"The extreme sick rate and mortality from fever amongst the native population occurring during the month of May and June (1884) in Freetown."

"The Registrar-General's return shows for May and June alone no less than 19 deaths amongst the resident natives." It is, however, not stated that these deaths were due to Yellow Fever, and from the analysis of the cases amongst the Europeans of which details are given, it is clear that there was also an epidemic of typhoid fever at the same time.

These extracts illustrate the difference between the observations of a layman and of medical men upon the same epidemic. In the extract from the description of the epidemic of 1778 in Senegal, by Schotte, the following passage occurs:—

"A most dreadful disease broke out which * * * * carried off the greatest part of the Europeans and a great number of the native

mulattoes and blacks, the Europeans suffered much more by it in proportion than the mulattoes, and those much more than the blacks."

This evidence is to some extent supported by figures, which must be taken for what they are worth, quoted by Augustin (p. 265) shewing the incidence of and mortality from the disease amongst the various races, observed in an epidemic of Yellow Fever at Goree (Senegal) in 1866.

	Cases.	Deaths.	Population.
Whites	242	107	268
Mulattoes ...	4	2	766
Blacks	3	1	2,500

The comment of the author, who is not a medical man, upon these figures, is as follows :—

"This remarkable immunity has always prevailed among the blacks, not only in Africa, but throughout the world."

It would be interesting to know how many cases of a mild type amongst the mulattoes and blacks were overlooked, as if the figures are accurate the case mortality amongst the former was 50 per cent. and amongst the latter 33 per cent.!

The same writer observes in reference to an epidemic of Yellow Fever in Senegal in 1878: "The course of the disease among the blacks, who in nearly every instance proved immune to Yellow Fever during epidemics in Senegal, is lightly touched upon by the numerous authors we have consulted, and the natural inference is that the natives must either have totally escaped or suffered so little that it was not thought worth while to go into details."

The evidence above adduced may be usefully contrasted with the following experience in America and West Africa. For the former we are indebted to an article by Dr. Charles Chassaignac, of New Orleans in Augustin's History of Yellow Fever (p. 1,054) on "Some Lessons Taught by the Epidemic of 1905" (Louisiana and Mississippi).

"It was shewn conclusively during 1905 that negroes are about as liable to contract the disease as the whites, but that they have it usually in a remarkably mild form."

He gives the following figures for the three places named :—

		Cases.		Deaths.		Per Cent.
TALLULAH ...	Whites	90	...	18	...	20
	Negroes	950	...	5	...	·5
LAKE PROVIDENCE	Whites	80	...	15	...	20
	Negroes	247	...	8	...	·3
PATTERSON ...	Whites	500	...	51	...	10
	Negroes	200	...	1	...	·5

"Several negroes were observed by me in Tallulah who had symptoms just about sufficient to make a diagnosis possible, yet who were scarcely sick, some not even interrupting their work."

"At first very few of the darkies reported their sick, and it was only when it became bruited about that the sick were supplied with delicacies, especially chicken during convalescence, that we obtained any idea of the large number who were having the disease" (p. 1055).

The following opinion is the result of the experience in Togoland, West Africa, of Dr. Sunder, of the German staff. It is contained in an article entitled "Yellow Fever among Negroes" (*Gazette*, 8th January, 1907). "It is to be hoped that the assertion that negroes are immune to Yellow Fever, which has for a long time been in contradiction with the known facts, may be regarded as finally disposed of. The black race is as little immune to Yellow Fever as it is to malaria."

It is unnecessary to labour this point further, as no one now contends that the native population of West Africa is immune to yellow fever; indeed, the evidence of their susceptibility obtained by the Commission is steadily increasing.

CLINICAL TYPES OF YELLOW FEVER.

If the form of the disease generally observed in Europeans and "Newcomers" is regarded as its only true manifestion it is not difficult to understand why it has been believed that the natives in the coast towns enjoy an immunity to its attacks.

The difference in the clinical picture presented by cases such as those met with in Tallulah by Dr. Chassaignac and by severe cases of

the hæmorrhagic type is so great that, at first sight, it appears almost impossible that they can be examples of the same disease. On consideration, however, it will be seen that the difference is not greater than that between a case of hæmorrhagic small-pox and one of a mild type occurring in an individual who, although vaccinated, was not completely protected, or than obtains between a mild case of enteric fever and one of the hæmorrhagic variety.

Few physicians in this country have seen cases of Yellow Fever, and a considerable experience of enteric fever may not include one of which the following is an example. The case was under the care of a member of the Commission in a London hospital.

H.H. æt. 20. Silversmith. Admitted, January 6th, 1901.

No history of hæmophilia in family or patient.

Measles and whooping cough in childhood: no illness since: no history of syphilis.

Onset. December 27th, headache and rigors. December 30th, had a "sore throat." December 31st, diarrhœa.

Temperature observed by medical attendant has been as follows:—

January 2nd.	103°F
January 3rd.	101·1,
January 4th.	101·2.
January 5th.	M. 100.
	E. 101·4.
January, 6th.	M. 100·4.

On several occasions during the week preceding admission he has noticed that when he blew his nose blood appeared on the handkerchief, on one occasion in considerable quantity.

On admission. Well nourished. Complains of fever, diarrhœa and abdominal pain. Lies low in the bed: knees are flexed and abducted. Lips dry and cracked; small aphthous ulcers on the anterior pillars of the fauces; tongue coated with white fur on dorsum, red at tip and edges; a few spots on the abdomen, which fade on pressure; gurgling in right iliac fossa; motions liquid and green in colour; heart and lungs normal; abdomen not tumid: spleen cannot be felt: urine normal does not give Ehrlich's reaction.

January 8th. Blood does not give Widal's reaction. Tâche cérébrale well marked on abdomen and face.

January 6th to 20th. Temperature of remittent type ranging between 100°–103° E. and 99°–100° M. Pulse 88–100; diarrhœa ceased on December 12th.

January 15th. Slow agglutinative reaction with culture of bacillus typhosus.

January 22nd. Slight epistaxis.

January 23rd. Very severe epistaxis; hæmatemesis; hæmaturia; urine resembled blood; ecchymosis in lobule of left ear, at site of puncture for examination of blood; purpuric spots above and below knees; no hæmorrhages in retina; bleeding from gums.

January 24th. Large quantity of blood in urine; epistaxis continues; gums still bleeding; purpuric spots on left upper eyelid and ecchymoses in left supra-spinous fossa.

January 25th. Less blood in urine; stools tarry from blood.

January 26th. Epistaxis ceased; blood disappeared from urine; 10.30 p.m. sudden pallor and abdominal pain; delirium; pulse imperceptible: death.

Post-mortem appearances.—

Numerous hæmorrhagic spots in the skin.

Stomach. Small hæmorrhages all over the mucous membrane.

Small Intestine. The mucous membrane of the lowest part of the ileum was grey and shreddy and there were several sharply cut ulcers; none of them were very deep, and all appeared to be in the early healing stage. Above this area some of the Peyer's patches had a "shreddy" loose network appearance, without definite ulceration: some small ulcers of the solitary follicles.

Large Intestine. Contained a large quantity of recent blood. The mucous membrane was stained of a reddish colour; there were a few small shallow ulcers near its upper end. The hæmorrhage did not appear to have come from some definite ulcer, but to be part of a general condition.

Mesenteric glands. Moderately enlarged and soft.

Spleen. Enlarged, dark and unusually firm.

Kidneys. Extensive hæmorrhage into the renal pelvis on both sides and into the peri-renal tissue on the right side; renal substance pale.

Liver. Some small hæmorrhages on the surface.

Bladder. A few small hæmorrhages in the mucous membrane.

Heart. Numerous hæmorrhages into the muscular tissue, valves and visceral layer of the pericardium.

Lungs. Œdematous; a few small pleural hæmorrhages."

No one, of course, would think of basing the clinical description of typhoid fever, as met with in this country, upon the record of such an exceptional case; but if it is true that the common type of Yellow Fever amongst the natives of regions in which that fever is constantly present (*maladie habituelle*) is a comparatively mild disease, it follows that an analogous error is committed when the hæmorrhagic type of Yellow Fever, as met with in a "new-comer" into a Tropical region, is regarded as the only form of that disease.

The necessity of insisting upon the existence of these two types, differing so widely in their gravity, appeared to be new, but a little

research into the literature of the subject shewed that it had not escaped the notice of a learned writer (Dr. Lind) from whose works we have already quoted.

AN ESSAY ON DISEASES INCIDENTAL TO EUROPEANS IN HOT CLIMATES (1777).

By JAMES LIND, M.D., F.R.C.P.E.,

Physician to Haslar Hospital.

> "In the West Indies, as in other unhealthy climates, fevers and fluxes are fatal to Europeans, but the disease which is commonly called the Yellow Fever is more particularly destructive to them.
>
> "Having considered this disease with attention, I am now of opinion: That the remarkable dissolution of the blood, the violent hæmorrhages, the black vomit, and the other symptoms which characterise the Yellow Fever, are only accidental appearances in the common fever of the West Indies.
>
> "They are to be esteemed merely as adventitious, in the same manner as purple spots and bloody urine are in the smallpox, or as an hiccup in the dysentery; like these, they only appear when the disease is accompanied with a high degree of malignity, and therefore always indicate great danger."

EPIDEMICS OF YELLOW FEVER OF A MILD TYPE.

There is abundant evidence available to prove the occurrence of cases of Yellow Fever of a mild type, firstly the direct inoculation experiments, of the American Commission consisting of Drs. Reed, Carroll and Agramonte, and secondly the records of numerous epidemics. Of these latter probably that at Ocean Springs is the most complete and the most instructive. The population of the States concerned is predominantly Negroid.

Ocean Springs is a health resort of Mississippi, a place at which in the summer there is a constant coming and going of visitors, and one therefore peculiarly adapted as a centre for distributing a transmissible disease. The epidemic is recorded in the Annual Report of the Surgeon-General of the Marine Hospital Service of the United States for 1897.

> "The epidemic of yellow fever which occurred shortly after the close of the last fiscal year has its official beginning from the 4th September,

when an officer of this service proved by post-mortem examination the existence of the disease in Ocean Springs, Mississippi. This, however, is not the actual beginning of the epidemic, for it had been in existence, though undiscovered, for many weeks before its formal announcement.* * Subsequent information has shewn satisfactorily that the first victim of the disease was a person who came from a Central American port, through a local quarantine, in April, prior to the beginning of the quarantine closed season. The mildness of the epidemic prevented it becoming a matter of public concern, and this, coupled with the hesitation which men naturally exhibit in admitting the existence of yellow fever, kept accurate knowledge from the hands of the authorities. The experience at Ocean Springs is evidence of the benignity of the disease, where there were 400 *cases of this unrecognised mild type of yellow fever* with extremely slight mortality.

"This mild type led to general denial of the first cases appearing in communities, and occasioned widespread discussion as to the correctness of the expressed opinions of acknowledged experts. Controversies proceeded with more or less acrimony in several localities, but the correctness of the opinion of the officers employed by the government as to the existence of yellow fever was promptly confirmed by local physicians and health authorities."

The first report of a Committee on August 23rd, 1897, stated positively that the disease was "Dengue."

The Marine Hospital Service (a Federal institution), however, persisted in their inquiry, and in September despatched another of their own officers, who, after much difficulty with the local authorities (State Officials), established by post-mortem examination the diagnosis of Yellow Fever. There were then records of over 500 cases of the disease.

"We then visited four cases of the so-called 'Dengue Fever.' The characteristic disproportion in pulse rate, icteroid skin, conjunctivæ and prostration appealed to us strongly."

The record of the final interview between the Federal and the State Officials, when the diagnosis of Yellow Fever was still being resisted and the tension extreme, is almost dramatic. Just as relations were about to be broken off and the Marine Hospital Service officers had decided to leave, "the resident physician hastily announced the imminent death from convulsions of Miss Shutze, the patient seen by Dr. Saunders and diagnosed as Yellow Fever. This information was a thunderclap to those who had announced it Dengue."

It is interesting to note that the case on which the diagnosis of Yellow Fever was finally accepted by all was one in which that disease proved fatal in an individual previously infected with malaria and in whose blood the malarial parasites were found shortly before death. They were present in four out of five cases of the fever then again specially examined, but it is not stated that the other cases were fatal.

The following extracts from the report (9, p. 622) of Surgeon H. R. Carter, a recognised authority on the disease, are of interest. Dr. Carter determined, before the discovery of mosquito transference, by accurate observation of cases, the existence and duration of the "extrinsic incubation period," a very remarkable achievement. It is now, of course, known that this corresponds to the period during which the virus is believed to be undergoing changes whilst it is in the body of the mosquito.

> "To understand the matter we must premise that Ocean Springs was not a business place, simply a health resort, or watering place. Its communications, then, with other places was almost entirely by persons (pleasure seekers) and the effects of such persons, and while of course these people came and went between it and the other towns, especially health resorts on the coasts near by, yet it had much communication also with somewhat distant places : New Orleans, Mobile and a number of places in Mississippi and some in Alabama and Louisiana. If yellow fever existed here to any extent and for a somewhat long time, many of these places must have already been infected and a somewhat widespread epidemic was impending."
>
> "Subsequent developments lead me to believe that all the fever reported generally as prevailing fever on the Mississippi coast, was yellow fever and that it was introduced early.
>
> "(1) Certainly there was much yellow fever at Ocean Springs, Scranton, Biloxi, Bay St. Louis, McHenry and Barkley, and at Edwards and other places in North Mississippi.
>
> "(2) At Ocean Springs, the local practitioners claim that none of the symptoms differentiating dengue from yellow fever : eruptions, double paroxysms, painful convalescence, arthralgia, etc., were observed by them in about 700 cases. They recognised only one kind of fever.
>
> "(3) At the places infected from Ocean Springs yellow fever was invariably observed, and at most of them no claim was made of the existence of any other disease save yellow fever.*
>
> "(4) I have made a careful enquiry of a number of physicians on this coast, and the places infected from this coast, for which unusual opportunities were given in the post-epidemic work, and they say,

* There was an epidemic of Dengue in Texas, as in the three cases seen by Dr. Carter the symptoms were typical.

without exception, that no one had the 'prevailing fever' a second time. This to me is very strong evidence, almost proof (unless an attack of some other disease gives a temporary immunity to yellow fever) that the prevailing fever was one disease, and that disease yellow fever.

"As to the time it had existed at Ocean Springs, a number of cases generally estimated at 600, had occurred in Ocean Springs before it was announced and guarded against. This would imply that it had been in this place a long time. Independently of this, a large number of physicians, and such laymen as I have had an opportunity to speak with, say this disease existed in Ocean Springs in the early summer. Dr. Bailey, of Ocean Springs, from a record, fixes one case in a resident of that place on May 19th, which would bring its introduction (if introduced by a person sick with the fever) not later than the first part of May; how much earlier this does not determine. There was little hope that this disease was confined to Ocean Springs."

From Ocean Springs as a centre Yellow Fever was carried to nine States and forty-two cities. The total number of cases officially recorded from September 4th, 1897, to December 25th, 1897, was 4,426 and the deaths numbered 494. In these figures the cases, variously given as 500, 600 and 700, which occurred before the disease was officially recognised are not included.

It would be difficult to find a more complete illustration than is afforded by the record of this epidemic of the occurrence in a Negroid population of Yellow Fever as a mild disease, and of the dire events which may follow failure to recognise its earliest appearance, even though it should present itself in that seemingly innocent garb.

This mild form occurs in West Africa, where hitherto only the appearance in Europeans of the type accompanied by hæmorrhage has been considered sufficient to justify a diagnosis of "Yellow Fever."

Epidemics of Yellow Fever of a Severe Type amongst Natives.

At the same time, other, and at first sight contradictory evidence is increasing, tending to show that amongst the natives living in regions either distant from the Coast or from the European Settlements on the Coast, epidemics of a disease, which cannot be

distinguished from Yellow Fever, are of occasional occurrence and that such epidemics are attended with a very high mortality.

The following are examples of such outbreaks :—*

1. The epidemic at Khartoum in 1865, referred to on page 103, which is said by (Sir) Samuel Baker to have been of such a fatal character that "out of 4,000 black troops only a remnant of 400 remained alive."

To this disease, which can only from the description have been Yellow Fever, although called plague, the death of (Sir) Samuel Baker's native attendants on the voyage to Khartoum was due.

2. The epidemic described on page 91 amongst the natives in the delta of the Niger in 1862 which was attended by a great mortality.

3. The epidemic in East Africa in which the son of the Missionary at the Ukemba Mission, Maindoindoni, Donyo Sapuk, died in November, 1913. (p. 104)

4. The epidemics described in the report of Dr. H. S. Coghill, one of the Investigators of the Commission, as having occurred, according to the statements of the native chiefs, in Senegal and the Northern Territories of the Gold Coast in 1910, and (?) 30 years previously (?1880) and at a still earlier date, again (?) 30 years previously (?1850) (*vide* p. 109) †

We have, therefore, to recognise the occurrence amongst the natives of the West Coast of Africa of two types of Yellow Fever, the one a mild type accompanied by such slight symptoms that its diagnosis is often very difficult, and another the hæmorrhagic type, presenting all the grave and fatal characters of the disease as it commonly affects Europeans and newcomers into any area in which it is more or less constantly present (*maladie habituelle*).

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* It is also questionable whether the fatal epidemic jaundice, observed from time to time in Egypt and especially in Alexandria, may not have some relation to Yellow Fever.

† It is to be noted that all these epidemics were reported by non-medical men.

(*C*)—YELLOW FEVER IN CHILDHOOD.

There have been differences of opinion with regard to most points in connection with Yellow Fever, and the incidence of the disease in childhood is not an exception.

European children are not, we imagine, very numerous in the West African Colonies, and it is not, therefore, probable that much evidence will be forthcoming as to the incidence of Yellow Fever amongst them.

As regards native children, it is apparent that much difficulty will be experienced in ascertaining the facts as to their illnesses, unless of a severe type. We learn from all witnesses that the natives are very suspicious of investigations into the nature of the diseases from which they suffer, and also that they have a far higher opinion of their own medicine men than of the white man's medicine. This, however, does not extend to his surgery, for which they now express great admiration ; if, therefore, the medical ailments of native children are to be investigated with success, it can only be done by first gaining the confidence of their parents through the treatment of their surgical affections.

On the general question of the incidence of and mortality from Yellow Fever at various ages, there is agreement that the disease occurs with greater frequency and greater severity amongst adults than at any other period of life.

In the Lisbon epidemic of 1857, out of 3,465 deaths 2,577 were in adults, 572 amongst the aged, 288 in children and in 28 the age was not known.†

In other terms, in every 1,000 deaths from Yellow Fever :—

750 were adults (16—60 yrs.) ;
166 were aged (61—100 yrs.) ;
84 were children (1—15 yrs.).

The percentage mortality at various ages is not stated.

† Bérenger-Féraud, p. 483.

In the 1905 epidemic in New Orleans,* up to November 8th, there were 430 deaths, thus distributed according to age :—

1—2	8
3—5	11
6—10	16
11—15	38
16—20	56
21—25	56
26—30	65
31—35	36
36—40	47
41—45	36
46—50	23
51—60	27
61—70	10
71—75	1
	430

Pothier † in an article on the pathology of Yellow Fever states :—

"We must not forget that the majority of fatal cases of Yellow Fever occur in adults" * * * * * * "It is remarkable how rarely children or young children die of Yellow Fever. In fact in them the disease is so mild as to pass unnoticed by the best experts on Yellow Fever : a fact noted by all who have seen Yellow Fever and all who have written on the subject. It is possible, however, that children are less susceptible to the poison."

If the above statements are accurate, and also are applicable to the native children of West Africa, it is not likely that it will prove an easy task to determine what proportion of such of the natives as now possess immunity to Yellow Fever acquired it in childhood.

It may be, as Dr. Pothier suggests, that children are less susceptible to the virus of Yellow Fever than adults ; but this would not be proved by showing that fewer children or still fewer infants contracted the disease.

* Statistical review by Lezard. Augustin (p. 107.)

† Augustin (p. 1147.)

(*D*)—TABLE SHEWING THE INCIDENCE OF YELLOW FEVER

IN THE WEST AFRICAN COLONIES AND SETTLEMENTS FROM 1900 TO FEBRUARY, 1914.

	1900	1901	1902	1903	1904	1905	1906	1907	1908	1909	1910	1911	1912	1913	1914
Sudan		++	++					++	++						
Senegal	++	+		++	++	++	++				++	++	++		
Gambia	++	−	−	−	−	−	−	−	−	−	−	++	−	−	
Portuguese Guinea											++	++	++	++	
French Guinea ...		+													
Sierra Leone ...	−	−	−	−	−	−	−	−	−	−	++	−	−	−	+
Liberia															
Ivory Coast ...			++	++	+	+					++				
Gold Coast ...	−	⊕⊕	+	+	+	+	+	−	−	−	++	++	++	+	+
Togoland... ...						++	++	++			++			+	
Dahomey ...						++	++	+						+	
Nigeria, Southern	−	−	−	−	−	−	−	−	−	−	⊕		⊕	++	++
,, Northern	−	−	−	−	−	−	−	−	−	−	−	−	−	−	−
Cameroons ...	−	−	−	−	−	−	−	−	−	−	−	−	−	−	−

Epidemic of Yellow Fever ... ... = ++
Yellow Fever reported ... ... = +
Suspicious cases ... ... = ⊕
Reported absent or not mentioned in report ... = −
No Reports received ... ... Blank.

GENERAL CONCLUSIONS.

A consideration of the facts brought out in the several sections of this report and in the evidence which has come before them during the course of the enquiry, so far as it has hitherto been carried, has led the Commission to the following general conclusions :—

1. That Yellow Fever has occurred from time to time since 1778 in various parts of the British West African Colonies.

2. That there is no evidence to shew that the infection in each outbreak has been introduced from outside Africa.

3. The mild nature of the attack in certain cases of Yellow Fever makes the identification of such cases a matter of great difficulty. It is therefore essential that in the future all cases of fever should be carefully observed and classified in order that, so far as possible, such mild cases of Yellow Fever may not pass unrecognised.

4. The attention of all workers at this subject should be specially directed to the discovery of a clinical test for Yellow Fever. The Commission do not in the least degree underestimate the importance of the researches which they are prosecuting in connection with the nature of the virus, and also of research as to the appearances by which its presence could be recognised in the body of the mosquito ; indeed, it is quite possible that by such researches the desired clinical test may be found, but the extreme practical importance of being able to determine whether a mild case of fever is or is not Yellow Fever renders it essential that all possible methods should continue to be employed in the clinical study of the disease.

5. The Commission are of opinion that the day has gone by for endeavouring by the use of euphemistic terms to conceal the presence of Yellow Fever, and that the only hope of eradicating that disease lies in boldly facing the facts ; also that failure to take all possible steps to destroy a focus of Yellow Fever is an offence against the comity of nations.

The Commission desire to thank the Liberian Minister for kindly making enquiries as to the occurrence of Yellow Fever in the Territory of the Republic.

The Commission also desire to thank the Director-General of the Medical Department of the Navy for kindly allowing extracts to be made from Journals of Surgeons on H. M. Ships on the West African Station, and also for obtaining leave for research to be undertaken in the Admiralty Library.

JAMES KINGSTON FOWLER.
W. J. SIMPSON.
RONALD ROSS.
W. B. LEISHMAN.

1st July, 1914.

APPENDICES.

APPENDIX I.

Bibliography.

A list of some of the works and papers consulted in the preparation of this report.

1. Official Despatches of Governors to the Secretary of State for the Colonies.

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3. Statistical Reports of the Health of the Navy.

4. Annual Reports of Surgeons of the Royal Navy on the health of the ships in which they are serving.

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19. Sir Rubert Boyce, M.B., F.R.S. Report on the Outbreak of Yellow Fever in British Honduras in 1905.

20. James Carroll. The History, Cause and Mode of Transmission of Yellow Fever (1903).

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24. James Carroll. The Treatment of Yellow Fever (1905).

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Robert Robertson, Surgeon, Royal Navy. A Physical Journal kept on board H.M.S. "Rainbow," 1772, 1773 and 1774, to which is prefixed a particular account of the Remitting Fever which happened on board H.M.S. "Weasel" on that coast in 1769. (1777).

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APPENDIX II.

Further List of Investigators and members of the West African Medical Staff engaged upon the work of the Commission.

At Freetown, Sierra Leone :—

J. M. Dalziel, M.D., C.M. (Edin.); B.Sc. Public Health (Edin.); D.T.M. (L'pool); W.A.M.S. (Medical Officer, Nigeria (N. Provinces)).

W. B. Johnson, M.B., B.S. (Lond.); F.R.C.S. (Eng.), L.R.C.P. (Lond.); W.A.M.S. (Medical Officer, Nigeria (N. Provinces)).

At Lagos, Nigeria (Southern Provinces) :—

A. Connal, M.D., Ch.B. (Glas.); D.P.H., D.T.M. and H. (Cantab.); W.A.M.S. (Nigeria (S. Provinces)); Director of the Medical Research Institute, Lagos.

APPENDIX III.

List of Reports already received.

1. Interim Report upon "Yellow Fever" at Abeokuta, Southern Nigeria, by Dr. E. J. Wyler.

2. Report on Work at Sekondi, by Dr. H. S. Coghill and Dr. H. M. Hänschell.

3. Yellow Fever Report, No. 1, by Dr. E. J. Wyler.

4. Experiments and Observations on Yellow Fever, by Dr. J. W. Scott Macfie and Dr. J. E. L. Johnston. (Read before the Royal Society of Medicine, and published in the Proceedings of that Society, Vol. VII., 1914 (Medical Section), pp. 49–67. Also published in the Yellow Fever Bureau Bulletin, Vol. III., No. 2, pp. 121–144.)

5. Southern Nigeria Yellow Fever Report, No. 2, by Dr. E. J. Wyler.

6. Yellow Fever Report, No. 3, by Dr. E. J. Wyler.

7. Report on Yellow Fever in the Northern Territories of the Gold Coast, by Dr. H. S. Coghill.

8. Report on the work carried out by the Local Investigator at Freetown from 1st of May to the 14th of September, 1913, by Dr. G. G. Butler.

9. Report to the West African Yellow Fever Commission on the Examination of the Blood of Twenty-five Normal Guinea-pigs for the Presence of "Seidelin Bodies," by D. Thomson, M.B., Ch.B. (Edin.), D.P.H. (Cantab.).

10. Yellow Fever Report, No. 4, by Dr. E. J. Wyler.

11. Notes on a Visit to Sherbro by the Local Investigators, Freetown (Dr. J. M. Dalziel and Mr. W. B. Johnson).

12. A note upon the Occurrence of a Plasmodium in the Blood of West African Monkeys, by Dr. Harald Seidelin and Dr. Andrew Connal. (Published in the Annals of Tropical Medicine and Parasitology, Vol. VIII., No. 1, April, 1914, pp. 81 and 82.)

13. Summary Report of Investigations carried out under the Yellow Fever (West Africa) Commission of the Colonial Office, August, 1913–January, 1914, by Dr. Seidelin.

14. Experimental Yellow Fever in Laboratory Animals, by Dr. Seidelin and Dr. Connal.

15. Further Report on Yellow Fever in the Northern Territories of the Gold Coast, by Dr. Coghill.

16. A Note on Mosquito Dissection, by Dr. Seidelin and Mrs. Sophie Summers-Connal, B.Sc.

17. Report on a Visit to Guayaquil, by J. M. O'Brien, M.R.C.S. (Eng.), L.R.C.P. (Lond.), D.T.M. and H. (Cantab), W.A.M.S. (Medical Officer, Gold Coast).

18. Notes on Cases reported to Yellow Fever Investigators, at Accra and Lagos, by Dr. Seidelin.

19. Notes on Pseudo Carriers, by Dr. Seidelin.

20. Report on Experiments with an Apparatus for Fumigating with Cresyl, by Dr. Seidelin.

21. Notes on the Biology of Stegomyia Fasciata, by Dr. Seidelin.

22. Mosquito Experiments, by Dr. Seidelin, Dr. Connal and Mrs. Summers-Connal.

23. Report on work done at Freetown, by Dr. Dalziel and Mr. Johnson.

24. Report on the Examination of Normal Guinea-pigs, by Major D. S. Harvey, M.D., Ch.B. (Glas.), R.A.M.C.

25. Report on Certain Outbreaks of Yellow Fever in 1913 and January and February, 1914, by Dr. T. M. R. Leonard.

26. Short Summary of Work Done on Natural Infections in Guinea-pigs, by Dr. Connal.

27. A Preliminary Report on the Histological Lesions in Guinea-pigs Infected with Yellow Fever, by Dr. Seidelin.

28. The Experimental Transmission of Paraplasma Flavigenum, by Dr. Seidelin.

29. Report on Two Months' Work at Quittah, by Dr. G. E. H. Le Fanu.

30. Report on the work done in Sekondi, from the 1st of October, 1913, to the 30th of April, 1914, by Dr. Hänschell.

31. Report on a Series of 800 cases of Fever investigated at Sierra Leone, by Major J. C. B. Statham, R.A.M.C.

Printed by Waterlow & Sons Limited, London Wall, London.
1914.

MAP I.

FREETOWN

SHEWING WHERE CASES OF YELLOW FEVER OCCURRED IN 1910.



0 500 1000 FEET

0 1 2 3 4 FURLONGS

Qtr where Europeans live

Qtr „ Syrians „

Y.F. cases numbered red to correspond with numbers in text.

For reduplication of the number 7 see page 7 of the Report.

WATERLOW & SONS LIMITED, LONDON WALL, LONDON.

LONDON SCHOOL OF TROPICAL MEDICINE
LIBRARY

MAP 2.

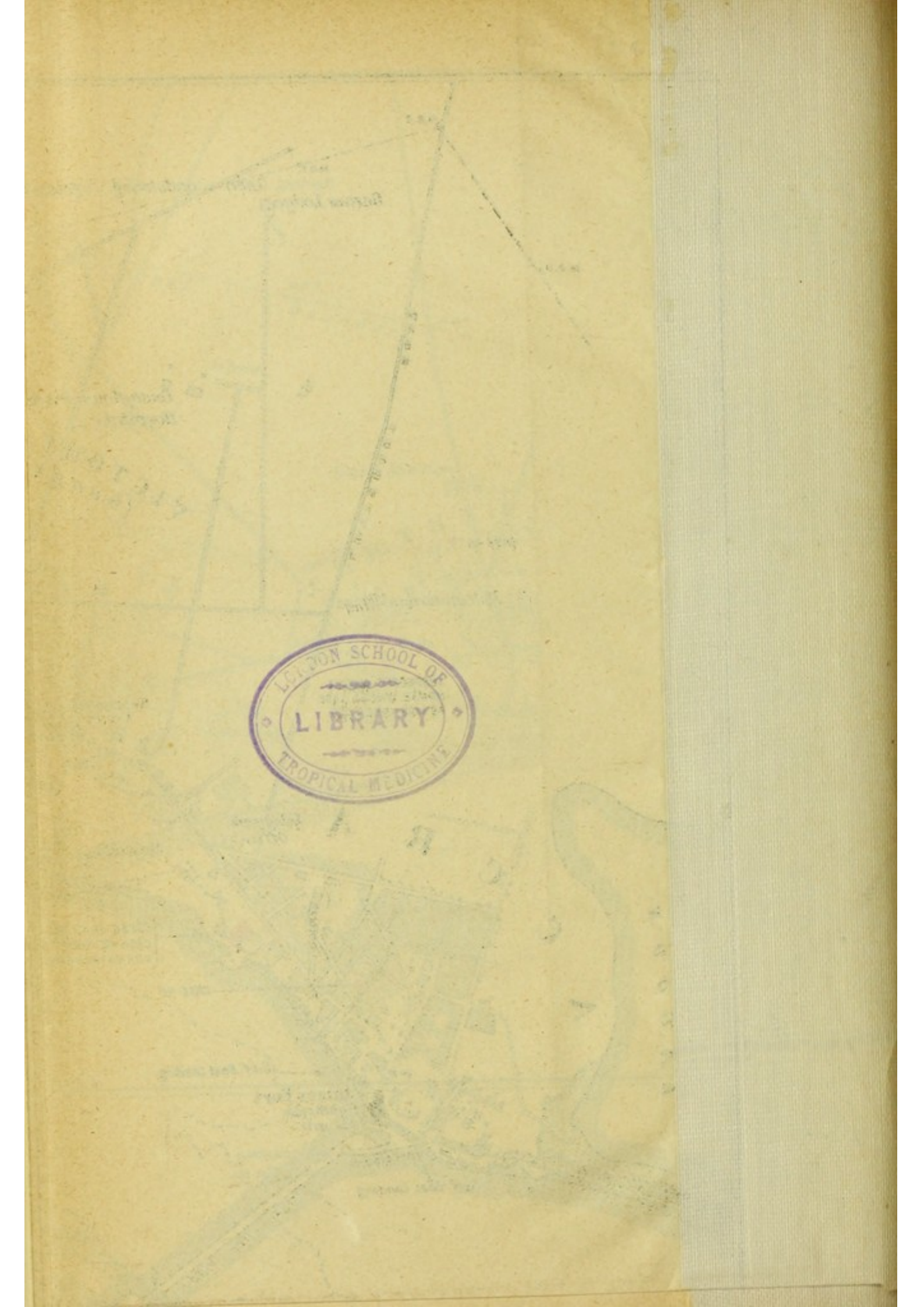
SKETCH PLAN
OF
SECCONDEE.

Scale:- 1:5000

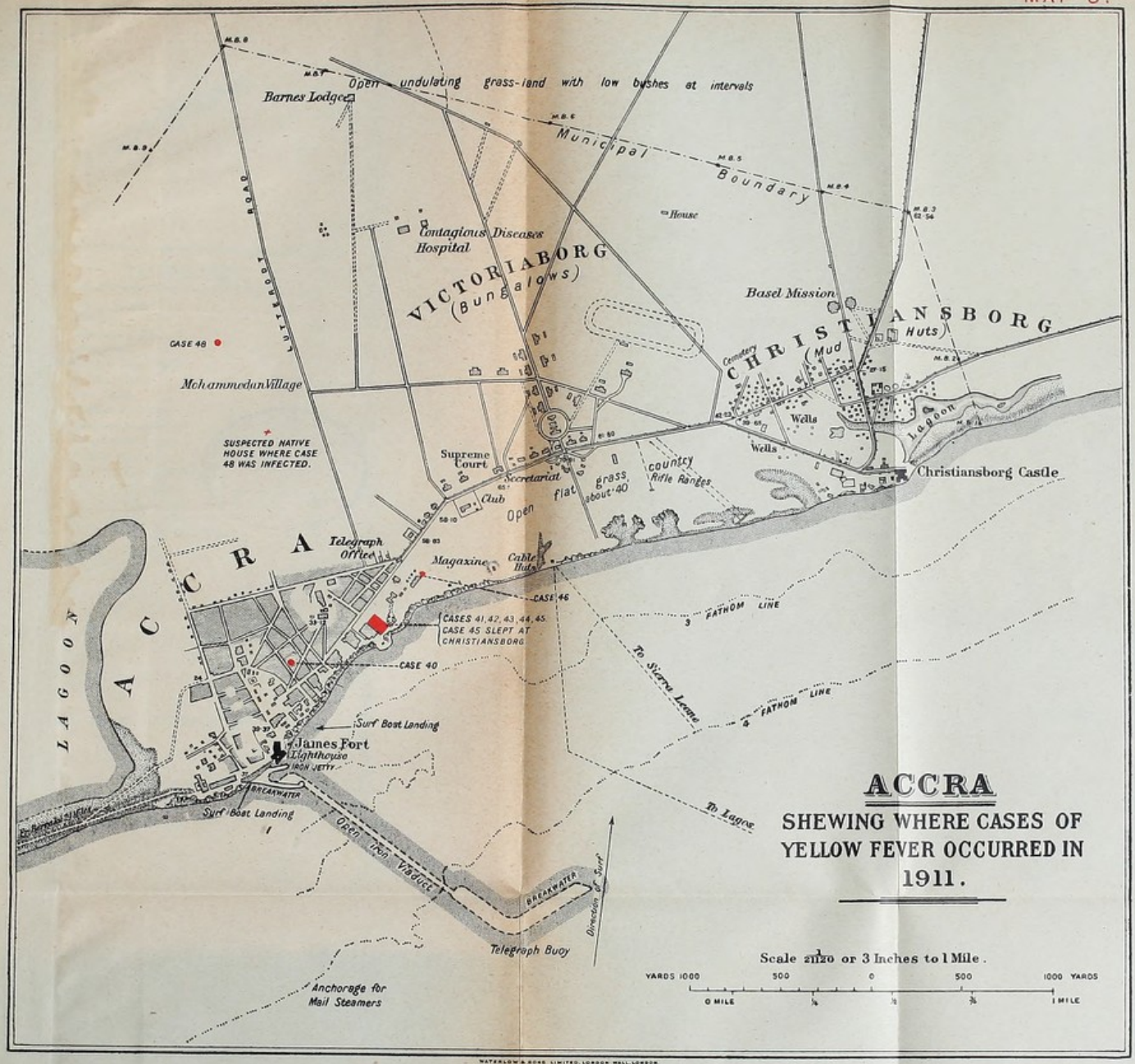
0 100 200 300 400 500 1000 1500 2000 FEET

Shewing the Houses where Yellow Fever occurred in 1910.




LONDON SCHOOL OF
LIBRARY
TROPICAL MEDICINE

MAP 3.



ACCRA

SHEWING WHERE CASES OF YELLOW FEVER OCCURRED IN 1911.

Scale 1/120 or 3 Inches to 1 Mile.

YARDS 1000 500 0 500 1000 YARDS

0 MILE ¼ ½ ¾ 1 MILE

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MAP 4.

SKETCH MAP OF BATHURST (THE ISLAND OF ST MARY) GAMBIA.

SHEWING HOUSES WHERE YELLOW FEVER OCCURRED.

1911.



REFERENCES

1. Albert Market
2. Barracks
3. Bathurst Gaol
4. Bungalow
5. Colonial Flag Staff
6. Colonial Church
7. Coal Depôt
8. Customs Warehouse
9. Customs Boathouse
10. Government House
11. Military Hospital
12. Merchant's Gunpowder Magazine
13. Sluice Gate Half Die
14. One Gun Battery
15. Sluice Gate (Box Bar)
16. Public Offices and Court House
17. Public Necessaries
18. Slaughter House
19. Six Gun Battery
20. Three Gun Battery
21. Victoria Hospital

Blue marks the houses occupied by Syrians.

Red marks the houses occupied by Europeans.

Government European officers quarters.

New Bungalow

Colonial Engineer's Office
Bathurst, Gambia.

WATERLOW & SONS LIMITED, LONDON WALL, LONDON.

YELLOW FEVER COMMISSION

(WEST AFRICA).

THIRD REPORT

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THIRD REPORT

OF

THE YELLOW FEVER COMMISSION

(WEST AFRICA.)

In the Second Report of the Commission a brief account was given of the incidence of the disease in the West African Colonies up to May 31st, 1914.

2. At that date it was thought that the epidemic in Lagos had not completely died out; but since February 15th, 1914, no fresh case has been reported.

3. Cases have been notified since the date of the last report at the following places :—Jebba, Burutu and Onitsha, in Nigeria ; Quittah, Axim, Somanya and Accra (Gold Coast Colony) ; and Tamale (Northern Territories, Gold Coast) ; the last to be noted being at Burutu, on the 23rd of September. The total number of cases up to the 30th of September, 1915, is therefore eighty-two. Of these forty-five have occurred in Europeans, including four Syrians, and thirty-seven in natives.

Twenty-five cases amongst Europeans and four amongst natives have proved fatal.

4. Owing to the exigencies of the public service it became necessary to recall to their ordinary duties those members of the West African Medical Staff who were engaged upon the work of

the Commission, and the outbreak of war has still further restricted the amount of attention which they and others in West Africa have been able to give to research.

5. It had been the intention of the Commission to establish a centre of work at Sierra Leone, and negotiations were in progress with men experienced in research in order to carry this into effect, but, for the reasons just stated, it has proved necessary to postpone the completion of this plan, although by the despatch of Mr. A. W. Bacot to Sierra Leone to study the life history of the *Stegomyia* mosquito, work for which he possesses special qualifications, the scheme has been in part fulfilled.

6. Since the issue of the last Report the Commission have had the advantage of the assistance of Dr. Andrew Balfour, C.M.G., who has been appointed by the Secretary of State to be a member of the Commission.

7. Two volumes containing reports from Investigators appointed by the Commission, and also other papers on subjects connected with the enquiry, have been published separately, under the title of "Yellow Fever Commission (West Africa), Reports on questions connected with the Investigation of Non-Malarial Fevers in West Africa."

It is believed that the records of these researches constitute a valuable addition to the literature of Yellow Fever. A third volume of Reports is in preparation.

8. In accordance with the intention expressed in their Second Report, the Commission have dealt in this Report with the questions of the occurrence and the significance of the bodies with which the name of Dr. Harald Seidelin is associated.

Its issue has been delayed, chiefly by difficulties connected with the production of the illustrations in the volumes of Investigators' Reports. Their prior publication was necessary, as in this Report there are many references to papers contained therein.*

---

* The references to these volumes in this Report are in the following form:—"I.R. Vol.——, p.——."

The Yellow Fever Bureau Bulletin (Liverpool) is referred to as "Y.F.B."

INTRODUCTORY.

In 1909 Dr. Seidelin published* an account of a supposed parasite which he had found in the blood of Yellow Fever patients, and two years later, in a paper entitled "Protozoon-like Bodies in the Blood and Organs of Yellow Fever patients,"† he gave a further and more complete description of these bodies, illustrated by plates showing in fifty separate figures the appearances which they presented when obtained from patients at periods varying from the third to the eighth day of the disease, and in one case on the fourteenth day. The majority of these forms were found in the blood, but some in organs, *e.g.*, the kidney, liver and spleen.

It is natural and necessary that any claim to have identified the virus of such a disease as Yellow Fever should receive the most rigid scrutiny, as, apart from the advance in medical science which such a discovery would mark, there are administrative problems of the highest importance which only await for their solution a knowledge of some certain method of identifying that disease, especially in its less severe forms.

The Commission now propose to review the evidence which has been adduced in favour of this claim and the arguments which have been brought forward in opposition to the view that these bodies are the parasite which gives rise to Yellow Fever.

Certain investigations which the Commission have undertaken, and researches on somewhat similar lines by other observers, have lately thrown fresh light upon the questions at issue, and would appear to justify the conclusions which are stated at the end of this Report.

It is of some importance that the discussion which has now been carried on for nearly five years should, if possible, be brought to an end, as its continuance has a tendency to divert research from other, and it may be more important, problems in connection with Yellow Fever.

It appeared to be desirable to allow Dr. Seidelin to state his case in his own words in order to avoid the possibility of controversy

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* Berl. Klin. Wochenschr., 1909, No. 18.
† Journal of Path. and Bact. 15, 1911, p. 283.

arising from the omission of points which he might consider of importance in the evidence upon which he bases his claim, and this course has been adopted wherever it has been consistent with the necessary limits of this Report.

Forms of the Parasite in Human Blood.

In the later paper* to which reference has been already made the following statement occurs with regard to the various forms of the parasite and their relation to the day of the disease on which their presence was observed: —

> "During the earlier days in which the initial fever occurs I have found only extremely small forms with a minute chromatin point and a generally feebly stained blue protoplasm; the chromatin is not very red, but rather dark violet. A little later, during the reduction of the temperature, when this occurs on the third or fourth day, or in the period of reactive fever, there are still seen the same small forms; these are usually few in number, but there are in addition others, a little larger, which, whilst they consist chiefly of a rather deeply stained blue protoplasm, contain a still very small, but more purple-stained chromatin point.
>
> "Still later, in the last days of the fever, and, as it seems, far into the convalescent stage, we found in the corpuscles chromatin granules, these being well stained single or double, round or pear-shaped, and with a very small border of protoplasm or quite free of protoplasm.
>
> "All these forms are intraglobular. Outside the red corpuscles very few were observed * * * * * * The observation of such small corpuscles is still more difficult outside than inside the erythrocytes. * * * * * * I consider their nature entirely doubtful; * * * * * * and am disposed to look upon them as artefacts.
>
> "I limit myself therefore to the reproductions of the larger extra-globular objects of whose preformed and probably protozoic nature there can be little doubt. There may, of course, be some doubt as to their specific nature, as they have as yet been found in very few cases. The two largest forms (Plate XXIX., Figs. 37 and 39), which have been found in two different cases, both fatal, and which show a quite characteristic structure and staining, recall somewhat the gametocytes of the malarial parasites, whilst the third shows a slight resemblance to some stages of the evolution of the Leishman-Donovan bodies. Moreover, there have been found in the same cases, and in a few others, similar but less fully developed forms. (pp. 283 and 284.)

---

* Journal of Path. and Bact. 15, 1911.

P. flavigenum *in the Tissues.*

" The positive findings in the tissues have been obtained principally in the kidneys. They have mostly been localised as a small number of groups in a section, not equally distributed over the whole. Two, or it may be three, different kinds of corpuscles have been observed.

" Firstly, the most characteristic present themselves as small, oval, faintly, or rather deeply bluish or somewhat reddish stained bodies with sharply defined, very small dark violet spots, generally one, sometimes two or, very seldom, three in each body. They are found in what seems to be but slightly altered or sometimes almost destroyed erythrocytes in capillaries or in renal tubules with degenerated epithelium.

" Their dimensions are from one-fifth to one-half of those of a normal red blood corpuscle. These bodies are so sharply limited and, on the whole, so well defined that I consider there can be little doubt as to their parasitic nature.

" Secondly, there were observed also in the renal capillaries very small elements which resemble division forms, being disposed in circles between, but apparently not inside, the blood corpuscles ; their number varies from five to nine ; they show a uniform violet colour, apparently without chromatin-point, but that may depend upon the technique employed (the sections coming from sublimate with acetic acid and being stained by Giemsa's method, while the other forms described were seen in sublimate-alcohol specimens stained by the Leishman method).

" Thirdly, finally, great numbers of a third class of small forms were found within large cells, probably endothelial, in liver and kidney sections ; they show a darker spot in their bodies, but do not show such clear-cut outlines or characteristic staining as those of the first class.

" This part of the work, the examination of the parasite in the tissues, is rather incomplete. * * * * * The very irregular, limited distribution in the kidney would suggest that this organ is not the principal site of multiplication of the microbe, and the same seems to be true only in a greater degree in the cases of the liver, pancreas, heart muscle, and spleen, which last organ in yellow fever does not, as a rule, show definite alterations, either macroscopically or microscopically. In freshly made preparations from spleen and bone marrow I have seen some microbes, and further study of the latter is evidently suggested." (p. 284.)

The Significance of the Discovery.

As to the significance of these observations, Dr. Seidelin states : —

" The possibility of artefacts I have discussed in my former article, and believe it can be excluded. Neither do I consider that there can be any serious doubt that we have to do with really foreign

elements and not with histological constituents, normal or abnormal, of the blood itself. Punctated erythrocytes are quite different from what I have described, and I have never seen any degeneration of these corpuscles really resembling the elements described.

"Blood platelets, though rather heteromorphous bodies, would seem never to become differentiated to a degree at all approximating the shape of the extraglobular forms I have observed.

"And I firmly believe that we can exclude this possibility with still greater confidence when we take into consideration the new facts now recorded regarding the findings in the sections of the organs. No kidney elements that I know of, and certainly no bacteria, would ever present the characteristics described. So I believe that I have demonstrated the presence in the blood and in some organs of micro-organisms which probably have not been seen or so interpreted before." (p. 285.)

Protozoal Nature of the Parasite.

"It would evidently be premature to pretend to determine the precise zoological place of the microbe. There can be little doubt as to its protozoic nature, considering its shape and staining reactions, but the forms observed do not suffice to enable us to make an exact diagnosis. The want of pigment and some of the morphological details, such as the double forms and the chromatin bodies almost without protoplasm, would suggest an affinity to the genus *Babesia* (*Piroplasma*),* whilst the aspect of the parasites in the kidney, and it may be the one apparently flagellated form observed, would seem to indicate a relation to the Leishman-Donovan bodies (*Herpetomonas*); in other details there is some resemblance to the malarial parasites." (p. 287.)

This organism was named by Dr. Seidelin *Paraplasma flavigenum.*

Other Forms of the Parasite in Inoculated Animals.

In a "Summary Report of Investigations carried out under the Yellow Fever Commission (West Africa),"† by Dr. Seidelin, reference is made to other forms of the parasite found in guinea pigs, which had been inoculated with blood from Yellow Fever patients at the Yaba Institute, Lagos, as follows:—

"In addition to the ordinary forms of the parasite, we found, in lungs and other organs, 'blue bodies'; we suggest that these bodies represent stages of division."

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* *Footnote by Dr. Seidelin.*—In case of a disease in imported cattle, very much like *piroplasmosis*, I found very numerous naked chromatin bodies.

† I.R. Vol. II, p. 423.

In a paper by Dr. Seidelin and Dr. Andrew Connal on "Experimental Yellow Fever in Laboratory Animals,"* further reference is made to the "blue bodies" as follows: —

"More interesting results were obtained from the examination of slide films (touch-preparations) from the organs.

"In these films ordinary forms of the parasite were found, occasionally in somewhat larger numbers than they had been found in the peripheral blood, or in the heart blood, but in no case could they be described as very numerous, and often they were quite scanty. Entire absence of the parasites in their ordinary forms was often observed when death took place a considerable time after the inoculation.

"Intracorpuscular division-forms, similar to those described in the peripheral blood, were sometimes met with, but were always rare. No other forms of special interest were noticed, except those which apparently represented the transition to the bodies now to be described." (p. 466.)

The "Blue Bodies."

"The most striking elements observed in the organ-touches were extracorpuscular bodies, which we will call provisionally and for the purposes of description 'blue bodies,' using the term commonly applied to the elements first described as 'Plasmakugeln' by Koch (1906) and others in East Coast Fever, in cattle. These bodies were in the first instance observed in 'lung-touches' from a guinea-pig which had been killed on the seventh day after inoculation. Afterwards they were seen in numerous cases in touch preparations from the various organs examined, i.e., lung, spleen, bone-marrow and liver, and though as a rule, most numerous either in lung or spleen touches, they were very rarely numerous in both these organs in the same animal.

"The advanced stages of the evolution of the blue bodies were found chiefly in the lungs. (pp. 466 and 467.)

Evolution of the Blue Bodies.

"After considerable experience had been gained in the examination of these elements it appeared evident that they developed from intracorpuscular forms, and their probable evolution can be described as follows:—

"The first stage seen differs but little from the ordinary intracorpuscular forms of *P. flavigenum*, though perhaps the chromatin is somewhat larger and the protoplasm more compact. These differences become more and more accentuated, and the parasite, whilst still intracorpuscular, grows to a size far in excess of that of the ordinary forms.

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* I.R. Vol. II, pp. 466 sqq.

"It now appears that the parasite develops in one or other of two different ways. In some cases they apparently become extracorpuscular, and the chromatin is still compact, forming one comparatively large mass. In other cases the chromatin becomes arranged along the periphery of the blue body whilst the latter still remains intracorpuscular. In this position the chromatin appears less compact and stains less deeply than in the ordinary forms.

"The largest of these intracorpuscular bodies have a diameter of about one-fourth to one-third of that of an erythrocyte. Once having become free, whether at an earlier or a later stage, the parasites further increase in size and the chromatin divides. It appears that the chromatin, if already peripheral, retains this position and breaks up into a considerable number of small elements; how many we cannot state at present. On the other hand, in the forms with compact chromatin at one extremity, the body becomes rounded, and the chromatin becomes more or less central before it proceeds to division.

"In these cases the division appears to be a simple repeated fission; thus in some forms two nuclei are seen, in others four, and in others, again, finally eight. Immediately after, or even at the time of the last nuclear fission, the protoplasm evidently divides, as no forms have been observed in which eight chromatin particles were present in an undivided protoplasm. Thus, eight elements result from the division, and they seem to belong to two different types. In some of the round bodies elongated elements appear in which no further process of division has been observed. In other cases the resulting elements are more or less polygonal in shape, and in these it appears that further division takes place, and thus perhaps a similar result is obtained to that observed in the bodies with peripheral chromatin. It is also possible that a similar process occurs in the case of the elongated 'spores,' but transitional stages have not been observed. This possibility, according to which secondary divisions would take place in all cases, suggests itself, because the larger division-elements have never been seen in a free state. If this be so, it is probable that the division goes on until exceedingly minute elements, apparently consisting entirely of chromatin, have been formed. Such minute elements have been seen inside round 'capsules,' and they are the only elements of the series which have also been observed in a free state." (pp. 467 and 468.)

The Forms of the Parasite in Inoculated Guinea-Pigs.

In the same paper, in the "Discussion of results obtained,"* the following further reference is made to the forms of the parasite discovered in the inoculated guinea pigs and to the nature of the "blue bodies."

"The forms of the parasite observed in the peripheral blood were identical with those found in the blood of yellow fever patients.

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* pp. 472 sqq.

"They were, as a rule, very scarce, thus corresponding in this particular also to the conditions obtaining in human infections. No process of division could be demonstrated directly in fresh specimens, or by combination of forms found in dried films, but a certain number of individual forms were seen to possess from two to four chromatin granules. This, considered with the corresponding forms described by one of us (Seidelin, 1912, Pl. I, fig. 21) in human cases, suggests that occasionally a partial or complete division takes place in the peripheral blood. So far, no new facts had been observed with regard to the parasites. We learned no more from the examinations of the peripheral blood in our guinea-pigs than we had known beforehand." (p. 472.)

The Blue Bodies in Inoculated Guinea-pigs.

"The examination of organ-touches proved more successful. The forms which have been described above were strikingly different from those observed in the peripheral circulation. So different were they, in fact, that the question arose whether they were of an entirely different nature. Their parasitic origin could not be doubted, their morphological characters pointing so distinctly to a protozoic organism; but the possibility had to be considered of their representing other spontaneously-occurring parasites. We had to consider this question very seriously, because the parasites show a certain resemblance to the elements first observed by Chagas (1909) in guinea-pigs' lungs, and regarded by him as a stage in the evolution of *Trypanosoma cruzi*, whilst it has later been declared by others (see Aragao, 1913) to be a lung-parasite of guinea-pigs with no relationship whatsoever to the trypanosome." (pp. 472 and 473.)

Nature of the Blue Bodies.

"Our elements are evidently not identical with those described by Chagas, but there is the possibility that they might belong to the same group. We believe, however, that we can discard this hypothesis.* Two important factors are against it. One reason is that we have, as far as we can judge by the morphological characters, found transitional stages from small intracorpuscular elements to the fully developed dividing forms, the intermediate stages being intracorpuscular bodies larger than the initial ones, and free bodies smaller than the fully developed elements. These initial bodies show great resemblance to ordinary forms of *P. flavigenum*, and if this interpretation of our observations be correct, then we have to do with a blood parasite, and not with one of the lung. The correctness of this view is confirmed by the frequent finding of similar though not fully developed forms in other organs, especially in the spleen, and

**Footnote by Dr. Seidelin.*—The hypothesis of a mixed infection may, however, be admitted. The 'sporulating bodies' might differ essentially from the 'blue bodies'; in the case of the latter we believe that we can safely exclude the possibility of their being lung-parasites, whilst in the case of the former the question must at present be left undecided. For further discussion of this point see also Seidelin: Division forms of parasites in the organs of guinea-pigs infected with *Paraplasma flavigenum* (*Journ. Pathol. & Bacteriol.*, Cambridge, Jan., 1915, XIX, 3, pp. 338—340); and Connal and Johnston, Natural infection of guinea-pigs (*infra*, pp. 595 sqq.).

by the occasional finding of advanced stages of division in various organs.

"Secondly, we never found the same parasite in non-infected guinea-pigs, although a considerable number of these died and were subjected to a careful post-mortem examination, as above stated." (p. 473.)

The Relation of the Blue Bodies to Paraplasma flavigenum.

"The only objection, we believe, which can be raised against our view of regarding these division forms as a link in the life-cycle of *P. flavigenum* is that they have been found neither in human organs nor in the organs of other animals experimented upon. Further researches will have to be carried out in this connection, in view of our observations on guinea-pigs, but at the present time it appears that the objection is of no great importance. A comparison with the plates in several of Seidelin's earlier publications will show that, as a matter of fact, elements closely resembling the intracorpuscular and some of the extracorpuscular forms of blue bodies have already been figured without their true importance having been realised. The failure to find the more advanced stages in the human host may be explained in different ways. These stages are comparatively scarce, and they seem to occur only at certain periods; besides, they appear to change soon after death, as we have found them only in those cases in which the post-mortem has been made immediately or shortly after the death of the animal. Any of these circumstances would easily account for the absence of the division forms in earlier observations.

"It appears, as far as our data go, that the formation of 'blue bodies' may start in various organs of the body, but that their complete evolution can only take place in the lungs. Possibly further research will show that it may occur also in the spleen. Their occasional appearance in the peripheral blood may depend either on their exceptional formation there, or upon their being casually washed out from the internal organs by the blood current." (pp. 473 and 474.)

Morphology of the Blue Bodies.

"The morphological appearances of the 'blue bodies' suggests that they are sexual forms, gametocytes. One would, however, *a priori* feel inclined to adopt the view that in a mosquito-transmitted disease the sexual evolution of the parasite would take place in the insect-host, especially as there is some reason to believe that under ordinary conditions the transmission takes place only after a certain period of evolution of the parasite in the mosquito. On the other hand, this preconceived idea may be erroneous, and it may here be mentioned that Finlay (1903) suggested many years ago that the conditions in yellow fever are probably the reverse of those obtaining in malaria, *i.e.*, that in yellow fever the sexual stage of the parasite would be found in the human host and the asexual stage in the mosquito.

"Adopting the first view, the morphological appearances of the 'blue bodies' would correspond quite well to the theory of a double schizogonic process, the first stage being the formation of eight elements secondarily subdividing, probably inside the same 'cyst-membrane,' into a very large number of exceedingly minute merozoites.

"This discussion is at the present moment entirely theoretical, but it would appear that the following hypothesis possesses a certain probability. The parasites are present, to begin with, in the blood-stream as more or less irregular 'ring,' or 'pear,' or 'rod' shaped forms, and they divide, in the blood corpuscles, into four or five merozoites which infect other red-cells. Some of these newly-formed elements are compact, and develop no clear space in their interior. They retire into the internal organs and grow to a relatively excessive size; earlier or later they become free and divide into eight elements. These elements remain inside the original membrane of the 'blue body,' and undergo a second division, the result being the formation of minute elements which become free and presumably pass into the blood current where they would have a chance of being taken up by mosquitoes.

"Several additions must be made to this hypothesis. The 'blue bodies' appear to leave the erythrocytes at very different stages of their development, some becoming free whilst still of a small size, others not doing so until they appear about fully developed. In some cases it would appear that even the division may take place inside the remains of an erythrocyte, as several fully developed forms have been seen in which the 'membrane' shows a staining very similar to that of hæmoglobin, thus giving the impression of representing the remains of almost completely digested erythrocytes. The 'blue bodies' may become phagocytosed by mononuclear leucocytes at any stage of their evolution. Whether they can continue their development in the leucocytes we have no means of discussing." (pp. 474 and 475.)

Two Groups of Blue Bodies.

"The 'blue bodies' would appear to belong to two groups, those with a pale protoplasm and fairly abundant chromatin, which as a rule occupies a peripheral position, and those with a more deeply blue-staining protoplasm and a scanty loose centrally-placed chromatin mass. This, as mentioned above, raises the question whether a sexual process takes place in the human host." (p. 475.)

Evolution of the Parasite in the Mosquito.

In the "Summary Report of Investigations carried out under the Yellow Fever (West Africa) Commission"* the following reference

* I.R. Vol. II, pp. 423 sqq.

is made to attempts to demonstrate changes in the parasite occurring in the mosquito:—

> "I regret that we were on this occasion, as in the case of my previous investigations, unable to demonstrate the evolution of the parasite in the mosquito, though we performed a number of experiments with this object in view. We found considerable difficulties in keeping the mosquitoes alive during the whole duration of the experiments, one of the difficulties being that the guinea-pigs, when exposed to the bites of the mosquitoes, apparently destroyed a considerable number of them. The technique of these experiments had to be worked out very carefully, and it has become evident to me that this important work has but little chance of success when it is carried out, as it was in this as well as in my previous attempts, as one out of several lines of investigation." (pp. 423 and 424.)

> "Some observations were however made, which we consider of interest, although they are incomplete; * * * * * *." (p. 424.)

These are no doubt referred to in the summary of the chief results of the work:—

> "III. The demonstration of certain elements—probably division forms of *P. flavigenum*—in infected mosquitoes." (p. 425.)

Epidemiology of Yellow Fever in Relation to *Paraplasma flavigenum*.*

In the following passage Dr. Seidelin discusses the relation of his observations to the established facts regarding the epidemiology of Yellow Fever. It is taken from the earlier paper in the *Journal of Pathology and Bacteriology*.

> "We must now consider the question, how do our observations correspond with the already established facts regarding the epidemiology of yellow fever? In the chief points they evidently agree perfectly by a blood-sucking insect. But there are two circumstances that do not seem to conform with the accepted theory. According to the observations of the American Yellow Fever Commission and others, the microbe ought to have an ultra-microscopical stage in its development, as such is suggested in connection with other diseases, *e.g.*, kála-ázar, instanced by Manson, and this solution would accord with the fact that the microbes are found generally only in small numbers in the blood; it might be that the visible bodies are present in a small minority in comparison with the invisible forms." (p. 287.)

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* Journal of Path. and Bact. 15, 1911, p. 287.

"The other circumstances, to which I formerly alluded, is that the germ can only be transmitted during the first three or four days of the disease, whilst the microbes are found for a much longer period. There may be two explanations of this, the first of which is essentially the same as that which has now been suggested, namely, that the ultramicroscopic stage, on which the transmission depends, exists, or is present in the blood, only during the first few days, although the larger forms may remain a much longer period. It ought to be remembered, however, that the observations on which the axiom mentioned has been founded are not very numerous, so that it can as yet scarcely be admitted as an established fact." (p. 287.)

OUR KNOWLEDGE OF THE VIRUS OF YELLOW FEVER.

Before proceeding to consider in detail the various questions which arise in connection with these bodies, it may be of use to set out succinctly the knowledge we possess of the virus of Yellow Fever. We shall thus see more clearly the conditions which must be fulfilled before the organism which Dr. Seidelin has described can be accepted as the active agent in the production of that disease.

(1) It is certainly transmitted by the *Stegomyia fasciata.* It is not known to be transmitted under normal conditions in any other way.

Dr. Seidelin is of opinion that "the axiom that Yellow Fever is transmitted by no other mosquito than the *Stegomyia fasciata*" is "an assertion entirely without proof," and also that "Yellow Fever is transmitted in nature by no other means than mosquitoes has never been proved, but is extremely probable in view of our knowledge of protozoal diseases."

It might have been added "and in view of our knowledge of the effects upon the incidence of the disease afforded by the destruction of the *Stegomyia fasciata.*"

(2) The transmission can only take place after the Yellow Fever parasite has undergone a development in the mosquito, the duration of which is, approximately, twelve days.

Dr. Seidelin considers that "this theory is likely to be correct, but has not been conclusively proved."

(3) The virus will pass through a Berkefeld filter and belongs to the class to which the term ultra-microscopic is usually applied.

It has been objected that the parasite as described by Dr. Seidelin cannot be supposed to be able to pass through a Berkefeld filter.

Dr. Seidelin meets this objection by the suggestion that there may be an earlier stage in the evolution of the parasite in which it is invisible and able to pass through the filter.

(4) The blood of the Yellow Fever patient is infectious only during the early period of the disease, probably not after the third day.

Dr. Seidelin does not accept the view of "the three days' infectiousness"; he believes that "a dogma in medicine has never been established on poorer evidence."

It is not possible within the necessary limits of this report to consider the evidence upon which this view has obtained general acceptance. Those interested in the question who still entertain doubts are referred to the original reports of the American Yellow Fever Commission.

THE ARGUMENT IN FAVOUR OF *P. FLAVIGENUM*.

The argument in favour of the acceptance of these bodies as the causal agent of Yellow Fever appears to involve the admission of the following propositions: —

(*a*) They are found in the blood of patients suffering from Yellow Fever.

(*b*) They are not found in human blood under other conditions.

(*c*) They are found in the blood and tissues of animals (guinea-pigs, white rats, dogs and monkeys) inoculated with blood from Yellow Fever patients.

(*d*) These animals are suffering from Yellow Fever.

(*e*) From such animals by sub-inoculation the disease (Yellow Fever) may be transmitted to successive generations and in the blood the specific bodies are found.

(*f*) If the bodies are found in the blood or tissues of animals which have not been thus dealt with, such animals are the subjects of a natural infection.

(*a*) Presence of the Bodies in Yellow Fever in Man.

In Dr. Seidelin's original paper* five cases are described in which the organisms were found, and fifty cases are referred to.

In the second paper it is stated that† :—

> "In thirty-three cases observed during the last year, after my former article appeared and which were officially declared to be cases of yellow fever, it was found twenty-five times; but of the negative cases six occurred during my absence, and the preparations which I received on my return did not stain well, so they may be excluded. We then get twenty-seven cases with twenty-five positive results. If we include those formerly observed, which formed the basis of the first publication, but which I have not exactly tabulated, we have about eighty cases, in about 90 per cent. of which we have positive findings."

In December, 1911, Dr. Seidelin visited Yucatan on behalf of the Liverpool School of Tropical Medicine to investigate the epidemic outbreak of Yellow Fever which lasted from August 3rd, 1911, to April 30th, 1912. This was the period during which cases occurred which were officially diagnosed as Yellow Fever; the number of these cases was 73, with 38 deaths.

Paraplasma flavigenum was found in the peripheral blood in sixteen confirmed cases out of seventeen in which the blood was examined microscopically. In one of these the diagnosis was made *post-mortem*.

> "The negative was that of J. R. of Kambul. This patient was apyretic and practically convalescent at the time when the blood smears were taken.
>
> "It is not surprising that parasites may be missed at this stage, either because they are absent or extremely scarce. (Y.F.B., Vol. II, No. 2, p. 171.)
>
> "Adding these cases to those of my last two series (1911, 1 and 5) we get 53 positive results in 57 cases. Including, also, my first series, in which the cases were not tabulated, the result is approximately 106 positive cases out of a total of 120." (*Ibid.*, p. 172.)

Paraplasma flavigenum in the Blood in Cases of Yellow Fever at Lagos.

Dr. J. W. Scott Macfie and Dr. J. E. L. Johnston, of the West African Medical Staff, who worked at the Medical Research Institute, Yaba, with Dr. Seidelin, in a paper on "Experiments and

* Berl. Klin. Wochenschr., 1909, No. 18.
† Op. cit., p. 285.

Observations on Yellow Fever,"* state their results with regard to the occurrence of *Paraplasma*-like bodies in the blood in cases of Yellow Fever as follows—

"We have had the opportunity of examining the blood films from nineteen cases of yellow fever; in sixteen we have detected *Paraplasma*-like bodies in the red blood cells." (p. 125.)

"In our earlier examinations we observed some simple ring-shaped bodies that stained blue. These were present, not only in the red blood corpuscles, but also free in the plasma.

"No chromatin granule could be detected, and although this fact would have been hard to explain were these bodies of a parasitic nature, we considered that the question of their occurrence was worthy of further investigation. Seidelin (1911) has figured bodies presenting very much the same appearance, and has called them 'protoplasma-bodies without chromatin.' He has suggested that 'the absence of a definite chromatin staining * * * * * * is probably a phenomenon of degeneration.' In one of the first cases examined these bodies were common; but in subsequent cases, although they were occasionally met with, they did not occur with that regularity that one would have expected had they been definitely associated with the cause of the disease. We are therefore inclined to think that they are not of great importance, and although we consider that they may be associated with yellow fever in some manner that is not understood, we do not believe that they are directly concerned in the ætiology of the disease.

"In all those cases of yellow fever from which we have had the opportunity of examining satisfactory blood films, we have detected the presence of minute endo-globular bodies resembling the *Paraplasma flavigenum* of Seidelin; in the accompanying plate (Pl. VI.) a number of these bodies is illustrated. In some cases they were very scarce, but in others they were by no means rare. They were, for instance, more common than malarial parasites are in adult natives suffering from mild attacks of malarial fever, in whom it is often extremely difficult to find conclusive evidence of infection, the parasites being sometimes detected only after examining several blood films, or by employing the thick film method.

"Figures 5-12, Pl. VI., represent different forms of bodies found on several days in a single case of yellow fever in a native. In this case blood films were obtained daily from the first day of the disease until the twelfth day, when convalescence was apparently complete." (pp. 125 to 127.)

Day of the Disease on which the Bodies are present in the Blood

"It is noteworthy that the bodies were found on eleven out of the twelve days of the illness, and that they persisted after the subsidence of the fever. This fact is not, of course, exceptional for

* Y.F.B. Vol. III, No. 2, pp. 125 sqq.

protozoal diseases of a chronic type, although at first sight it seems remarkable in an acute febrile disorder like yellow fever, which, moreover, is said to be infective only during the first three days. It should be remembered, however, that, as Seidelin has pointed out, this belief rests on a very flimsy basis of fact, and cannot be considered as yet to have received satisfactory scientific proof. It is possible that the persistence of these bodies in the blood during convalescence may explain some of the obscure features of the epidemiology." (p. 127.)

The foregoing statements furnish, in the opinion of the Commission, sufficient proof that these bodies have been found in the blood of a very large number of cases of Yellow Fever; it is, however, hardly necessary to point out that this is only one link in the chain of evidence upon the integrity of which the claim is founded.

If it can be shown that similar bodies are of frequent occurrence in the blood or tissues of man or animals apart from any suspicion of Yellow Fever, it is obvious that the whole contention falls to the ground, and that there is no necessity for any further discussion as to their specific nature.

(*b*) Absence from Human Blood in other Conditions.

Control Observations.

The control observations of Dr. Seidelin and other observers will first be stated and subsequently the cases will be referred to in which Dr. Seidelin himself admits that the diagnosis of Yellow Fever was at least sufficiently doubtful to require careful examination, or to need the construction of a theory to account for the presence of the *Paraplasma flavigenum* under the circumstances in which it was found.*

"In my earlier work I had, quite naturally, examined with special care the blood from yellow fever cases, the control material consisting in the numerous blood examinations occurring in the daily work in my laboratory. This time I proposed to lay special stress on obtaining a large control material. This I did by examining the blood from all cases admitted to the lazaret, from a number of patients seen in the hospital or with physicians in their practice, or from patients whom I had not seen, and, finally, from numerous healthy individuals. In each case I used the same microscope which I used in the yellow fever examinations, always working with the same 3 mm. apochromatic immersion objective (Zeiss) and No. 12 com-

* Y.F.B. Vol. II, No. 2, pp. 176 sqq.

pensating eyepiece; at least one hour was dedicated to the examination of a smear, before it was declared negative. This was carried out in the malarial cases, as well as in those in which no parasites at all were found. The presence of malarial parasites caused but little difficulty. Very young forms, even of *Plasmodium præcox*, were easily recognised by their larger chromatin granule, but occasionally some slight doubt arose when remains of malarial parasites were seen in the erythrocytes, as a rule, after quinine treatment. Such doubt, however, was soon solved by comparison with films containing *Paraplasma*.

"On specially important occasions, special precautions were taken; in such cases blood films were prepared, at the same time, from other individuals and treated all through in the same way as those which were of particular interest.

"In this manner blood specimens were examined on 421 occasions, in each case at least one, and often two or three, slide-smears being thoroughly searched. In 136 cases malarial parasites were found, and in 283 no parasites at all. Finally, in two cases, in which there was no suspicion of yellow fever, *P. flavigenum* was present in small numbers.

"The two individuals, in which *P. flavigenum* was found, were young children seen in a school in Temax on the occasion of a visit which I made with Dr. Casares in order to study the sanitary conditions of that place, from which two yellow fever patients had been brought to the lazaret in Mérida. It was my intention to examine the blood of children with febrile disorders, but we had the opportunity of seeing only two such cases (enteritis), and in both the blood proved negative.

"We then examined the children in the schools, more with the object of discovering cases of malaria, than in the hope of finding cases of larval yellow fever.

"Blood-smears were taken from a number of children with a very slight increase of the spleen dulness (in no case was the spleen considerably increased). Amongst these cases were the two under discussion. As the microscopical examination was made after our return to Mérida the children could not be identified; thus I cannot assert that they were in good health, but, at any rate, they cannot have been severely ill since they went to school. They have certainly not been perfectly healthy, since they were selected for examination as suspicious of malaria. These two cases must be considered together with the two somewhat similar cases which I reported in an earlier paper (1911, 1); in those, *P. flavigenum* was likewise observed in two individuals not suffering from yellow fever.

"The one was a young girl with anæmia, the other a boy with nephritis; both were natives.

"In these four cases we may possibly have to do with microbe carriers, in the true sense of the word—individuals harbouring parasites in their blood for a considerable length of time. But there is no proof that it is so. It may just as well have happened that the blood of

these individuals has been examined during one of the repeated attacks of yellow fever, or, rather, infections with yellow fever parasites, which are supposed by various authors to occur with a certain frequency in natives, producing no characteristic symptoms, or that the individuals have been suffering from chronic infections." (pp. 176 to 178.)

The following occurs in the paper by Dr. Seidelin already referred to* :—

"In these dispensaries" [at Christiansborg and Labadie] "we observed a large number of children, making examinations of the blood whenever we found any rise of temperature or any complaint, the nature of which was not at once clear. Unfortunately the result was negative; in no case was the *Paraplasma flavigenum* found, whilst, on the other hand, malaria parasites were present in the majority of cases.

"An examination of a small number (14) of school-children was likewise negative so far as the *P. flavigenum* was concerned. The only result of a positive nature which we obtained during two months' work" [at Accra] "was the demonstration of *P. flavigenum* in the blood of two patients suffering from mild febrile disorders, not unlike the mild cases of yellow fever, which have been described from various localities by many observers, including myself. The first of these patients was a native of West Africa, but not of Accra; the second case occurred in a European who had arrived in West Africa shortly before he was taken ill." (pp. 421 and 422.)

Doubtful Cases.

"Only in one case was the blood given me before I saw the patient; in this I found the forms seen in Plate XXIX., Figs. 20, 21 and 25, and made the diagnosis of yellow fever, which was at first doubted by the physicians in charge, but afterward fully agreed to. The patient entered the hospital on the third day of his disease, and the preparations were taken the same day.

"In another case, which was diagnosed as typhoid fever, the same corpuscles were observed; but I think that I am able to uphold the clinical diagnosis of yellow fever and will give, with purpose, a short résumé of the clinical history, for which I am indebted to Dr. Vargas, Director of the Lazaret, and to Dr. Vega, to whose service in the hospital the patient was afterwards transferred.

'Case—M.B. aet. 25. Admitted 12 December, 1909. Onset same day with headache and pains in the back. Temp. 103° F. Symptoms increased and the temperature on the third day was 39·7°, descending to 37·2 on the sixth day, rising on the seventh to 38·9; from the eighth day it was about or below 37°. The pulse during the first days was about 100, subsequently it fell to 40 on the eighth day and 38 on the twelfth day. Abdominal pain, at first rather diffuse, was later localised in the epigastrium, especially on pressure. From the third day there was jaundice, first conjunctival, afterwards diffuse. Stools mostly pale, but during several days with melaena. The urine contained albumen, casts, bile pigments and indican; diazo reaction negative.'

* I.R. Vol. II, pp. 412 sqq.

'Widal reaction positive in 1 to 20 1 to 50 and higher negative, so it cannot be considered as conclusively demonstrative of typhoid fever. In the service of the hospital to which the patient was transferred a diagnosis of bilious catarrh was made, but by this time all the febrile symptoms had subsided.'

"This case, therefore, if it be not considered wholly conclusive, can be taken in no wise as demonstrative against the specificity of the microbe; from my point of view, and I followed the clinical course of the malady, it may be looked upon as showing the usefulness of the microscopical examination in difficult cases.

"Another case was observed where influenza was diagnosed, principally because the patient, a negro from Jamaica, was considered immune to yellow fever. Here the corpuscles were also found.

"Serious doubts arose when I found them also in two individuals who certainly did not suffer from yellow fever—in one a young man with a chronic parenchymatous nephritis, and in the other a girl with chronic digestive, somewhat sprue-like, troubles. Both were natives of Yucatan. In the first case there were small forms, in the second only a single free form was found, almost identical with that seen in Plate XXIX., Fig. 39." (Journal of Path. and Bact. 15, 1911, pp. 285 and 286.)

Theories accounting for Doubtful Cases.

"If we consider that the immunity of natives against yellow fever is due, on the consensus of medical opinion, to one or more previous attacks of the disease, atypical and not recognised as such; and, moreover, that the malarial parasites and some piroplasmas, in cattle, for instance, are known to persist for a considerable time without producing any symptoms, then the findings referred to do not seem very much out of line.

"In the case of nephritis, more especially, it would perhaps not be too remote to admit the possibility of yellow fever as an etiological factor, as there was no history of any of the ordinary conditions likely to give rise to nephritis. When I first saw the patient the case looked rather serious, but afterwards it took a surprisingly benign course." (Op. cit., pp. 285 and 286.)

Objections of other Observers.

In Dr. Seidelin's paper* already referred to the following occurs:—

"I would not omit to refer to a paper in which some bodies are described† which show a great similarity to those I have described. These have been seen in quite another disease, namely, *typhus exanthematicus*, and the authors do not discuss the nature of their microbe. If both are confirmed there would be a still further increase in the already numerous protozoal diseases, which in recent years, and more especially in tropical countries, are rapidly acquiring an importance almost as great as that of the bacterial infections."

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* Journal of Anat. & Path. Vol. 15, No. 3, p. 288.

† Krompecher Goldzieher u. Augyán Centralbl. f. Bakteriol. u. Parasit. Jena, 1909, Abth. 1, Orig. Bd. 1. S. 612.

"In my earlier papers* I have already discussed some objections which have been made, mostly in private discussions, against my findings. Since then a few criticisms have appeared, though none of them has been based upon actual observations on yellow fever. The most important is that of Schilling-Torgau (1912—1 and 2), who has found in human blood and in blood from various laboratory animals intracorpuscular bodies very similar to those described by me. The elements which he has observed are, in his opinion, remainders of more or less hypothetical structure which he regards as normal constituents of erythrocytes. This is, of course, a serious objection, being based, as it is, upon careful investigations. The only way to meet it was by a comparative study of blood from other individuals in the same place and with the same technique.

"This is what I have done now, and I think a better material for control than the one discussed above could hardly be obtained. This also answers the objection made at a discussion in Habana by Dr. Guiteras, that I might have encountered an innocent parasite living in the blood of inhabitants of Yucatan."

It may be convenient to state here the reply of Schilling-Torgau to Dr. Seidelin. The article is chiefly of a polemical nature.

"Possibly *P. flavigenum* is the true cause of yellow fever, but its parasitic nature has not yet been determined, much less its etiological relationship to yellow fever, considering the occurrence of very similar bodies in the blood in other conditions."

Archiv. für Schiffs und Tropen-Hygiene (Band. 16, 1912), "Zur Frage des Gelbfiebererregers."

Dr. Agramonte on the *P. flavigenum*.

Dr. Aristides Agramonte, a member of the American Yellow Fever Commission which established the mosquito transference of Yellow Fever, in a paper read before the International Congress of Medicine, London, 1913, "On a Supposed Parasite of Yellow Fever,"† states that he has met with the Seidelin bodies in various conditions which certainly are not Yellow Fever, *e.g.*, goitre, uncinariasis, and Weil's disease. Also in a *post-mortem* blood smear from a case of tuberculosis.

These bodies are also stated to have been present in smears from a guinea-pig which had been treated with human blood.

Dr. Agramonte states that Cartaya has described intracorpuscular bodies in a case of human glanders, and Guiteras in two cases of intense jaundice, not due to Yellow Fever.

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* Y. F. B. Vol. II, No. 2, p. 182.
† Trans. Section 21, Part 2, pp. 71 to 81.

Dr. Agramonte urges various reasons against the acceptance of these bodies as the virus of Yellow Fever, one of which is that in all acute blood infections the parasites usually disappear from the circulation before the last symptoms of the disease, whereas these bodies may be found in Yellow Fever cases up to the eighth or even the fourteenth day.

He considers that "the Seidelin bodies may very well appear in the blood in convalescence from any severe disease, since they represent residual elements produced during a reconstructive process in the blood, and that the blood is often impoverished in Yellow Fever when the attack has been at all marked."

He is disposed "to believe that they are, some of them, chromatoid nuclear fragments of blood elements in the process of reconstruction. That others are protoplasmic residue eosinophilic granules, caused by the hæmolytic action of various pathologic processes."

Dr. Seidelin's Reply.

Dr. Seidelin, in reply, states that having seen Guiteras's specimens from the case of *Icterus gravis*, he has no doubt that they are different from those occurring in Yellow Fever, and that the single indefinite structure which he observed was probably a degenerated malarial parasite. He agrees with Dr. Cartaya that those in the case of glanders were nuclear remains.

Discovery of *P. flavigenum* in Jamaica.

In December, 1912, Dr. Seidelin visited Jamaica at the request of the Liverpool School of Tropical Medicine to investigate the disease called vomiting sickness, prevalent in that island during the winter months and responsible for a considerable mortality, chiefly amongst native children.

In a report of an investigation previously made by another observer the disease had been regarded as Yellow Fever.

As the result of his investigation Dr. Seidelin came to the conclusion that the disease was not Yellow Fever, and that until further evidence may be brought forward we may assume that "vomiting sickness" is a local disease of Jamaica.

In one case, however, in smears of peripheral blood a few intracellular ring-shaped organisms were found of the type of *Paraplasma flavigenum*, and the case is regarded by Dr. Seidelin as having been one of Yellow Fever.

Dr. Agramonte has criticised the diagnosis of this case, and has pointed out the improbability of a single case of Yellow Fever occurring in the course of an epidemic of another disease in an island where Yellow Fever has not been recognised, at any rate officially, for years. This case, if it was one of Yellow Fever, has not been followed by the reappearance of that disease in the long period (now two years) which has since elapsed.

Dr. Seidelin, in reply, maintains the correctness of the diagnosis.*

(*c*) Presence in the Blood and Tissues of Animals Inoculated with Blood from Yellow Fever Patients.

In a paper on Experimental Yellow Fever in Laboratory Animals, by Dr. H. Seidelin and Dr. Andrew Connal,† it is stated that:—

> "In 96 cases" [guinea-pigs injected with blood from cases of yellow fever] "examination of the specimens showed the presence of *P. flavigenum*, whilst 9 cases were negative. In 3 of these, parasites were found in material obtained after death, whilst in 6 cases the results of examination were negative. * * * * * * Thus we had positive results in 99 out of a total of 105 cases examined; about 94·3 per cent."
>
> "In the vast majority of smears the parasite was as scarce as we have usually found it to be in human blood, namely from two or three to about a dozen in a thin film. We found however, in a few cases (as one of us—Seidelin, 1912—has also found in human blood), the parasites in large numbers, comparatively speaking, namely, over fifty in a smear, and sometimes as many as three or four parasites have been seen in one microscopical field. The morphological characters of the parasites were very much the same as those in human blood." (p. 465.)

Presence of Blue Bodies.

> "In these films" [touch preparations from the organs] "ordinary forms of the parasites were found, occasionally in somewhat larger number than they had been found in the peripheral blood, or in the heart blood, but in no case could they be described as very numerous, and often they were quite scanty. Entire absence of the parasites in their ordinary forms was often observed when death took place a considerable time after the inoculation." (p. 466.)

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* Y.F.B. Vol. III, No. 1, p. 69.
† I.R. Vol. II, pp. 464 sqq.

"The most striking elements observed in the organ-touches were extra-corpuscular bodies, which we will call provisionally and for the purpose of description 'blue bodies,' using the term commonly applied to the elements first described as 'Plasmakugeln,' by Koch (1906) and others in East Coast Fever, in cattle. These bodies were in the first instance observed in lung-touches from a guinea-pig which had been killed on the seventh day after inoculation.

"Afterwards they were seen in numerous cases in touch-preparations from the various organs examined, i.e., lung, spleen, bone-marrow and liver, and though as a rule most numerous either in lung or spleen touches, they were very rarely numerous in both these organs in the same animal. The advanced stages of the evolution of the blue bodies were found chiefly in the lungs." (p. 467.)

In the paper entitled "Experiments and Observations on Yellow Fever,"* by Dr. Scott Macfie and Dr. J. E. L. Johnston, from which we have already quoted, the following evidence is given of the presence of *Paraplasma flavigenum* in guinea pigs inoculated with the blood of Yellow Fever patients:—

"Thomas (1907) succeeded in producing a reaction in guinea-pigs from four-and-a-half to thirteen days after being bitten by infected *Stegomyia*, and Seidelin (1912) observed intracorpuscular bodies resembling *P. flavigenum* in two guinea-pigs which he had inoculated from a case of yellow fever. We, therefore, decided to attempt the infection of guinea-pigs by inoculation from the yellow fever cases at Lagos."

"Fourteen guinea-pigs were thus inoculated from eleven cases. A single animal was injected from each of the first ten cases, and four animals from the eleventh. In each case only one or two drops of blood diluted with 1 per cent. sodium citrate solution were used for the injection, which was made subcutaneously. Ten of the animals showed a definite febrile reaction. Three guinea-pigs that were inoculated in a similar manner with normal human blood did not show any such reaction. Positive results have been obtained by inoculations made as late as the eighth day of the disease." (p. 131.)

"Four of the guinea-pigs inoculated failed to show any definite febrile reaction. In two of these, at any rate, auto-erythrophagocytosis was observed. Elsewhere (1913) we have suggested that the phenomenon of auto-erythro-phagocytosis seems to be peculiarly associated with protozoal diseases. Connal (1912), moreover, has suggested that the ingestion of red cells by macrophages may be a natural reaction of the host to combat an infection. In these guinea-pigs, therefore, the occurrence of this phenomenon may have indicated a successful reaction on the part of the host, and may thus explain the absence of fever, the attacks being, in short, aborted. (p. 132.)

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* Y.F.B. Vol. III, No. 2, pp. 129 sqq.

"That the animals were infected, we believe to be proved by the fact that we detected in the blood of three of them the *Paraplasma*-like bodies that we have found associated with yellow fever.

"In all the guinea-pigs inoculated, with the single exception of the first, No. 49, bodies were found closely resembling the *Paraplasma*-like bodies present in the blood from the human cases. No such bodies were found in healthy guinea-pigs, nor were they present in the blood of the animals before inoculation.

"Seidelin found similar elements in the blood of two of his inoculated guinea-pigs, and stated that 'their resemblance to *P. flavigenum* is also very great.' He considers the question of their being a *Babesia*, such as that described by Baldrey; and also the possibility that they may have been some yellow fever parasites, introduced at the time of inoculation, that had succeeded in surviving in the human blood corpuscles which had been injected. The latter consideration cannot apply in our cases, as the quantity of human blood injected was in every case exceedingly small, and was not introduced directly into the blood stream of the animals. It seems inevitable, therefore, to conclude that these bodies must have been developed in the blood of the guinea-pigs.

"In one case a sub-inoculation was made. One or two drops of blood were obtained from guinea-pig No. 56, which had been inoculated from yellow fever case No. 42, on the sixth day after inoculation, and whilst it still showed some degree of fever, and were injected into guinea-pig No. 63. The latter guinea-pig showed a well-marked, although somewhat irregular, febrile reaction, and on examining its blood *Paraplasma*-like bodies were found to be present." (p. 134.)

Evolution of the Parasite in Animals.

"Some other forms of these bodies encountered in the blood of yellow fever patients are illustrated in Figs. 1-4 and 13-15, Pl. VI. Figures 16-27 represent the bodies found in guinea-pigs, figures 28-39 those found in dogs, and figures 40-44 those found in rats. The earliest form consists of a mere dot of chromatin with a small blue-stained body. In later stages the size of the blue-stained body increases, until a definite ring-form is developed. Several stages of this phase are figured. Ultimately a body of relatively considerable size is produced.

"The general resemblance of these bodies to the *Paraplasma flavigenum* of Seidelin cannot be denied. We have found the same forms, and although we have not been able to make out a definite cycle of development, the types of body illustrated have been constant in our cases. We are aware that Seidelin's bodies have been severely criticised by various authors, but we are, nevertheless, inclined to the belief that they are parasites. We are of opinion that the constancy with which they are found in the blood of yellow fever patients is a matter of considerable importance, and should be a valuable aid to the diagnosis of doubtful cases." (pp. 127 and 128.)

Animal Experiments.

"The experiments on animals, of which an account follows, supply in our opinion, confirmation of the parasitic theory. It would be a remarkable coincidence if bodies of this type were found in human blood from a case of yellow fever, and in the blood of guinea-pigs and dogs inoculated with it, were they not specifically related to the disease." (p. 129.)

Biology of Paraplasma flavigenum.

"As regards the biological nature of these bodies, we agree with Seidelin in regarding them as belonging to the *Babesiidæ*.

"The cycle undergone by the parasite cannot at present be described in detail, several different forms occurring in the blood at the same time, and unfortunately it has been impossible for us to carry out any experiments with infected mosquitoes." (p. 129.)

Paraplasma flavigenum *in Dogs.*

"We have inoculated subcutaneously five dogs with blood obtained from yellow fever patients. Young puppies were chosen for this purpose, as it was thought possible that older dogs might have acquired some degree of immunity to the disease." (p. 135.)

"None of the animals, therefore, showed any febrile reaction, their temperatures remained steady, and they did not appear to suffer any symptoms as a result of the inoculations. Nevertheless, on examining blood films, *Paraplasma*-like bodies were detected in four out of the five puppies. The pathological conditions found at the examination of Dog 96 were probably the result of intercurrent disease, but it is impossible to be certain whether or not they were entirely so.

"We have also examined eleven stray dogs from Lagos that had being procured for us by the police. In the blood of two of these *Babesia*-like, or *Paraplasma*-like bodies were found."* (p. 136.)

"It is, perhaps, too much to suppose that this dog suffered from yellow fever, but in some respects the pathological conditions suggested this disease, and the occurrence of a few *Babesia*-like bodies in the red blood corpuscles, which were very like the *Paraplasma*-bodies found in the dogs inoculated from cases of yellow fever, may be considered to support this hypothesis.

"Our observations on this point have been too few and too incomplete to justify any conclusions. The two dogs referred to certainly appeared to be naturally infected with a *Babesia* resembling the *Paraplasma flavigenum*. It is, of course, possible that the parasite was of another nature; but so far as we are aware, no *Babesia* of dogs has hitherto been described presenting the appearance of that described by us.

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* *Footnote by the Authors.* Similar *Babesiæ*, resembling *Paraplasma flavigenum*, have been found by one of us (J.W.S.M.) to be common in sheep and cattle also.

> "The experiments on puppies, already referred to, further suggests that it might be possible for dogs to be naturally infected with yellow fever, and, although harbouring the parasite in their blood, to exhibit no symptoms of the disease. In this way they might conceivably become a reservoir of yellow fever, and the disease might be maintained in them." (p. 137.)

Remarks.

The evidence here given is, we think, sufficient to justify the conclusion that these bodies may be found in the blood of guinea-pigs and other animals which have been inoculated with blood from Yellow Fever patients.

But here, again, the same caution is necessary in accepting the evidence as proof of the specific nature of the parasites, as, if they can be shown to be present in the blood of guinea-pigs and other animals which have not been thus treated, the whole argument fails.

The suggestion that non-inoculated animals in which the parasites are found must be reservoirs of Yellow Fever is ingenious, but not convincing; the more scientific method would be to institute an extensive research in animals of the same species which have never been in a Yellow Fever country.

(*d*) Absence of the Bodies in the Blood or Tissues of Animals which have not been Inoculated with Blood from Yellow Fever Patients.

The following extracts from the paper by Dr. Seidelin and Dr. Connal* show that they appreciated the fact that the discovery of these bodies in apparently healthy guinea-pigs, if they cannot be in some way brought into relation with Yellow Fever, is fatal to the argument.

> "The question of the natural infection of guinea-pigs by *Paraplasma*-like or other protozoic parasites has received the attention which its great importance requires in our experiments."

The authors naturally assume:—

(1) that the *P. flavigenum* is a parasite;

(2) that it belongs to the order Protozoa; and

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* I.R. Vol. II, p. 469.

(3) that if it is found in a guinea pig, or other animal, the animal is suffering from an infection, possibly of Yellow Fever.

"The two safeguards which we adopted with the object of controlling our experiments were the examination of a smear from the peripheral blood of every animal before inoculation, and a complete post-mortem examination of all stock guinea-pigs which died without having been used in the experiments.

"The blood from a total of 170 guinea-pigs and 3 monkeys was examined. All the monkeys showed *Plasmodium*, but none of the stages observed of these parasites resembled in any way the forms of *P. flavigenum*.

"With regard to the guinea-pigs, however, six animals had to be discarded on account of their harbouring in the peripheral blood a minute parasite which resembled *P. flavigenum*.

"These animals were killed, and post-mortem material was taken for examination in the same manner as from the inoculated guinea-pigs. Whilst we consider that the elements which we observed in the blood of these six animals could not with certainty be distinguished from the yellow fever parasite, we can definitely state that in none of these cases were any of the more advanced forms of *P. flavigenum*, which we have described in this paper, found in touch-preparations from the internal organs." (p. 470.)

"It is difficult to explain the mode of infection * * * * * * in the six guinea-pigs which were eliminated from the experiments.

"The infection may have been a chronic or latent one, its inception dating back to some time before their arrival at the Institute. Infection during their transit from their place of origin must also be considered. The possibility of other insect hosts, such as fleas and lice, must be borne in mind." (p. 471.)

In a paper on "Natural Infections in Guinea-Pigs,"* by Dr. A. Connal, Director of the Medical Research Institute at Lagos, and Dr. J. E. L. Johnston, a description is given of the appearances found in 128 guinea-pigs received from Abeokuta and Lagos. Thirty-four guinea-pigs were found to harbour a body believed to be an intra-corpuscular parasite, "although in a few instances the body may have been an artefact."

"The intra-corpuscular inclusion which was regarded as a parasite, so closely resembled the *Paraplasma flavigenum* as to be undistinguishable from it in most cases."

In four guinea-pigs the "blue bodies" previously described in this report were found in the "lung touches." In this paper they are referred to as "division forms."

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* I.R. Vol. II, p. 595.

The opinion is expressed in conclusion that "the guinea-pig is very frequently infected in its natural state by a parasite which in its pleo-morphism, but not in its pathological effects, resembles the *Paraplasma flavigenum*." Also that "it is probable that the guinea-pig harbours the true Yellow Fever parasite."

Paraplasma flavigenum IN NORMAL GUINEA-PIGS.

In a Report on the examination of the blood of twenty-five normal guinea-pigs for the presence of Seidelin bodies, undertaken in London at the request of the Commission by Dr. David Thomson,* it is stated that:—

"In all the guinea-pigs except four, bodies resembling Seidelin's Yellow Fever parasites were found."

The blood films were obtained from the ears of the animals.

Sometimes they were very scarce, only one being found after an hour's search. As a rule one fairly definite body containing a red chromatin dot, with a bluish tag or ring attached, could be found within the hour, but other bodies bearing some resemblance to a Seidelin body, were also found. The guinea-pigs examined were obtained in England, and varied in age.

Dr. Thomson states that in some marked blood films sent home by Dr. Seidelin, showing the supposed Yellow Fever parasites in inoculated guinea-pigs, nearly all the bodies shown are more indefinite than he anticipated, and that in his examination of normal guinea-pigs' blood he has seen several such bodies, but has passed them over as artefacts, and as too indefinite to paint.

"The bodies found in normal guinea-pigs bearing a marked resemblance to Seidelin's paintings are depicted in the accompanying coloured plates. In figs. 1-4 signet ring forms are depicted, bluish rings, with a chromatin-like dot on the margin. In some of the signet ring forms the colour of the ring was reddish instead of blue (figs. 11-15). The second group consisted of a chromatin-like dot with a bluish tag of protoplasm attached, as seen in figs. 16-22. Some of these were found free from the red cells, *vide* figs. 23 and 24. The third group consisted of a bluish circle with the chromatin

* I.R. Vol. II, p. 479.

dot in the centre, as in figs. 5-10. The fourth variety consisted of an elongated bluish streak with a chromatin dot in the centre or at one end; some of these were free (figs. 25-28). The fifth group consisted of reddish granules made up of dark and lighter staining parts as depicted in figs. 29-55. The bodies belonging to this latter group were fairly numerous."

Dr. Thomson is of opinion that "with regard to the nature and origin of these bodies no dogmatic statement is possible, but that it is highly probable they arise from various sources. Without doubt the great majority of them are artefacts, and cannot be considered as protozoal in nature, though some of those consisting of a reddish ring with a darker staining centre may possibly be an early stage in the *Lymphocytozoon cobayae* (Kurloff bodies), which were found in practically all of the guinea-pigs examined. The most common origin of the majority of the bodies of the first three groups I consider to be a chance combination of dust, dirt or stain deposit. Stain deposit produces chromatin-like granules, and also, at times, bluish rings of varying size. However clean one may try to make the slide, it is not possible to exclude this source of artefact. In taking blood from a guinea-pig's ear, the film is very liable to be contaminated with epithelial débris, etc., which would take on a bluish stain. Another source of these bodies might be a scratch in the red corpuscle. The leucocyte shown in fig. 38 shows another possible source of chromatin dots, and that in fig. 37 shows another possible source of a complete 'Seidelin body.' A probable organismal source is a type of bacillus, which, when stained with Giemsa, shows a definite blue protoplasm, containing a definite chromatin dot in the centre or at one end, *vide* figs. 26, 27 and 28. This bacillus might explain the origin of group 4. These bacilli are commonly found in the faeces of guinea-pigs, and may easily get on to the blood films from the skin or hair of the animal. I have noticed on occasions that the bodies are sometimes removed from the red cells by cleaning the slide with xylol; this would support the artefact hypothesis."

Lieutenant-Colonel David Harvey, R.A.M.C., in a Report on the results of the examination of normal and inoculated guinea-

pigs,* undertaken at the request of the Commission, states that one hour and a half was given to each slide and as a rule two slides were examined from each animal.

"In practically every slide examined one or two bodies were found which simulated piroplasmata. Some of which are figured are described in detail. These bodies could be divided into the following classes:—

"(*a*) Extraneous, such as bacteria and deposit, sometimes lying between and sometimes on the red cells.

"(*b*) Folds and tears in the red cells, with or without granules.

"(*c*) Polychromatophilia of the red cells with granular stippling.

"(*d*) Occasionally small blue staining rod shaped bodies with a granule, not to be accounted for by (*a*), (*b*) or (*c*), and to all appearance identical with the 'Seidelin bodies.'

"(*e*) Kurloff bodies.

"I laboured under the disadvantage of never having had the opportunity of studying the *Paraplasma flavigenum* under the microscope, but many of the bodies seen and figured resembled the pictures closely."

With regard to the examination of guinea-pigs received from Dr. Seidelin, which had been inoculated with blood from cases of Yellow Fever, and also of those inoculated therefrom, Major Harvey states:—

"Twenty-nine guinea-pigs have been inoculated from these strains; blood films were taken daily for some time and latterly twice a week.

"More than 500 slides were taken, and the majority of them have been stained and examined. Some of the appearances are figured.

"As in the normal guinea-pigs, no definite protozoic parasites of the red cells were seen, although some 'bodies' which simulated such parasites were observed, but rarely, not more commonly than in the normal animals.

"I had the opportunity of examining a stained preparation sent by Dr. Seidelin, showing some stages of a protozoal parasite in the lung of a guinea-pig; in none of the ten guinea-pigs mentioned above was anything resembling this condition seen."

* I.R. Vol. II, p. 731.

(*e*) By the Inoculation of Blood from Yellow Fever Patients that Disease may be produced in certain Animals.

(*f*) From such Animals by Sub-Inoculations Yellow Fever may be Transmitted to Successive Generations and in the Blood the Specific Organisms are found.

The evidence which is relied on to prove the above statements is that: —

(*a*) a certain type of pyrexia is observed in the inoculated animal,

(*b*) albuminuria occurs,

(*c*) the *Paraplasma flavigenum* is found in the peripheral blood during life,

(*d*) the same organism is found in the blood and tissues after death,

(*e*) certain lesions are found in the gastro-intestinal tract and in the kidneys, similar to those observed after death from Yellow Fever.

Remarks.

It is obvious that two questions are here involved, as, apart from any view that may be taken of the specific nature of the "bodies" dealt with in this Report, the proof that the inoculated animals were suffering from Yellow Fever might possibly be accepted on the clinical and pathological evidence alone.

It does not appear to the Commission to be necessary to express any opinion on the general question of the possibility of thus conveying Yellow Fever to animals; all that they propose to consider here is the evidence afforded by the experiments of Dr. Seidelin and others, as detailed in the reports under review, that the particular animals inoculated suffered from Yellow Fever.

Following the order adopted in other sections of the Report, this evidence will now be stated in the observers' own words.*

> "Seidelin (1912) injected guinea-pigs with blood taken from a yellow fever patient on the fifth day of illness and containing *Paraplasma flavigenum*. He found the parasites in the blood of two of the injected animals, but no marked febrile reaction was observed. Another experiment with blood taken from a patient on the seventh day of illness gave a negative result."

* I.R. Vol. II, p. 427. Experimental Yellow Fever in Laboratory Animals. Seidelin & Connal.

" Four guinea-pigs were injected on 4th October, 1913, from the patient No. L 69,* and four others on October 15th from the patient L 73† of the Nigeria cases studied under the Yellow Fever Commission. The former patient * * * * * * was on the fourth day of illness when the experiment was made, the temperature having dropped from 38·9° C. (102° F.) on the previous night, to below the normal. * * * * * * At the time of withdrawing the blood he was on the third day of the disease, and his temperature was about 40° C. (104° F.). * * * * * * Two animals were injected intraperitoneally and two subcutaneously from each patient. The quantity of blood injected varied from 0·35c.c. to 3·5c.c.

" An uninterrupted series of infections was carried on from one of these animals inoculated intraperitoneally from Case L 73. At the end of January, 1914, twenty-three animals had thus been infected consecutively.

" From one of the guinea-pigs in this series another series was carried on.

" Additional animals were infected from time to time, or minor series continued for different periods, for special purposes, or in order to have material to fall back upon should the infection die out in the principal series." (p. 436.)

" The guinea-pigs showed great variations in the way in which they reacted, after infection.

" They showed considerable rises of temperature in some cases, and occasionally marked remissions; in fact, some of the temperature charts might be taken for charts from yellow fever in the human.

" A sudden drop of the temperature occurred in several of these cases, after four to nine days; and in such cases death as a rule took place at this stage, the post-mortem examinations showing alterations typical of yellow fever. More or less marked, but rather irregular, rises of temperature were observed in other cases, and death followed in one to two or three weeks after inoculation, a sudden drop of the temperature just before the fatal issue often occurring also in this group.

" In other cases, again, recovery took place, which was, as far as one could judge, often final, but sometimes only apparent, death supervening one or two months after inoculation.

" Emaciation and albuminuria were the only abnormal conditions found post-mortem in these instances." (p. 428.)

" With regard to the stage of the infection in the guinea-pig from which the blood to be injected was taken, * * * * * * there is no definite relationship between this stage and the severity of the infection produced." (p. 450.)

" We have not found any relationship between the height of the temperature of the animal at the time the blood was withdrawn, and the severity of the infection produced in the sub-inoculated guinea-pig." (p. 451.)

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* *Vide* Dr. Leonard's report. (I.R. Vol. I, p. 268.)
† *Ibid.* (I.R. Vol. I, p. 270.)

" Thus it would appear that the severity of an infection depends more upon other factors than upon the intensity of the infection in the animal from which the inoculations are made." (p. 451.)

" No definite incubation period was apparent. In some cases the temperature rose on the day of inoculation, in others the rise did not set in until two, three or four days after.

" The one symptom of which it is possible in a series of animal experiments to keep a careful record, is the pyrexia.

" The record of the course of the temperature in our cases could not be made as carefully as desirable, for practical reasons." (p. 457.)

" With regard to the normal temperature of guinea-pigs observed under the conditions existing at the place and time of our work, we would say that it shows a considerable range of variation. Our impression is that any temperature between 37·2° and 38·4° C. (99° and 101° F.), may, generally speaking, be considered normal. This, of course, does not exclude that, in individual cases, isolated rises of temperature to or just above 38·4° C. (101° F.) may be pathological, especially if they occur shortly after injection or just before death.

" The temperature, in marked reactions, may rise to or above 39·4° C. (103° F.), * * * * * * *."

" The charts, in such cases, show a marked resemblance to those observed in cases of yellow fever in the human, but this condition cannot be laid down as a rule."

" Albuminuria was only observed at the post-mortem examination, as we did not find it practicable to collect the urine from the living guinea-pigs." (p. 459.)

" Omitting the cases in which no urine could be obtained for examination we find that albumen was present in 25 out of 36 cases in which death had occurred spontaneously, and in 9 cases out of 30 in which the animals had been killed. The intensity of the reaction varied from a faint trace, only occasionally observed by Tanret's test, to a dense disc 1 mm. thick, by Heller's reagent.

" It is difficult to make any definite statement with regard to the true mortality due to the infection, as a certain number of non-inoculated guinea-pigs died spontaneously at the same time." (pp. 459 and 460.)

" In addition to these cases of death in the acute stage, we observed several cases in which death occurred from some weeks to two months after inoculation. The post-mortem examination showed an entire absence of lesions corresponding to an acute infection, a more or less marked albuminuria being the only phenomenon noted." (p. 460.)

Anatomical Lesions.

" The most striking lesion observed was undoubtedly a marked affection of the mucous membrane of the stomach, which was present in the vast majority of the cases.

"This affection varied from a more or less marked hyperæmia to an intense acute gastritis with swelling and hyperæmia, hæmorrhages, occasionally in patches, and hæmorrhagic erosions." (p. 460.)

"Other organs appeared but slightly affected. Some cases showed a marked hyperæmia of the lungs, but this was by no means a constant nor even a common phenomenon. Other cases presented moderate hyperæmia of the liver and kidneys, but just as often these organs appeared perfectly normal. The liver appeared distinctly fatty on macroscopical examination, in some few cases. In no instance was any abnormal condition of the spleen recognised macroscopically." (pp. 460 and 461.)

Monkeys.

The observations on three monkeys were incomplete, but after inoculation* *P. flavigenum* was found in the blood of one and "blue bodies" in touch preparations from the lungs. In two other monkeys inoculated parasites were found in the blood smears.

One monkey suffered "a very marked reaction" after inoculation, but its temperature before inoculation had not been observed.

From the curve of the temperature it is concluded that the animal was suffering from Yellow Fever and not from malaria; the parasite of which latter disease was found in its blood. The monkey recovered.

The conclusions of this paper are as follows:—

1. "The yellow fever parasite, *Paraplasma flavigenum* (Seidelin, 1911), has been transmitted to guinea-pigs and monkeys by direct inoculation of blood.

2. "The infection has been carried seriatim through twenty-three guinea-pigs.

3. "The peripheral blood of the infected animals contains forms of the parasite identical with those occurring in human blood in yellow fever.

4. "Various internal organs of the infected animals, particularly the lungs, contain elements which we have found good reason to regard as division forms of *P. flavigenum*" (pp. 475 and 476.)

These division forms are one type of the "blue bodies" to which frequent reference has been made.

These "blue bodies" were demonstrated to the Commission by Dr. Seidelin, and were considered to be identical with the elements described by Carini, and now usually termed "Carini bodies."

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* I.R. Vol. II, p. 462.

They have been found in lung smears from guinea-pigs and rats, quite apart from any inoculation with material from cases of Yellow Fever.

From the paper by Dr. Scott Macfie and Dr. Johnston, already referred to, the following extracts are taken: —

* * * * *

> "* * * * * * * our guinea-pigs, which showed a well-defined febrile reaction following inoculation. The guinea-pigs did not appear to suffer from any other symptoms of disease, but it is often difficult to detect signs of illness in these small animals. Three guinea-pigs, however, died suddenly on the 38th, 20th and 16th day after inoculation respectively. All three had shown a well-marked febrile reaction, but their temperatures had returned to normal some time before their deaths occurred * * * * * * in all three the liver was congested, and the kidneys showed signs of parenchymatous nephritis. In two the urine obtained from the bladder was albuminous.
>
> "As no other deaths occurred among our stock of guinea-pigs at the same time, it would appear probable that the fatal results in these three animals must be attributed to the effects produced in them by the inoculation with yellow fever blood.
>
> "Four of the guinea-pigs inoculated failed to show any definite febrile reaction." (p. 132.)

EXAMINATION OF THE EVIDENCE.

It can hardly be claimed that these papers contain a record of the production of a well-defined disease in the animals submitted to experiment. Uniformity in the symptoms could not be expected, for it is contrary to the nature of the acute infectious diseases in man, but before it is accepted that Yellow Fever was produced in these animals, apart from the finding of the bodies named *P. flavigenum*, it would be necessary to prove an assemblage of symptoms and pathological changes presenting a picture which was recognisable, in at any rate a considerable proportion of the infected animals, and strongly suggestive of Yellow Fever.

In the opinion of the Commission the authors have failed to prove either that they succeeded in transmitting Yellow Fever or in producing any well-defined disease.

There is, for example, no suggestion of a period of incubation, followed by a well-marked onset of the symptoms, progressing

through various stages either towards death or recovery, and confirmed in the fatal cases, by pathological lesions unmistakably suggestive of Yellow Fever.

It is recorded that "the guinea-pigs showed great variations in the way in which they reacted after infection": "some cases showed a hyper-acute course, death resulting a few days after the infection," whereas other cases, "although terminating fatally, showed a prolonged course"; others, again, died several weeks after inoculation.

One animal inoculated from a patient in the third day of his illness, when the virus of the disease should have been active, presented no symptoms during the eighteen days it was under observation; whereas another inoculated with blood from a patient on the eighth day of the disease, when the blood should, according to the generally accepted view, have ceased to be infective, suffered from a rise of temperature three days later and continued in a pyrexial condition for eleven days. It is recorded that blood taken on the fifth day and on the eighth day respectively produced acute fever on the day following inoculation, whereas, after inoculation with blood taken on the third day, there was no febrile reaction until four days later. In another case in which the patient was in the second day of the disease "the febrile reaction of the animal was a slight one." Of the second of two similar cases it is recorded that, "as in the previous animal, no febrile reaction occurred." Other animals inoculated from Yellow Fever cases had rises of temperature of which the description is variously given as "well marked," "very slight," "moderate," and "definite, but somewhat irregular."

The following is significant, and tends to throw considerable doubt upon the conclusions arrived at: –

"It is difficult to make any definite statement with regard to the true mortality due to the infection, as a certain number of non-inoculated guinea-pigs died spontaneously at the same time."

One would like to know exactly what number of deaths occurred after inoculation and "spontaneously," and, if possible, from what disease the latter animals died and the lesions found in them *post-mortem*, as such evidence might throw light upon the cause of death in the inoculated animals.

Symptoms.

Pyrexia. One would be disposed to agree with the authors that "the one symptom of which it is possible in a series of animal experiments to keep a careful record is the pyrexia."

Before attempting to draw conclusions as to the effect upon the temperature of inoculating blood from cases of Yellow Fever into any animal, it is obviously necessary to know the ordinary range of temperature in the kind of animal under experiment, and also the effect of inoculation of blood from healthy animals.

Lieutenant-Colonel Harvey's Studies.

With a view to testing this point, the Commission requested Lieutenant-Colonel David Harvey, R.A.M.C., to observe the temperature in twenty-five healthy guinea-pigs in this country, and to compare it with that of guinea-pigs sub-inoculated with blood from animals brought from Lagos by Dr. Seidelin. The latter animals belonged to the series of sub-inoculations referred to in Dr. Seidelin's paper, and were, therefore, supposed to be suffering from Yellow Fever.

He reported as follows:—"The normal temperature of the College guinea-pigs is apparently between 102° and 103° F., and keeps fairly steady. A curious fact is that, on the whole, apart from one or two rises to 104° F., the temperature of the inoculated guinea-pigs was lower than that of the normal."

Having been informed of these observations, Dr. Seidelin, in a "Further Report on Experimental Transmission of *P. flavigenum*," writes as follows:—*

> "Another point which requires further investigation is that of the temperature reactions. Several of the animals showed what appeared to be very marked reactions, but serious doubt as to the importance of these reactions was produced by the statement made by Sir William Leishman that he had observed very high temperatures in non-inoculated animals, and perhaps, on the whole, lower temperatures after inoculation. Since then I have made further observations on this subject, always personally taking the temperatures. I have observed high temperatures also in non-inoculated guinea-pigs, even above 104° F., though the highest temperatures recorded have been in inoculated

* I.R. Vol. II, pp. 485 sqq.

> animals. I am continuing these observations, but, on the whole I should at the present time lay little stress on this symptom. It would appear that the temperatures of guinea-pigs in this country are, on the whole, considerably higher than those observed at Yaba, a point which likewise deserves special investigation. My impression is that the animals often show very high rises after inoculation, and sometimes also very low temperatures, but more especially that they show very considerable variations. It also remains to be seen whether the high temperatures observed in non-inoculated animals are due to insignificant causes, or whether they are due to disease. I have so far been unable to find out that these animals have been suffering from any disease; as mentioned above, no deaths have occurred spontaneously, and the animals appeared quite healthy." (pp. 485 and 486.)

It is obvious from the above that the claim of the authors to have succeeded in conveying Yellow Fever from man to guinea-pigs cannot be based upon the type or degree of pyrexia produced in the inoculated animals.

If this is true with regard to the direct inoculation of blood from cases of Yellow Fever, it appears hardly necessary to examine in detail the evidence on the same point in the cases of the sub-inoculated animals, as the possibility of reproducing the disease by the former experiment is necessarily far greater than by the latter.

Albuminuria.—This is undoubtedly an important symptom in Yellow Fever, but it is not merely the occurrence of albumen in the urine which is significant, but its appearance at a certain period of the disease—at first in small quantity, then gradually increasing according to the severity of the case, persisting in severe cases up to the end, but in milder cases gradually diminishing and finally disappearing altogether.

With the increase in the amount of albumen there is often a diminution in the quantity of urine, varying in degree up to complete suppression. Casts of the urinary tubules are frequently found and may be bile stained. It will be remembered with regard to these animals that in no case was the observation of the urine made during life.

The evidence on this point would have been much stronger if conditions somewhat similar to the above had been observed in the inoculated animals.

The occurrence of albumen in the urine of an animal suffering from pyrexia does not point specially to Yellow Fever, as it is a well-known symptom occasionally accompanying certain febrile diseases in man.

It would also, we think, have been more satisfactory if the tests for albumen used in these experiments had been the common, well-known tests employed in hospitals, as the desire is to bring the observation into line with clinical conditions occurring in man.

There appears to be the same absence of consistency with regard to this symptom as we have already noted with regard to the clinical picture as a whole. For example, one guinea-pig, which had been inoculated with Yellow Fever blood, in which the temperature had been normal for 27 days, died suddenly, and albumen was found in the urine, whereas it should have been absent under such conditions. In another, in which the temperature had been normal for seven days, sudden death occurred, and the urine was found to contain a trace of albumen.

A similar case is recorded in which the temperature had been normal for eight days, when death occurred. The description of the kidneys is as follows:—"The kidneys were congested. In one examined microscopically a number of small hæmorrhages had taken place, the tubules contained a little débris, and their lining epithelium was somewhat swollen." In this case there was no albumen in the urine.

Another guinea-pig, inoculated directly from a Yellow Fever patient, on the fourth day of the disease, showed "a very slight rise of temperature." It was killed on the sixth day. "The kidney was congested, the tubules contained débris, and the lining membrane was swollen and granular." There is no statement as to the condition of the urine.

The clinical value of "a very slight rise of temperature" will be gathered from what has been stated already, yet the kidneys show well marked lesions, although, beyond the discovery of *P. flavigenum*, there is no other evidence that the animal was infected. The question of the value of this evidence as regards both albuminuria and gastric lesions is further discussed on p. 42 *infra*.

Pathological Changes.

The following account is given by Dr. Seidelin and Dr. Connal* of the pathological changes found in the inoculated guinea-pigs:—

> "The most striking lesion observed was undoubtedly a marked affection of the mucous membrane of the stomach, which was present in the vast majority of the cases. This affection varied from a more or less marked hyperæmia to an intense acute gastritis with swelling and hyperæmia, hæmorrhages, occasionally in patches, and hæmorrhagic erosions. Between these two extremes all transitional stages were observed. The hæmorrhages varied in size from minute petechial to confluent ecchymoses of quite considerable dimensions. The erosions were in some cases so minute that it was necessary to use a hand-lens to make certain of their nature; in other cases they exceeded the size of a linseed. No definite localisation of the hæmorrhages and erosions seemed typical; they were observed in all parts of the stomach, though perhaps the cardiac end was somewhat more frequently and more intensely affected than the pyloric and intermediate parts.
>
> "Other organs appeared but slightly affected. Some cases showed a marked hyperæmia of the lungs, but this was by no means a constant nor even a common phenomenon. Other cases presented moderate hyperæmia of the liver and kidneys, but just as often these organs appeared perfectly normal. The liver appeared distinctly fatty on macroscopical examination, in some few cases. In no instance was any abnormal condition of the spleen recognised macroscopically." (pp. 460 and 461.)

Those who have had the greatest experience in the macroscopic and microscopic examination of the organs in Yellow Fever are, we believe, in agreement that in doubtful cases the condition of the liver affords the most trustworthy evidence of the presence of that disease. If therefore the inoculation of these animals had been successful it is, at any rate, highly probable that in a considerable number of them it would have been possible to make a much more convincing statement than that "other cases (it is not stated how many) presented moderate hyperæmia of the liver and kidneys, but just as often these organs appeared perfectly normal. The liver appeared distinctly fatty on macroscopical examination in some few cases."

As with the clinical symptoms, so with the anatomical lesions, the necessary proof depends greatly upon the assemblage of changes commonly met with in Yellow Fever. If, for example, the changes

* I.R. Vol. II, pp. 460 sqq.

observed in the stomach in that disease had been found in association with the typical lesions of the liver and kidneys, and with the presence of albumen in the urine, a strong case would have been made out.

The Condition of the Stomach and of the Urine in healthy Guinea-pigs and in inoculated animals.

With a view to testing the value of the evidence, the Commission requested Major (now Lieutenant-Colonel) D. Harvey to examine the condition of the urine during life in 25 healthy guinea-pigs and in those sub-inoculated from the animals brought from Lagos by Dr. Seidelin, which were supposed to be infected with Yellow Fever.

Lieutenant-Colonel Harvey* states that in the peripheral blood of four guinea-pigs received from West Africa, and in that of 29 normal guinea-pigs inoculated from this strain, bodies resembling the *Paraplasma flavigenum* were found in 15.

Post-mortem Examination.—Twelve of these animals were killed, in ten the mucous membrane of the stomach was normal, whilst in two there were hæmorrhages. In the first eight, which had not been fed in the morning and were killed in the afternoon, the stomach was examined immediately after death, and in all the organ was normal.

As a result of observations on the effect of previous feeding upon the condition of the stomach, it was found that the stomach of an animal inoculated from the West African strain which had been fed showed small petechial hæmorrhages, whereas in another animal under similar conditions, except as regards food taken, the stomach was normal.

An animal inoculated with blood from a normal guinea-pig killed shortly after feeding also showed hæmorrhages and injection of the vessels of the stomach wall.

In the course of observations upon the effect of *post-mortem* changes in producing the lesions of the stomach regarded as characteristic of Yellow Fever, the interesting discovery was made that

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* I.R. Vol. II, p. 740.

if the *post-mortem* examination is delayed for twenty-four hours hæmorrhages appear in the stomach wall and albumen is present in the urine.

Moreover, when the stomach was found to be stippled with what appeared to be small petechial hæmorrhages they all disappeared when the organ was placed in Kaiserling fluid, and on section of the wall no red cells could be seen but only granular débris (hæmoglobin).

Urine.—An important fallacy attending the presence of albumen in the urine of guinea-pigs was discovered, as mentioned above. Thus two guinea-pigs in which during life the urine had been found to be free from albumen were killed at 4 p.m. At the *post-mortem* examination on the following day the urine of both animals was found to be loaded with albumen. One of these animals belonged to the West African series, whilst the other had been inoculated with blood from a normal guinea-pig, yet the result in both was the same, proving clearly that the albuminuria was a *post-mortem* phenomenon and had no relation at all to any supposed infection with the parasite of Yellow Fever.

Touch Preparations.

In two instances "blue bodies" were found in the blood.

In the peripheral blood of three guinea-pigs inoculated from normal animals in exactly the same manner as in the West African series bodies resembling the *P. flavigenum* were found, and in touch preparations of lung and spleen from one of them "blue bodies" were found and were very numerous.

GENERAL CONCLUSIONS OF LIEUTENANT-COLONEL HARVEY.

The general conclusions at which Major Harvey arrived as the result of his examination of inoculated guinea-pigs from West Africa and normal guinea-pigs with reference especially to three points, viz.:—

(*a*) The presence of *P. flavigenum.*

(*b*) The significance of petechial hæmorrhages in the gastric mucous membrane; and

(*c*) The occurrence of albuminuria,

were as follows:—

1. Bodies resembling *P. flavigenum* were found in the red cells both of normal and inoculated animals.

2. If the guinea-pigs are killed whilst feeding the vessels of the stomach wall will be found injected, and a few small sub-mucous hæmorrhages may be present.

3. If the *post-mortem* examination is delayed for some hours after death an extreme condition of hæmorrhagic (hæmoglobinuric) stippling may be found in the stomach wall. This colouration disappears in the mounting fluid, and no red cells can be found in section.

4. The examination of the urine of guinea-pigs is liable to fallacy owing to the extreme alkalinity and turbidity of the urine.

Post-mortem, both in normal animals and in animals inoculated from others, albumen is almost invariably present in the urine, and becomes more marked the longer urine is allowed to remain in contact with the bladder.

Report by Dr. C. M. Wenyon and Dr. G. C. Low on the occurrence of *P. flavigenum* in the Blood of Normal Guinea-pigs.

The Commission desire to thank the authors of the above paper (since published in the "Journal of Tropical Medicine and Hygiene," December, 1914, Vol. XVII., No. 24), for permission to incorporate their conclusions in this report.

Their conclusions are:—

"(1) In the blood of normal guinea-pigs, born and bred in England, are to be found bodies indistinguishable from the so-called '*Paraplasma flavigenum*' of Seidelin.

"(2) In most cases these appear to be definite structures, which probably have to do with the development of the red cells.

"(3) They are not parasitic, because they occur in the blood of newly-born animals, not forgetting even the possibility of a placental transmission.

"(4) The apparent success of the inoculation into guinea-pigs of such bodies from Yellow Fever cases is due to a failure of a sufficient examination of control animals.

"(5) The evidence in favour of the Yellow Fever bodies being parasites thus breaks down.

"(6) The presence of such bodies in Yellow Fever bears, therefore, no diagnostic significance, apart from the evidence of blood alteration.

"(7) It is frequently impossible to separate real bodies from pure artefacts, a fact which renders their differentiation one of extreme difficulty."

SUMMARY.

Attention may be directed to the manner in which important facts not fitting in with Dr. Seidelin's theory are met by him. The explanations put forward are not only of a most varied character, but are also often in themselves unsatisfactory. For example: —

In the examination of the blood of certain clinically diagnosed Yellow Fever cases for *P. flavigenum*, "six negative cases," occurring during the absence of the observer, are excluded, because the preparations did not stain well.

A very doubtful case in which the *Paraplasma flavigenum* was found and which was diagnosed as Typhoid Fever and presented a positive Widal reaction in a dilution of 1 to 20, is admitted to be "not wholly conclusive," but "proves the usefulness of microscopical examination in difficult cases."

It is claimed that the clinical diagnosis of influenza in a negro from Jamaica, in whose blood the bodies were found, rested chiefly on the fact that he "was considered immune to Yellow Fever."

When the bodies are found in two patients admittedly not suffering from Yellow Fever, the theory is put forward that they are the remains of previous atypical and unrecognised attacks of that disease, the virus persisting but not producing any symptoms.

As one of the patients was suffering from nephritis, it is suggested that Yellow Fever is a possible etiological factor in nephritis, on the ground that "there was no history of any of the ordinary conditions likely to give rise to nephritis."

The shape of the *Paraplasma flavigenum* is spoken of as though it were uniform in appearance and an easily recognisable object under the microscope; yet fifty figures presenting great variety of form are given. And this notwithstanding that some forms "suggest an affinity to the genus Babesia," whilst others "indicate a relation to the Leishman-Donovan bodies" (*Herpetomonas*), and yet others "present some resemblance to the malarial parasites."

The difficulty as regards the ultra-microscopic character of the virus is met by the suggestion that there are two stages in its development, in one of which it is invisible, whilst in the other it can be seen.

The great difficulty in accepting as the virus of such an acute disease as Yellow Fever, an organism which admittedly is only found in small numbers in the blood, is met by the suggestion that "the visible bodies are present in a small minority in comparison with the invisible forms." That the virus can only be transmitted by the mosquito during the first three or four days of the disease, whereas the "bodies" may be found up to the eighth or fourteenth day or longer, is partly explained by Dr. Seidelin on the assumption that "the ultra-microscopic stage on which the transmission depends exists or is present in the blood only during the first few days," whereas "the larger forms may remain a much longer period."

On reference to the Yellow Fever Bulletin, Volume II., No. 2, Plate II. (facing page 238), one finds: "Figs. 1-15 Forms observed in the case H.S., 1-4 on the forenoon of the first day, 5-8 on the evening of the same day, 9-11 on the second day, and 12-15 on the sixth day." Here it was necessary to prove that an illness of a very doubtful nature was really a second attack of Yellow Fever, and that the parasites were present in the blood during the period in which it is admitted to be infective. It may be mentioned in passing that a second attack of Yellow Fever in a European is not of common occurrence.

Also in the paper on "Experimental Yellow Fever in Laboratory Animals" the "parasites" were frequently found very shortly after inoculation, although previously reported to be absent,* *e.g.*:—

* I.R. Vol. II, p. 464. (Seidelin and Connal.)

"With regard to the first appearance of the parasite in the peripheral circulation, it seems advisable to consider only the small group of twenty cases in which daily examination, of the blood were carried out. One of these cases must be eliminated for reasons presently to be stated. In nineteen cases, then, we found that parasites were present in the peripheral blood; in seven cases after one day, in six after two days, in two after three days, in two after four days, and in one case after six days. In the remaining case, the results were negative during the first eight days of observation, and the blood examination was discontinued thereafter. The case referred to as necessitating elimination is guinea-pig 140: it was injected on 13th October, 1913, and parasites were found in the blood taken before inoculation. It was, however, found afterwards that this animal had been used for another experiment several days previously, in which an intracardial injection of heart blood from an infected guinea-pig had been attempted. This experiment was not considered of any value at the time, as the blood had coagulated in the syringe, but there seems to be no doubt that one or a few drops of blood had actually been injected. Before the first injection, the blood-examinations had been negative." (pp. 464 and 465.)

It will be observed that, as in guinea-pig 140 the blood was found to contain parasites before inoculation, it is suggested that they must have been injected in an experiment which at the time "was not considered of any value." We have already seen, however, that they are frequently found in the blood of normal guinea-pigs.

The following are further examples: —

P. flavigenum was found in twenty-one cases in which Yellow Fever was not diagnosed, but which were all febrile cases of short duration with no local symptoms. One was a case of bronchitis; this leads to the statement that "bronchial affections are occasionally seen in severe cases of Yellow Fever, but in this case I should be inclined to believe that there has been a coincidence of two infections."

The blood of two young children in a school is found to contain the parasites.*

"These two cases must be considered together with the two somewhat similar cases which I reported in an earlier paper (1911, 1); in those, *P. flavigenum* was likewise observed in two individuals not suffering from yellow fever. The one was a young girl with anæmia, the other a boy with nephritis; both were natives.

* Y.F.B. Vol. II, No. 2, p. 177.

"In these four cases we may possibly have to do with microbe carriers, in the true sense of the word—individuals harbouring parasites in their blood for a considerable length of time. But there is no proof that it is so. It may just as well have happened that the blood of these individuals has been examined during one of the repeated attacks of yellow fever, or, rather, infections with yellow fever parasites which are supposed by various authors to occur with a certain frequency in natives, producing no characteristic symptoms, or that the individuals have been suffering from chronic infections." (pp. 177 and 178.)

This involves three propositions none of which are established: —

1. That there are human "carriers" of the virus of Yellow Fever;

2. That this virus consists of parasites, which the carriers harbour in the blood;

3. That chronic infections with the virus of Yellow Fever may occur.

As already mentioned, six guinea-pigs in the Lagos experiments were found to harbour the parasites before inoculation. Thus the authors are compelled to rest their case upon the "more advanced forms of *P. flavigenum*," *i.e.*, the "blue bodies," which were not found in those six animals. But the case for regarding these "blue bodies" as the virus of Yellow Fever is, if possible, weaker than with the other forms. Moreover, there is absolutely no proof that these larger bodies are produced by a process of evolution from the smaller

In discussing the *post-mortem* appearances in thirty-nine stock guinea-pigs which died before inoculation, the authors state*: —

"The remaining two cases require some discussion. The first of these died at an early period of our work, and the blood had not been examined in life. At the post-mortem examination there were hyperæmia and hæmorrhages in the stomach, albuminuria was present, and 'blue bodies' were found in liver and bone-marrow touches. The second case was that of a guinea-pig which had been used for feeding mosquitoes in the room which we had prepared for the breeding of these insects. The blood-examination beforehand had proved to be negative, and at the end of about two months this animal died. The post-mortem revealed the presence of gastric hæmorrhages and of albuminuria, whilst blue bodies were found in the lung, liver, and spleen touch-preparations. Another guinea-pig, whose blood was also free from parasites before being put into the mosquito-house, inhabited the same room and fed the same mosquitoes for the same period of time, and died shortly after the first. The post-mortem findings in this case were negative.

* I.R. Vol. II, pp. 470 sqq. (Seidelin and Connal).

"The parasite found in these cases may have been quite a different one, perhaps another representative of the *Babesiidæ*. But the morphological resemblance, and the presence in the hosts of pathological lesions similar to those observed in the yellow fever infected animals, made us regard it as more likely that the animals had really been infected with *P. flavigenum*. If this is so, the authorities may be right who (Manson and Licéaga) have suggested that endemic yellow fever might be kept up in animals—and the question of prophylaxis would be further complicated. We wish to add, however, that we see no epidemiological reason why this hypothesis should be accepted. Whilst we admit the possibility of this source of infection, we believe that it would in practice prove to be a non-important one.

"It is difficult to explain the mode of infection in the two guinea-pigs whose history has just been described, and also in the six guinea-pigs which were eliminated from the experiments.

"The infection may have been a chronic or latent one, its inception dating back to some time before their arrival at the Institute. Infection during transit from their place of origin must also be considered. The possibility of other insect hosts, such as fleas and lice, must be borne in mind.

"And finally, the question of hereditary transmission by *Stegomyia fasciata* cannot be excluded in the case of the guinea-pig which was used to feed the newly-hatched mosquitoes in the breeding-house, although this theory is not supported by the negative post-mortem results obtained from the other guinea-pig which occupied the room during the same period." (pp. 470 to 472.)

Here again we are asked to accept the following: —

1. That nearly all the lesions relied upon to prove the presence of Yellow Fever in inoculated guinea-pigs may be met with when death occurs "at the end of about two months" after inoculation;

2. Whereas in another guinea-pig which lived under precisely similar conditions and died "shortly after the first" no lesions may be found;

3. That the parasite found in these cases may have been quite a different one, perhaps another representative of the *Babesiidæ;*

4. That it is more likely that the animals had really been infected with *P. flavigenum;*

5. That there may be chronic or latent infection in Yellow Fever;

6. That guinea-pigs may be infected with Yellow Fever whilst in transit in cages from one place to another by the bites of mosquitoes;

7. That there may be insect hosts, *e.g.*, fleas and lice, other than the *Stegomyia;*

8. That the newly-hatched mosquitoes may have been by hereditary transmission carriers of the virus of Yellow Fever and have infected the guinea-pig.

All this is still in the region of speculation.

When the "bodies" cannot be differentiated from those found by others in a disease having no known relation to Yellow Fever, it is suggested that this disease must be of protozoal origin.

> "I would not omit to refer to a paper in which some bodies are described, which show a great similarity to those I have described. These have been found in quite another disease, namely, *typhus exanthematicus*, and the authors do not discuss the nature of their microbe.
>
> "If both are confirmed there would be a still further increase in the already numerous protozoal diseases, which in recent years, and more especially in tropical countries, are rapidly acquiring an importance almost as great as that of the bacterial infections."

Finally, as in one kind of animal after another, viz., normal guinea-pigs, puppies, stray dogs and white rats, the *P. flavigenum* is found, the number of possible reservoirs of the virus of Yellow Fever increases. Dr. Seidelin is, however, not responsible for the following:—

> "The experiments on puppies, already referred to, further suggest that it might be possible for dogs to be naturally infected with yellow fever, and, although harbouring the parasite in their blood, to exhibit no symptoms of the disease. In this way they might conceivably become a reservoir of yellow fever, and the disease might be maintained in them."

In the opinion of the Commission the evidence is conclusive against the claim to have established by the following proofs:—

(*a*) The presence of a protozoon-like body in the blood, the *P. flavigenum*,

(*b*) the occurrence of pathological lesions in the stomach, and

(*c*) the production of albuminuria,

the transference of Yellow Fever to guinea-pigs, either by the injection of blood from cases of that disease, or by inoculation from one infected animal to another.

Conclusions.

The Commission have arrived at the following conclusions upon the subjects dealt with in this Report: —

1. That no proof has been given that the bodies named *Paraplasma flavigenum* are of protozoal nature.

2. That under that name a number of microscopic objects are included.

3. That, excluding artefacts, the origin of most of these objects is at present uncertain, and so far none have been proved to possess any definite physiological or pathological importance.

4. That there is so far no reason to regard any of these objects as the cause of Yellow Fever.

5. That the nature of the virus of Yellow Fever still remains undetermined.

JAMES KINGSTON FOWLER.
W. J. SIMPSON.
RONALD ROSS.
W. B. LEISHMAN.
ANDREW BALFOUR.

ALEX. FIDDIAN,
Secretary to the Commission.

H. LYNCH BURGESS,
Medical Secretary.

1st November, 1915.

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1915.

YELLOW FEVER COMMISSION

(WEST AFRICA).

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FOURTH AND FINAL REPORT

OF

THE YELLOW FEVER COMMISSION

(WEST AFRICA.)

PART I.

WORK OF THE COMMISSION.

The period of three years for which the Commission were appointed having expired, it becomes their duty to present a Fourth and Final Report of their proceedings.

2. Since August, 1914, the work upon which they have been engaged has been seriously hindered by the outbreak of war.

The atmosphere which war creates renders research, unless in subjects directly connected therewith, almost impossible. This is in part due to the fact that nearly all who are qualified for research desire to undertake work of a more active kind on behalf of their country.

In the West African Dependencies it became necessary to recall the members of the West African Medical Staff who were acting as appointed Investigators of the Commission to other duties, and it was not found possible to replace them.

3. Owing to these circumstances the Commission are compelled, with regret, to bring the enquiry upon which they were engaged to an end, whilst many of the problems under investigation are still unsolved.

This is the more unfortunate as, after one of those periods of quiescence, which are so characteristic of the course of this disease, a

fresh outbreak occurred in September and October, 1915, at Onitsha, Nigeria, where there were two cases in natives, one of which was fatal; at Burutu, a fatal case in a native; and at a camp known as "Engenni Concessions," on Engenni River, twenty miles from Degema, where seven cases occurred in natives, of which two were fatal. From Kaduna, one fatal case in a European is also reported.

Possibly, at some later period, when the conditions are more favourable, these researches may be resumed and carried to a successful conclusion.

4. The continuity of attendance at the meetings of the Commission has been from time to time interrupted by the calls made upon its members for service under the Government abroad. Thus Professor Simpson was absent on an important mission to East Africa from May, 1913, to January, 1914. The services of Sir William Leishman have not been available since the outbreak of war. Sir Ronald Ross was engaged on a mission to Cyprus in March and April, 1913, and on military duty in Egypt from July to the end of November, 1915. Dr. Andrew Balfour, who was added to the Commission in November, 1914, was called upon for service in the Eastern Mediterranean in July, 1915.

5. The Commission were appointed by Mr. Secretary Harcourt in January, 1913, with the following reference: —

> "To study the nature and the relative frequency of the fevers occurring among Europeans, natives and others in West Africa, especially with regard to Yellow Fever and other non-malarial fevers in that country."

6. The Commission have held seventy-four meetings, including several laboratory meetings, and have also personally carried out laboratory examinations in connection with material sent home by Investigators and others. They have had interviews with the following gentlemen, who kindly attended to place their knowledge at the disposal of the Commission: —

J. B. Tombleson, M.B., B.Ch. (Oxon), late W.A.M.S.

David Thompson, M.B., Ch.B. (Edin.), D.P.H. (Cantab.).

T. E. Rice, L.S.A. (Lond.), D.P.H. (Ireland), W.A.M.S.; Principal Medical Officer, Gold Coast.

H. S. Coghill, M.B., Ch.B. (Edin.), W.A.M.S.; Assistant Bacteriologist, Medical Research Institute, Lagos.

H. M. Hänschell, M.R.C.S. (Eng.), L.R.C.P. (Lond.), late W.A.M.S.

Lieut.-Col. A. Lisle Webb, C.M.G., R.A.M.C.

E. A. Chartres, F.R.C.S. (Ireland), D.P.H. (Ireland), W.A.M.S.; Deputy Principal Medical Officer, Nigeria (Northern Provinces).

Harald Seidelin, M.D. (Copenhagen).

Major W. H. G. H. Best, L.R.C.S., L.R.C.P. (Ireland), W.A.M.S., R.A.M.C. (S.R.); Principal Medical Officer, Nigeria (Southern Provinces).

G. E. H. Le Fanu, M.B., Ch.B. (Aberd.), W.A.M.S.; Medical Officer, Gold Coast.

A. Connal, M.D., Ch.B. (Glas.), D.P.H. (Cantab.), W.A.M.S.; Director of the Medical Research Institute, Lagos.

J. M. O'Brien, M.R.C.S. (Eng.), L.R.C.P. (Lond.), W.A.M.S.; Medical Officer, Gold Coast.

Surgeon-General Sir Charles Purdey Lukis, M.B. (Lond.), F.R.C.S. (Eng.), K.C.S.I., K.H.P.; Director-General, I.M.S.

A. E. Horn, M.D., B.Sc. (Lond.), W.A.M.S.; Senior Medical Officer, Gambia.

G. G. Butler, M.B., B.C. (Cantab.), M.R.C.S. (Eng.), L.R.C.P. (Lond.), W.A.M.S.; Medical Officer, Sierra Leone.

Lieutenant-Colonel J. C. B. Statham, C.M.G., R.A.M.C.

J. E. L. Johnston, M.B., B.S. (Lond.), M.R.C.S. (Eng.), L.R.C.P. (Lond.), W.A.M.S.; Medical Officer, Nigeria.

S. T. Darling, M.D.; Chief of the Laboratory, Ancon Hospital, Panama Canal Zone.

Surgeon-General W. C. Gorgas, Medical Corps, United States Army; Chief Sanitary Officer, Isthmian Canal Commission.

R. Mugliston, M.R.C.S. (Eng.), L.R.C.P. (Lond.), W.A.M.S.; Medical Officer, Gold Coast.

F. Beringer, M.R.C.S. (Eng.), L.R.C.P. (Lond.), D.P.H. (Ireland), W.A.M.S.; Sanitary Officer, Sierra Leone.

F. G. Hopkins, M.D., B.Ch. (Dublin), W.A.M.S.; late Principal Medical Officer, Gold Coast.

T. Hood, M.R.C.S. (Eng.), L.R.C.P. (Lond.), W.A.M.S.; Director of the Medical and Sanitary Service of Nigeria.

J. C. M. Bailey, M.D. (Lond.), M.R.C.S. (Eng.), L.R.C.P. (Lond.), W.A.M.S.; Medical Officer, Nigeria.

S. C. O. Pontifex, Collector of Customs, Nigeria.

D. Mackinnon, M.B., Ch.B., D.P.H. (Edin.), W.A.M.S.; Medical Officer, Nigeria.

A. Hutton, M.B., Ch.B. (Aberd.), W.A.M.S.; Medical Officer, Nigeria.

J. W. Collett, L.R.C.S., L.R.C.P. (Edin.), L.F.P.S. (Glas.), W.A.M.S.; Provincial Medical Officer, Nigeria.

E. W. Graham, M.B., C.M. (Glas.), W.A.M.S. ; Provincial Medical Officer, Gold Coast.

J. A. Pickels, M.B., B.S. (Lond.), D.P.H. (Liverpool), W.A.M.S. ; Senior Sanitary Officer, Nigeria (Southern Provinces).

J. W. Scott Macfie, M.B., Ch.B. (Edin.), W.A.M.S. ; Pathologist, Gold Coast.

T. M. R. Leonard, L.R.C.S., L.R.C.P. (Edin.), L.F.P.S. (Glas.), W.A.M.S. ; Medical Officer, Nigeria.

A. W. Bacot, F.E.S., Entomologist to the Lister Institute of Preventive Medicine.

W. E. Deeks, M.D. ; Chief of the Medical Clinic, Ancon Hospital.

Major Perry, Medical Corps, United States Army ; Sanitary Department, Panama Canal Zone.

W. H. A. Gordon Hall, M.B., C.M. (Edin.), W.A.M.S. ; Provincial Medical Officer, Nigeria.

Dr. Felix Paez, Director of the Medical Department of the Hospital Ruiz, Ciudad Bolivar, Venezuela.

7. The various steps taken by the Commission to organise their work are fully stated in the First Report and need not be repeated. They included the appointment of Investigators detailed for work at various places on the West Coast of Africa. A list of the Investigators is given below, showing where they worked and the reports which they have furnished, with references to such of them as have been published, either in the Volumes of Reports issued by the Commission or elsewhere : —

Name, Title and Place of Work.	Reference to Report.
Lieutenant-Colonel J. C. B. Statham, C.M.G., M.R.C.S., (Eng.), L.R.C.P. (London), D.P.H. (R.C.P.S., Eng. and London) ; R.A.M.C. ; at Freetown, Sierra Leone.*	I.R. Vol. II., pp. 353 to 387.
G. G. Butler, M.A., M.B., B.C., (Cantab.), M.R.C.S., (Eng.), L.R.C.P., (London) ; W.A.M.S. ; at Freetown	I.R. Vol. II., pp. 389 to 417.
J. M. Dalziel, M.D., C.M. (Edin.), B.Sc., Public Health (Edin.), D.T.M. (Liverpool) ; W.A.M.S. ; at Freetown.	I.R. Vol. II., pp. 527 to 579.
W. B. Johnson, M.B., B.Sc. (London), F.R.C.S. (Eng.), L.R.C.P. (London) ; W.A.M.S. ; at Freetown.	Do. do.
A. W. Bacot, F.E.S., Entomologist to the Lister Institute of Preventive Medicine ; at Freetown.	Investigators' Reports, Vol. III.†

*Lieut.-Col. (then Major) Statham resigned his position as Investigator shortly after his appointment, but continued to do similar work and to collaborate with Dr. Butler in a private capacity.

†Not yet published.

Name, Title and Place of Work—*continued.*	Reference to Report—*continued.*
H. S. Coghill, M.B, Ch.B., (Edin.), D.T.M. & H. (Cantab.); W.A.M.S.; at Sekondi and Accra, and in the Northern Territories, Gold Coast.	I.R. Vol. II., pp. 653 to 730.
H. M. Hänschell, M.R.C.S. (Eng.), L.R.C.P. (London), D.T.M. (Liverpool); late Senior Demonstrator, London School of Tropical Medicine; late W.A.M.S.; at Sekondi, Gold Coast.	Do. do.
G. E. H. Le Fanu, M.B., C.M. (Aberdeen), D.T.M. (Liverpool); W.A.M.S.; at Accra and Quittah, Gold Coast.	I.R. Vol. II., pp. 581 to 594; I.R. Vol. III.*
Harald Seidelin, M.D. (Copenhagen); (late) Director, Yellow Fever Bureau, Liverpool; at Accra, Gold Coast, and Lagos, Nigeria.	I.R. Vol. II., pp. 421 to 478; 483 to 526.
A. Hutton, M.B., Ch.B. (Aberdeen), D.T.M. & H. (Cantab.); (late) W.A.M.S.; at Accra, Gold Coast.	—
†T. M. R. Leonard, L.R.C.S., L.R.C.P. (Edin.), L.F.P.S. (Glas.): W.A.M.S.; at Lagos, Nigeria.	I.R. Vol. I., pp. 207 to 316.
†J. W. Scott-Macfie, B.A. (Cantab.), M.B., Ch.B. (Edin.); D.T.M. (Liverpool); W.A.M.S.; Pathologist, Accra; at the Medical Research Institute, Lagos, Nigeria.	Proceedings of the Royal Society of Medicine, Vol. III., 1914, (Medical Section), pp. 49-67 (also published in the Yellow Fever Bulletin, Vol. III. No. 2, pp. 121-144).
J. E. L. Johnston, M.B., B.S. (Lond.), M.R.C.S. (Eng.), L.R.C.P. (Lond.), D.T.M. & H. (Cantab.); W.A.M.S.; at the Medical Research Institute, Lagos, Nigeria.	Do. do. and I.R. Vol. II., pp. 595 to 652.
†(Temporary) Captain E. J. Wyler, M.D., B.S. (Lond.), M.R.C.S. (Eng.), L.R.C.P. (Lond.); R.A.M.C. (late W.A.M.S.); at Lagos, Abeokuta, Warri, Forcados and Lagos, Nigeria.	I.R. Vol. I. pp. 2 to 206.
†A. Connal, M.D., Ch.B. (Glas.), D.P.H., D.T.M. & H. (Cantab.); W.A.M.S.; Director of the Medical Research Institute, Lagos, Nigeria; at the Institute.	I.R. Vol. II., pp. 421 to 478; 595 to 652.

*Not yet published.

†These gentlemen were not definitely appointed Investigators under the Commission, but carried out work on the same lines. Dr. Connal was the appointed officer through whose hands "case cards" and other records passed from Nigeria to the Commission, and blood films and pathological material from suspected cases were examined at the Medical Research Institute under his supervision.

8. The Commission are also indebted to the following members of the Medical Profession who have assisted in their work in various ways, either in West Africa or at home: –

Sir PATRICK MANSON, G.C.M.G., M.D. (Aberd.), F.R.C.P. (Lond.), F.R.S.

Lieutenant-Colonel S. L. CUMMINS, C.M.G., M.D. (R.U.I.), R.A.M.C.

Lieutenant-Colonel D. HARVEY, M.D. (Glas.), R.A.M.C.

(Temporary) Lieutenant-Colonel C. M. WENYON, M.B. B.S., B.Sc. (Lond.), R.A.M.C.; Wellcome Bureau of Scientific Research.

H. M. TURNBULL, M.D., B.Ch. (Oxon.), M.R.C.S. (Eng.), L.R.C.P. (Lond.); Director of the Pathological Institute, London Hospital.

J. W. CROPPER, M.B., Ch.B., M.Sc. (Liverpool), M.R.C.S. (Eng.), L.R.C.P. (Lond.), Lister Institute of Preventive Medicine.

(Temporary) Captain A. LUNDIE, M.B., Ch.B. (Edin.), B.Sc. (St. Andrews), R.A.M.C. (late W.A.M.S.).

(Temporary) Lieutenant J. C. THOMSON, M.B., Ch.B. (Edin.), R.A.M.C.; Lecturer in Protozoology, London School of Tropical Medicine.

A. C. STEVENSON, M.B. (Lond.), M.R.C.S. (Eng.), L.R.C.P. (Lond.); Wellcome Bureau of Scientific Research.

E. F. WARD, M.D., B.Ch., B.A.O. (Belfast); W.A.M.S.

M. E. MACGREGOR, B.A. (Cantab.); Wellcome Bureau of Scientific Research.

9. The Commission have already presented three Reports, and have published two volumes* containing Reports received from appointed Investigators and others. (A third volume is in the press.)

These volumes contain many papers of great interest, and it is believed that they form a valuable addition to our knowledge of Yellow Fever, and in a lesser degree also of Malaria and other diseases.

10. The First Report was presented in order to make clear the scope of the reference and the steps which had already been taken to give effect to the instructions.

This step appeared to be desirable, in order that there might not be overlapping, should it be decided to appoint another Commission

* The full reference is as follows: "Yellow Fever Bureau Bulletin, Yellow Fever Commission (West Africa). Reports on questions connected with the Investigation of Non-Malarial Fevers in West Africa." These volumes are here referred to thus: "I.R., vol.——."

to consider the possibility that, on the opening of the Panama Canal, Yellow Fever might be carried to countries in which hitherto it had been unknown.

11. In their Second Report the Commission dealt chiefly with the history of Yellow Fever in relation to the West African Colonies. The evidence adduced to prove that the disease had been present in one or other Colony upon the Coast for at least 130 years has been accepted as justifying that conclusion.

It was shown that during this period its activity had been subject to great variations, and that in every Colony, during recurring periods, often of prolonged duration, there was no record of the occurrence of an epidemic amongst the European inhabitants, although during the years comprised within these intervals cases of a suspicious character had often occurred, which had been recorded under one or other of the numerous euphemisms commonly employed in the past to hide the presence of Yellow Fever.

In some Colonies these intervals had in later times become fewer and briefer, as the records became more complete, and the necessity for constant attention to sanitary measures more appreciated by the Government concerned.

12. The Third Report of the Commission was almost entirely devoted to the various questions connected with the claim of Dr. Harald Seidelin to have discovered the virus of Yellow Fever, in the form of bodies to which he had given the name of *Paraplasma flavigenum*.

As the result of researches undertaken or suggested by the Commission, evidence was obtained which led them to conclude that the bodies in question had no pathological significance, and that they were in no way specially connected with Yellow Fever.

The Commission are of opinion that the facts therein set out are conclusive against Dr. Seidelin's claim.

13. This Fourth and Final Report is divided into five parts, of which the foregoing sections constitute Part I.

Part II. deals with the presence of various fevers among natives and Europeans, in West Africa, excluding Yellow Fever.

Part III. is devoted especially to Yellow Fever.

Part IV. contains suggestions for further research and in regard to quarantine, the general conclusions at which the Commission have arrived, and also references to the services of Investigators and others.

Part V.—Appendices.

At the head of Parts II., III. and IV. a synopsis is given of the contents of those parts of the Report.

PART II.

THE PRESENCE OF VARIOUS FEVERS AMONG NATIVES AND EUROPEANS, EXCLUDING YELLOW FEVER.

SYNOPSIS.

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One of the problems to which the attention of the Investigators appointed by the Commission was specially directed was stated thus: —

"Do the following diseases occur in West Africa?

"If so, to what extent?

"(*a*) Dengue Fever.
"(*b*) Pappataci Fever.
"(*c*) Typhus.
"(*d*) Rocky Mountain Fever.
"(*e*) Double continued Fever.
"(*f*) Typhoid.
"(*g*) Paratyphoid.
"(*h*) Undulant Fever (formerly Malta Fever).
"(*i*) Para-undulant Fever.
"(*j*) Cerebro-spinal Fever."

Another problem was: —

"The nature of the fevers which have been termed—

"(*a*) Bilious Remittent Fever.
"(*b*) Malignant Bilious Remittent Fever.
"(*c*) Inflammatory, Endemial or Acclimatising Fever.
"(*d*) Hyperpyrexial Fever.
"(*e*) Three Days' Fever.
"(*f*) Seven Days' Fever.
"(*g*) Low Fever.
"(*h*) Febricula."

The Commission cannot claim to have made, through their Investigators, an exhaustive study of these various types of fever; that part of the work has been rendered incomplete by the events to which reference has already been made.

A considerable amount of evidence as regards the occurrence in West Africa of some of these fevers has however been obtained and will now be stated.

SECTION I.

DENGUE, PAPPATACI FEVER, THREE DAYS' FEVER AND SEVEN DAYS' FEVER.

Dengue.

There has certainly been no epidemic of Dengue Fever on the West Coast during the period covered by the work of the Commission, and in the absence of such a clear indication of the presence of that disease it is advisable to speak with some reserve as to the nature of the cases which have presented signs suggesting such a diagnosis.

I. R. Vol. II., pp. 353—386.

The second volume of the Investigators' Reports contains an account by Lieutenant-Colonel J. C. B. Statham, C.M.G., R.A.M.C., of a series of 800 medical pyrexias investigated by him at Sierra Leone in 1912 and 1913. In all 1,100 cases were investigated.

Colonel Statham, in discussing the possible nature of 70 cases of undiagnosed fever where no malaria parasites were found in the blood, writes as follows (p. 381):—

> "*Pappataci, Dengue, Three-day Fever and Seven-day Fever.*—* * * * * * The majority of the remaining cases were, I think, from clinical and bacteriological grounds, cases of malaria where the parasites had been missed, either owing to a single blood examination only having been made, or to the great scarcity of parasites, a condition which one so often notices in subtertian malarial infection out here. There remain other cases where the most complete search on successive days failed to reveal malaria parasites, and some of these cases may have belonged to the group of diseases mentioned above.
>
> "The sporadic rather than epidemic nature of the cases, and the absence of rashes, conjunctival injection, and joint affections, appears to negative pappataci fever, or dengue in the epidemic form, but some of the cases may have been of the nature of sporadic dengue or seven-days' fever, if these are clinical entities. * * * * * * Though *Simuliidæ* and *Chironomidæ* abound in Sierra Leone, I have never met with nor heard of the *Phlebotomus pappatasii*."

One case in Colonel Statham's series is classed as " ? Dengue or exanthem." The patient was a European woman, age 35, resident in Freetown, who was taken ill on August 29th, 1913, and when seen on the following day had a temperature of 102°F. She complained of fulness in the head, pains and aches all over the body, slight sore throat, dyspepsia and buzzing in the ears. The tongue was furred, but with a slight strawberry appearance. The face was flushed, there was no conjunctival injection, no jaundice, vomiting or diarrhœa. A slight cloud of albumen was present in the urine. The pulse varied between 86 and 94. The temperature fell to 100°F. on the third day and remained almost steady at that level for five days; on the seventh day it became normal. An erythematous rash was present on the face, chest, back and arms; it did not resemble any specific rash. Four days later, 4/10/13, a punctate rash appeared over the whole of the body, and was especially marked on the forearms, palms and fingers. This rash faded on the following day, and was almost immediately followed by a third rash of a diffuse morbiliform character. This also lasted one day, and after it the skin peeled. The patient stated that she always had a rash after a chill. Two blood examinations for malaria parasites were negative. I.R. Vol. II. p. 371 (No. 71.)

In the house in which the patient lived many *Culex* and *Stegomyia* were found and three other cases of fever had occurred amongst the inmates.

The evidence afforded by a single case of this kind is obviously insufficient to establish the fact that Dengue fever is to be met with in Sierra Leone.

Dr. Hutton, one of the Investigators of the Commission, stated in an interview: --

> " One case of dengue had been diagnosed in the Gold Coast just before he went there.
>
> " The patient was a Mrs. H. (she left hospital a few days after Dr. Hutton's arrival). who had been a nurse, and recognised that the rash was quite different from that of scarlet fever, etc. Dr. O'Brien and Dr. Connal had diagnosed the case, and their diagnosis had been confirmed by Dr. Dowse, who had experience of dengue in Fiji."

A case which was classified by the Commission as " Possibly Dengue " occurred at Naraguta, in Northern Nigeria, in April, 1913.

The clinical record is, briefly, as follows:—

L. 126.* "Mr. A., Surveyor, ? age, had been feeling unwell for a day or two, with aches in his bones. When seen on April 23rd he complained of headache and a rash. The eyes were deeply injected. Face flushed, tongue coated; temperature, 102° F. The whole body was covered with a profuse scarlatiniform rash, slightly marked on forehead, absent on palms and soles. The rash was slightly rough to the touch, and the affected skin was tender.

"April 24th. Temperature, 103° F.

"April 25th. Temperature, 99° F. Rash partially faded. Eyes still injected.

"April 28th. Rash disappeared. Temperature normal. No desquamation."

A second case of a similar nature, also classified as "Possibly Dengue," occurred at Naraguta, in November, 1913.

L. 127. The following are the notes of this case:—

"Mr. B., Mine Manager.

"On Nov. 16th complained of severe pains in body and legs, especially on movement. Could with difficulty get out of bed.

"Temperature 102° F. at 7 p.m.

"For the next two days pains grew less, but temperature was still raised in the evening.

"Nov. 19th. Scarlatiniform rash appeared first on chest, abdomen, and back. Eyes injected. Face flushed. Temperature, 99° F. at 6 p.m.

"Nov. 20th. Rash had extended to arms and legs, and was very profuse on body, slightly marked on forehead. Eyes deeply injected. Palms and soles free, but he complained of head and tenderness in them. Rash generally was tender to touch and heat. There was some tenderness of glands in axilla and groin. Temperature, 99° F.

"Liver and spleen normal.

"Urine contained no albumen.

"Nov. 22nd. Rash much faded. Temperature normal.

"Nov. 23rd. Rash entirely disappeared. No signs of desquamation.

"Blood showed no parasites.

"Mononuclear ... ... 21 per cent.

"Eosinophiles ... ... 5 " " "

* The numbers quoted in the margin, where no other reference is given, are those assigned to the cases by the Investigators (at Lagos and elsewhere), through whose hands the records passed to the Commission. For an account of the system adopted see the First Report of the Commission (page 33, etc.).

Pappataci Fever.

In a synopsis of cases of fever reported from Nigeria to the Medical Research Institute, Yaba, S. Nigeria, up to July 22nd, 1913, Dr. J. W. Scott Macfie, the Acting Director, summarizes four cases of Pappataci fever, all of which occurred in Europeans, thus: — L. 17. L. 18. L. 19.

"*Pappataci Fever.*

"Three cases of fever reported from Ibadan (Nos. 17, 18 and 19), and one (No. 20) from Lagos, are suggestive of pappataci fever. These cases were characterised by the sudden onset and the short duration of the fever; pains in the back and limbs; headache; nausea or vomiting, and digestive disorders; and pharyngitis. The pulse was slow, but of good quality. There was neither tenderness nor enlargement of the liver and spleen. Albuminuria was not present; and the blood was negative in the cases in which examinations were made. In two cases convalescence was prolonged, in the other two it was brief. In this respect the latter cases (Nos. 18 and 19) differed from typical pappataci fever. A history of bites from sand-flies accompanied the cases. It can scarcely be doubted, therefore, that these were cases of pappataci fever.

Table of symptoms in four cases, probably Pappataci Fever.

Case No.	17	18	19	20
Onset, sudden...	+	+	+	+
Fever, 1 to 2 days	+	+	...	+
Convalescence, slow	+	–	...	+
Headache	+	+	+	+
Severe pains in the back, loins, &c.	+	+	+	+
Eyes injected	...	...	+	+
Vomiting and digestive disorders	+	+	...	+
Pharyngitis and tonsilitis ...	...	+	+	+
Tongue, tip red	+	+	...	+
Slow pulse of good quality ..	+	+	+	+
Slow pulse in convalescence ...	+	+	...	+
Albuminuria	–	–	–	–
Blood—Malarial parasites ...	–	...	–	–

+ : present; – : absent; ... : no observation.

"A case (No. 21) reported from Ebute-Metta, near Lagos, should also, perhaps, be included here. With regard to the occurrence of sand-flies, *Culicoides grahami* is the only species known to occur at Lagos; but I believe that the Entomologist to the Agricultural Department has recently taken specimens belonging to both the genera *Phlebotomus* and *Simulium* at Ibadan."

One of these cases was reported by Dr. T. W. Russell Leonard, as follows: —

L .20. "CASE OF PAPPATACI FEVER.

"*No.* 20. *Name.*—D. L. D.

"*Sex.*—Male.

"*Age.*—23 years.

"*Nationality.*—British.

"*Occupation.*—Assistant Auditor.

"*Date of admission.*—21st May, 1913.

"*Date of discharge.*—26th May, 1913.

"*Diagnosis.*—Pappataci fever (sand-fly fever, three days' fever).

"*History.*—Patient states that he was apparently quite well and fit up to 10 p.m. on the night of the 20th of May. At 10.30, after going to bed, he began to have a severe frontal headache, accompanied by aches and pains in the muscles of the legs, thighs and loins. Later he experienced pains in the epigastrium, which were followed by vomiting, accompanied by several profuse watery motions; his bowels had previously been constipated. His temperature rose, but he had no thermometer to register it. He spent a very restless night, the vomiting and diarrhœa continued on and off, the headache got worse, and the muscular pains increased; so at 5 a.m. he sent for a doctor, and Dr. Wyler went and saw him and sent him into hospital at 7.30 a.m., the 21st.

"*Condition on admission.*—Patient complains of severe headache, sore throat, muscular pains in the leg, thigh and lumbar muscles; the vomiting had stopped.

"Face was flushed, the conjunctivæ of both eyes were red and injected, the injection appearing as a red band passing across the eye and corresponding to palpebral fissure.

"*Alimentary system.*—Tongue is coated, with clean tip. Pharynx is congested. Tonsils also congested and red. Complains of soreness when swallowing. Stomach is irritable. Epigastrium is tender on pressure. Liver is normal. Spleen also normal, no tenderness on palpation. Vomiting had been very troublesome, but had now stopped. Had several watery motions through the night accompanied by pains in the epigastrium. The motions were yellow and watery, otherwise normal

"*Circulatory system* —Area of cardiac dulness is normal. Heart sounds are normal in character. Pulse rate 78 mt.

"*Nervous system.*—Headache pronounced, felt in the frontal region.

" Pains in the muscles of the leg, thigh, of both lower extremities, and also in the lumbar muscles. The pains were increased on pressure. There was pronounced tenderness of both peroneal nerves.

" *Urinary system.*—Urine was passed freely; on examination high coloured. Acid reaction. Sp. gr. 1,030. No albumen.

" *Blood examination.*—No malaria fever parasites found. Red cells normal in appearance.

" Leucocyte count: polymorph., 80 per cent.; l. mononuclear, 10 per cent.; lymphocyte, 10 per cent.; eosinophiles, nil.

" *Other systems.*—The skin over both lower extremities shows the marks of numerous bites by sand-flies, the patient stating that he was bitten chiefly at night.

" The patient is a new arrival in West Africa, and has never been in the tropics before; he takes quinine regularly and uses a mosquito-net at night.

" *21st May.*—The pulse rate on admission was 78 mt., but during the day there was pronounced bradycardia, the pulse rate at 12 noon being 56 mt., and faintly dicrotic; temperature being 98°. At 6 p.m. the pulse was 52, and at 8 p.m. it was 64 mt. The muscular pains continued, but the frontal decreased in severity under the treatment.

" *22nd May.*—Patient had a good night, slept well, and feels more comfortable this morning. Temperature is 97·2°, pulse 50 mt., still faintly dicrotic. At 11 a.m. the pulse was 48 mt., and at 6 p.m. it was 50 mt. The muscular pains are much easier, but the peroneal nerves are still very sensitive to pressure. Appetite is poor; bowels moved once. The pharynx is still sore on swallowing, and is red and congested in appearance.

" *23rd May.*—Patient passed a good night, feels much better this morning. Temperature is 97·4°, pulse 62 mt. At 10 a.m. pulse rate was 48 mt., and at 8 p.m. was 64. Muscular pains are very much lessened, but still present on pressure; the peronii nerves are also still sensitive to pressure.

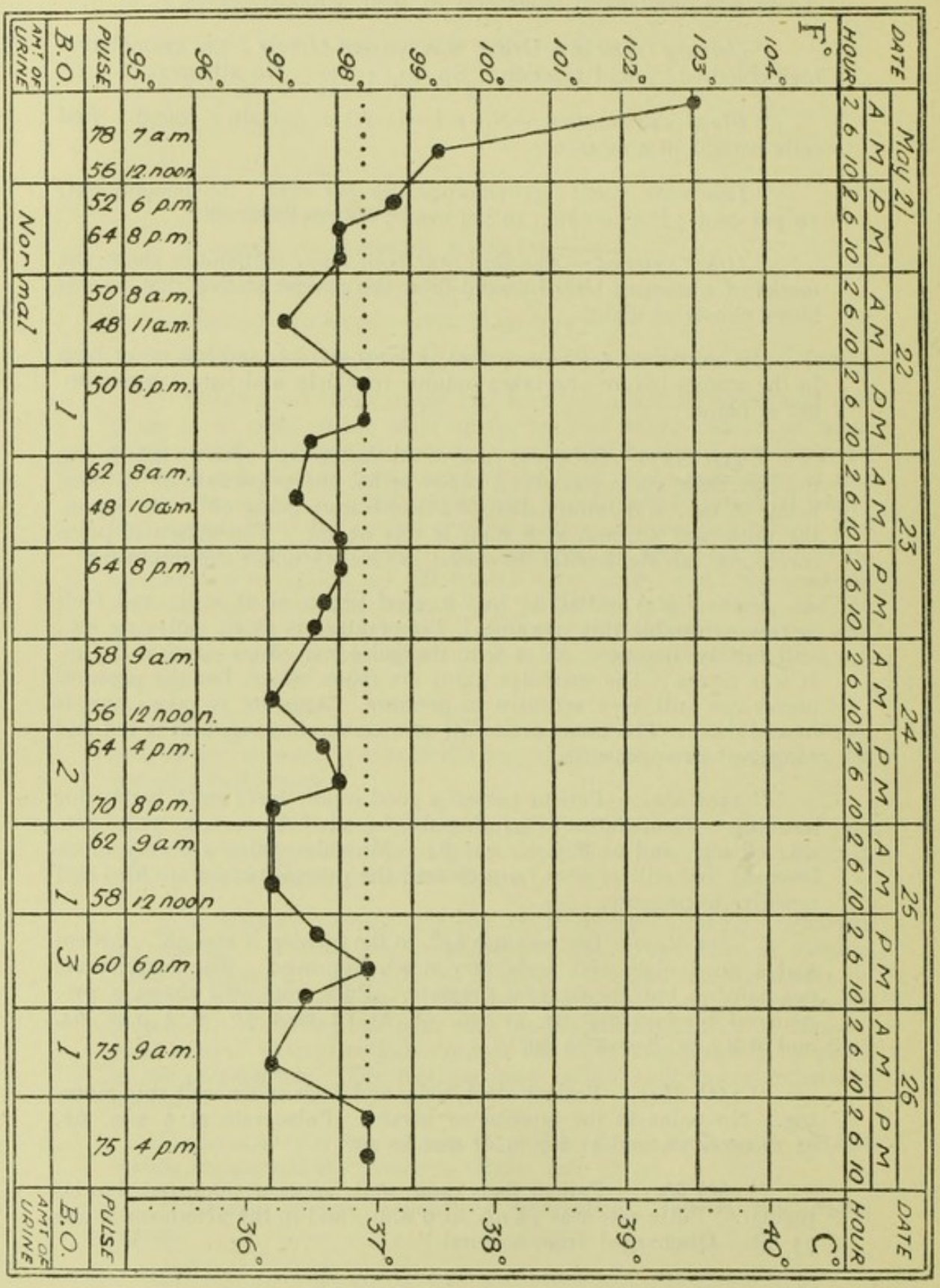
" *24th May.*—Temperature 97°, in the evening it was 98°. Patient had a good night and feels very much improved. The muscles are not painful, but are on firm pressure. Pulse rate still shows a pronounced bradycardia—at 9 a.m. 58, at 12 noon 56, at 4 p.m. 64, and at 8 p.m. it was 70 mt.

" *25th May.*—Patient slept well, and feels quite well this morning. No pains in the muscles or nerves. Pulse rate at 9 a.m. 62, at 12 noon 58, and at 6 p.m. it was 60 mt.

" *26th May.*—Patient feels quite well, appetite improved, bowels regular. Pulse rate was 75 mt. at 9 a.m., and in the afternoon it was 75 mt. Discharged from hospital."

Name, D. L. D., British. *Sex*, Male. *Age*, 23 years.

Occupation, Assistant Auditor. *Disease*, Pappataci Fever.



In Appendix A of Dr. T. M. Russell Leonard's "Report on certain outbreaks of Yellow Fever in Lagos, 1913, and January and February, 1914," the following reference to Pappataci fever occurs:— I.R. Vol. I., pp. 207—307 (p. 299).

> "In pappataci fever, of which I have had several cases here in Lagos, we also have a pyrexia ushered in with violent headache, chiefly frontal and orbital, aching pains in the muscles of the limbs, epigastralgia, pain in the peroneal and intercostal nerves, flushed face with conjunctival injection, the injection taking the form of a red band across the eyes. Vomiting and diarrhœa are present in most cases and are often the initial symptoms. An important symptom is the presence of a pharyngitis; epistaxis very often occurs. The temperature and pulse both rise and, as the temperature falls, a typical bradycardia is established, with a slow return to normal conditions during convalescence. The urine is high coloured, but contains no albumen. There is no tendency to hæmorrhages from the stomach or intestinal tract."

Dr. Chartres stated to the Commission that "he thought that Sand-fly fever occurred at Bathurst; in fact, he considered that an attack of fever associated with severe headache from which he had suffered might have been due to that disease. Sandflies at certain seasons of the year were extremely numerous. He had not observed the occurrence of Dengue at Bathurst."

In a report by Drs. J. M. Dalziel and W. B. Johnson the following occurs:— Report on Yellow Fever Investigation in Freetown, September, 1913, to March, 1914. I.R., Vol. II., pp. 541—578 (p. 554).

> "No *Culicoides* or *Phlebotomus* have been observed by us during our six months, but they were not altogether absent from Bonthe, and they are stated to be abundant in some parts of the Protectorate."

Seven Days' Fever.

The nature of the fever thus named by Rogers is doubtful. By many it is regarded as Dengue.

Dr. J. W. Scott-Macfie's Report, quoted above, refers to this fever as follows:—

> "Three cases (Nos. 7, 9, and 10), occurring in Europeans at Forcados and Burutu, have been provisionally diagnosed as seven days' fever. The symptoms were as follows:—The fever lasted for seven to nine days, and was saddlebacked in type; the pulse was relatively slow; the patients were prostrated, and suffered from severe pains in the back, and from headache. A rash, 'like rubella,' was observed in two of the cases. There was no albuminuria. The details of the cases, which occurred in 1909, are somewhat scanty; but in the absence L. 7. L. 9. L. 10.

of any mention of jaundice, hæmatemesis, catarrhal symptoms, sore throat, swellings of the joints, and malarial parasites, they may be regarded as suggestive of seven days' fever, or the saddleback type of dengue fever, which is considered by some authors to be the same disease."

Dr. Bailey, West African Medical Staff, who has been stationed chiefly in Southern Nigeria, stated to the Commission that—

"In 1909 he had had some cases of fever in Europeans which he had thought at the time might be seven-day fever, as described by Rogers. The grounds of his suspicion were that in two of the three cases there was a very marked pain in the back, and in all there was a saddleback temperature. There was no albuminuria when the tests of the urine were made, but there was a rash in two cases which he thought was not quite the same as Rogers'; the rash was very persistent in one case, lasting some time after convalescence. There was a slow pulse, but no itching of the hands. All three cases occurred within two months; one was fatal, but there was no post-mortem examination. That case had been in close contact with the others."

The following case, which occurred at Lokoja, in Northern Nigeria, on September 21st, 1913, in a European, aet. 30, was classified as "Possibly Seven Days' Fever" by the Commission.

L. 70. "P. A. A., æt. 30, British. He had been travelling on the Benue river, visiting a sleeping sickness area.* Admitted to hospital, September 21st, 1913.

"Complains of pain in back and legs: Intense frontal headache and pains in the eyes. Face flushed: conjunctivæ injected. Skin dry. Pulse 96, resp. 18. Tongue thickly coated with white fur. No epigastric tenderness. No nausea or vomiting. Stools bilious. Nervous system depressed. Urine, Sp. gr. 1030. No albumen, blood or bile pigment No rash. Seven examinations of the blood for malaria parasites were negative.

"Sept. 24th. Leucocyte count:—

Leucocytes	17·2
Mononuclear	10·25
Polymorphonuclear	72·7

"Blood serum was negative to Widal: typhoid and para-typhoid *A* and *B*.

"During the illness the pulse varied from 86 to 60, the respirations from 24 to 16. There was a slight degree of diarrhœa.

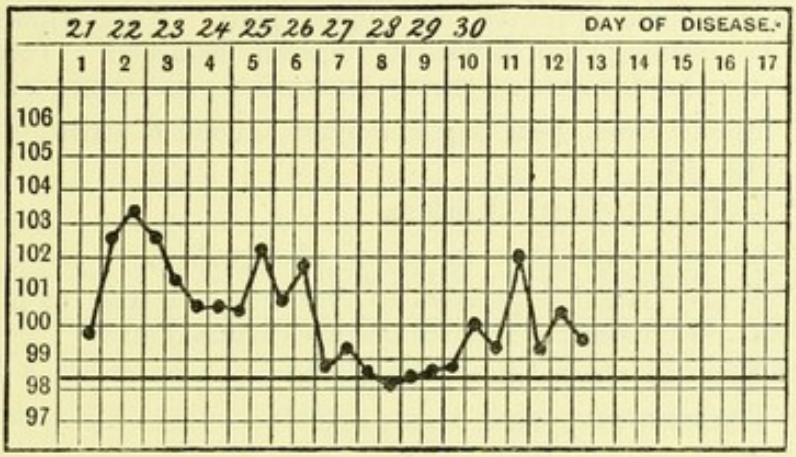
"The temperature chart is annexed. The patient had no quinine from the date of admission up to September 30th.

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* This patient was subsequently (December, 1914) found to be suffering from sleeping sickness.

"There was a small dark-coloured area on one of his legs, about the size of a threepenny piece, which rapidly increased to the size of a five-shilling piece, but it did not suppurate and was not tender; the swelling subsided.

"On Sept. 30th there was soreness of the naso-pharynx and a small ulcer appeared behind the left pillar of the fauces."



SECTION II.

TYPHOID AND PARATYPHOID FEVERS.

One case of typhoid at Sierra Leone was proved bacteriologically. The patient was a sailor on a German cruiser, and it is not certain that the disease was contracted on the Coast. Two cases with typhoid symptoms were observed amongst West African soldiers. Colonel Statham expresses the opinion that typhoid will be proved to exist amongst the West African natives.

Typhoid fever was certainly present in Freetown in 1884 (*vide* Second Report, p. 37). One of Colonel Statham's cases is classed as paratyphoid. The organism found closely resembled that isolated from a similar case, which occurred in December, 1912, but owing to difficulties of transport the culture flasks in both cases were contaminated, and it was not certain that the organism isolated was actually the cause of the condition, although clinically both cases presented the characters of a mild typhoid infection.

Dr. Butler also observed two cases of typhoid fever at Sierra Leone; in one case, which was fatal, the diagnosis was confirmed on post-mortem examination; the second was proved by the agglutination reaction. Z. 6.* Z. 1.

* For explanation of these numbers see footnote, page 12.

At Freetown, Sierra Leone, a male native, aet. 19, was admitted to hospital on September 1st, 1913, with pyrexia; diagnosed as Enteric Fever.

"Onset 25.8.13, sudden, with rigor and pain in back, but no headache; vomited once.

"Headache appeared on August 29th. No conjunctival injection; no flushing; no jaundice. Spleen enlarged. Tongue clean, inclined to be dry; no epigastric tenderness; no nausea or vomiting.

"Stools loose, pea-soup character, about 6 daily. Pulse 112-132, resp. 36.

"Dull, occasional delirium.

"Cloud of albumen in urine. No rash.

"Widal reaction positive to typhosus, negative to paratyphosus *A* or *B*. No malaria parasites on two examinations.

"Type of temperature: Remittent.

"Duration of pyrexia: 26 days.

"Termination: Recovery."

In the report on their investigation in Sierra Leone from September, 1913, to March, 1914 (*vide* I.R., Vol. II., pp. 541-578), by Drs. J. M. Dalziel and W. B. Johnson, it is stated (p. 549) that two cases proved to be *Enteric* with a positive Widal reaction for *B. typhosus*. In one of these cases the reaction was positive up to dilutions of 1/800, while negative except for group reactions in 1/20 dilutions, for *B. paratyphosus A* and *B.*

Dr. J. W. Scott-Macfie in a report entitled "A Synopsis of Cases of Fever reported from Nigeria to the Medical Research Institute, Yaba, S. Nigeria, up to July 22nd, 1913," states under Typhoid Fever:—

"Eight cases have been reported that appeared to be typhoid fever. Seven (Nos. 11, 13, 28, 29, 30, 31 and 32) occurred in natives and one (No. 27) in a European. Two of the cases occurred at Burutu, one at Calabar, and five at Lokoja. One case (No. 32) terminated fatally.

"*European case.*—The one case in a European (No. 27) occurred at Calabar. The symptoms and the course of the disease presented a typical appearance, and the serum of the patient, which was kindly examined by the investigators at Sekondi, was reported as giving a positive Widal reaction for typhoid.

"*Native cases.*—Of the native cases, four (Nos. 28, 29, 30 and 31), all of which occurred at Lokoja, were typical of the disease. The fifth case from Lokoja (No. 32) was only diagnosed after death, on finding at the post-mortem examination numerous ulcers in the small intestine.

"The remaining two (Nos. 11 and 13) occurred at Burutu, and are at any rate suggestive of typhoid fever, complicated in the one case (No. 11) by febrile albuminuria, and in the other (No. 13) by otitis media."

Dr. H. A. Foy, in an interview with the Advisory Medical and Sanitary Committee for Tropical Africa, on 5th October, 1915, stated "that he had recently seen typhoid and paratyphoid and isolated the bacillus at Kano from a case of paratyphoid *A.*—a diagnosis confirmed by positive reaction from the blood test, and a culture of the bacillus isolated was sent to Lagos where it was verified as *B. paratyphosus A.* The case was that of a young European in the Political Department, who suffered from a low fever with diarrhœa, varying in intensity, for from fourteen to fifteen days, after which he got better and was allowed to get up, and later on to return to duty. In a week or ten days he had a relapse, and for fourteen days more he suffered from an illness of the same character as previously. It happened that Dr. Foy visited Kano shortly after this relapse to investigate an outbreak of dysentery in the prison. The Medical Officer in charge of the case asked him to look at it, and he took specimens of the blood, urine, and fæces, and made cultures from the latter. He saw none of the clinical symptoms."

The following cases are given as illustrating the frequency of continued fevers of a doubtful nature.

A case which occurred at Lokoja, in Northern Nigeria, on March 7th, 1913, was classified as "Possibly Typhoid":— L. 29.

"Native: Hausa. W.A.F.F.

"Admitted 7th March, 1913.

"Duration of fever: 37 days.

"Character of fever: Remittent.

"Onset, with intense headache and depression; the latter continued until the headache was relieved.

"Tongue coated; no epigastric tenderness; no vomiting. One or two fluid stools daily, yellow in colour.

"No albumen in urine.

"Skin dry; no rash.

"Four examinations of blood were negative to malaria.

"Other cases of a similar nature were occurring in barracks."

The temperature chart shows a pyrexia of remittent type, ranging between 102° F. and 99° F. (105° F. on admission), a fall by

lysis, and a nearly normal temperature about the 27th day; normal after the 37th day.

L. 58. A case which occurred at Lokoja in July, 1913, was classified by the Commission as "Possibly Typhoid":-

"Negro. Aet. 19.

"Onset 7.7.13, with severe headache and pain in the splenic region. Temperature 101° F., pulse 100, resp. 24. Tongue white and furred; no epigastric tenderness; no nausea or vomiting; no jaundice. Two semi-solid motions daily.

"Depressed nervous condition; no rash.

"Urine contained albumen, blood and granular casts.

"No malaria parasites.

"Similar cases were occurring among his family or neighbours. No other details given.

"Type of fever: Irregular. Remittent.

"Duration of fever: 30 days.

"Defervescence by lysis."

L. 65. The following case occurred at Lagos, on February 11th, 1911, and was reported to the Commission by Dr. Craig (West African Medical Staff). It was diagnosed by them as ? Typhoid ? Paratyphoid.

"Male. Aet. 43.

"European.

"Onset 11th February, 1911. Result: Recovery.

"Symptoms: Vomiting and feeling of distension.

"Tongue furred.

"Slight epigastric tenderness.

"Vomiting during the first four days.

"Pulse 80, regular: mitral murmur.

"No albumen in urine.

"Rose spots or papules on abdomen.

"Widal twice negative to typhoid. Not tried for paratyphoid *A* or *B*."

Dr. Craig's diagnosis was:—

"A case of Enteric Fever, followed by a deep abscess after injection.

"Character of pyrexia: Remittent.

"Duration of fever: 10 days."

The following case which occurred at Burutu, in Southern Nigeria, on January 22nd, 1913, was classified as "Possibly Typhoid":— L. 11.

"Name: Abumselu.

"Race: Negro.

"Age: 30.

"Sex: Male.

"Occupation: Engineer.

"Date of admission to hospital: 22nd January, 1913.

"Date of discharge: 13th February, 1913.

"History.—Of three weeks' fever.

"Condition on admission:—Admitted *very prostrate*—wasted. Temperature 105° Fahr. Pulse 120. Eyes—no jaundice. No vomiting. Liver slightly enlarged and tender. Chest, some natural râles. Urine, no albumen; bilious appearance, but nitric acid test negative. Blood, negative.

"Course: 30th January.—Cloud of albumen appeared in urine and remained till 4th February.

"27th January.—Patient began complaining bitterly of burning pain in soles of feet. This symptom persisted after discharge. K.J.'s were present.

"The fever took a long time to wear out; finally after nearly three weeks the temperature became sub-normal and of moderate excursion and convalescence started.

"The case completed showed a fever *not malaria*, characterized by *great prostration*, albumen in urine, no jaundice or vomiting, pulse rate not helpful, no parasites in blood, a slow convalescence with no relapse."

The following case, which occurred at Burutu, S. Nigeria, on April 8, 1913, was classified as "Possibly Paratyphoid." It is noted that there were "other similar cases at Burutu." L 13.

"Name: James II.

"Race: Negro.

"Age: 29.

"Sex: Male.

"Occupation: Labourer.

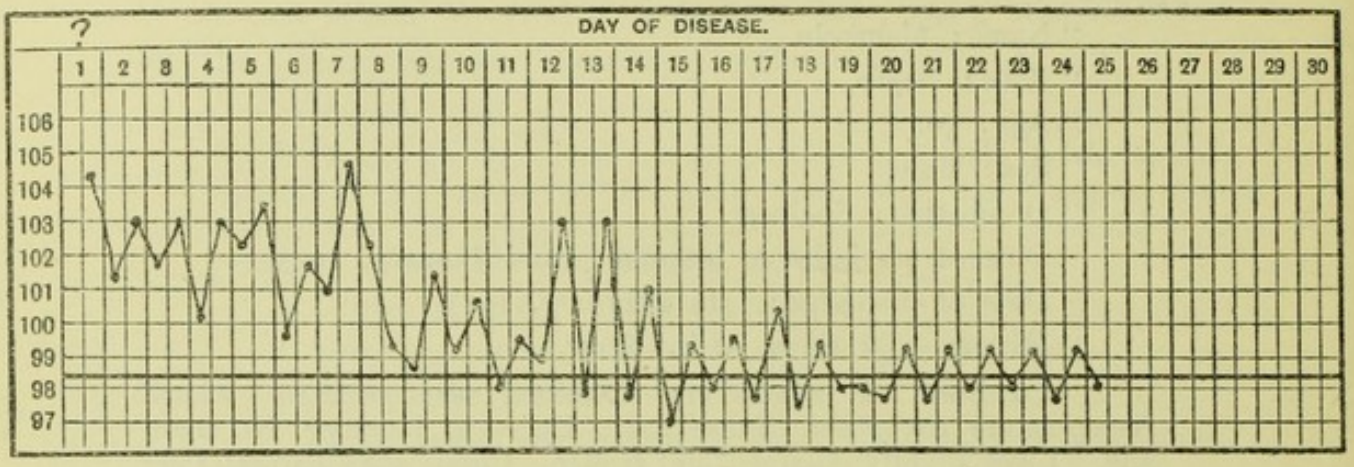
"Date of admission to hospital: 8th April, 1913.

"Date of discharge: 18th April, 1913.

"History.—Admitted so deaf as to be useless for any history.

"Condition on admission.—Temperature, 103·4° Fahr. Pulse, 124. Tongue, coated with fur. Spleen, enlarged two fingers below ribs. Albuminuria marked. Deafness ceased on 25th April.

"Case completed shows a fever, not malarial, characterized by: Albuminuria. Slow pulse. White fur on tongue. Deafness."



SECTION III.

UNDULANT FEVER. PARA-UNDULANT FEVER.

Work done at Freetown from May 1st to September 14th, 1913; I.R. Vol. II., pp. 389–416 (p. 393).

Report of a series of 800 Medical Pyrexias, etc. I.R. Vol. II., pp. 353—386 (p. 383).

One case of "possibly undulant fever" is referred to by Dr. Butler (p. 393).

It was reported from Daru by Dr. Mayhew (West African Medical Staff) on a card.

Colonel Statham observes (p. 383): "*Undulant Fever.*—Though no case has yet been found where the blood reacted with the *Micrococcus melitensis* (and several have been tried), yet as goats abound in Freetown and the milk is sometimes drunk by natives, I think Undulant Fever may be present in Sierra Leone."

In the report by Drs. H. Sinclair Coghill and H. M. Hänschell, "On Work at Sekondi from 1st October, 1913, to 30th April, 1914" (*vide* I.R., Vol. II., p., 714), it is stated that "Serum from two cases —one European, one native—was sent by Dr. W. J. Bruce from Abosso with details of the cases. The serum in both cases agglutinated *Micrococcus melitensis* in dilution of 1/80—complete in 3 hours. No clumping was obtained with control bacteria, *e.g.*, *B. typhosus* and *B. paratyphosus.* With normal control serum the bouillon culture of *M. melitensis* gave partial clumping up to 1/20 dilution only."

SECTION IV.

TYPHUS. ROCKY-MOUNTAIN FEVER. DOUBLE CONTINUED FEVER. CEREBRO-SPINAL FEVER.

No example of any one of these fevers has been reported to the Commission as occurring during the three years covered by their investigations.*

The nature of bilious remittent fever in its various forms is fully considered in Part III. sections.

SECTION V.

CONCLUSIONS.

From the evidence given above, the Commission are of opinion that the following fevers have been met with in the West African Colonies, viz.:—Pappataci Fever, Typhoid and Paratyphoid Fevers, and (possibly) Undulant Fever and Seven Days' Fever. As regards Dengue, its presence there cannot be held to have been proved. The evidence does not suggest that any one of the fevers named is widely prevalent.

* Dr. A. E. Horn reported in 1908 on an Investigation of two Outbreaks of Cerebro-Spinal Fever in the Northern Territories of the Gold Coast in 1906 and 1907-8. (Report published by the Government Printer, Accra). In the Report he refers to a "severe epidemic in Northern Nigeria" in 1905, and says that serious outbreaks have occurred in the latter Dependency "at intervals during the last fifty years."

PART III.

YELLOW FEVER.

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SECTION I.

INTRODUCTORY.

The Historical Retrospect of the occurrence of Yellow Fever in the Dependencies, both British and foreign, on the West Coast of Africa, which forms the greater part of the Second Report of the Commission, was undertaken in order to determine whether Yellow Fever was then present on that Coast, and if so, whether it had been there for a very long period.

These questions may now be regarded as settled. If in this Report the same ground is traversed to some extent, it is with a different object.

We are now specially concerned to discover, if possible, what were the factors which led to the occurrence of epidemics and sporadic cases of that disease during the period under review; what influence the slave trade in its various phases had upon the incidence of the disease; what places may be considered to have been endemic foci where its presence was continuous, and how they ceased to possess that character.

The types of Yellow Fever met with in natives and Europeans, the symptomatology, diagnosis, pathological anatomy and cytology of that disease, and other questions of importance connected therewith, are considered in detail in this part of the report, and it is hoped that the study which has been given to these points has brought to light some facts which may help to solve the many problems which still surround the subject of the endemic and epidemic prevalence of Yellow Fever on the West Coast of Africa.

SECTION II.

THE NOMENCLATURE OF VARIOUS FORMS OF FEVER.

The difficulty which is referred to in the previous report, of deciding when we are certainly dealing with Yellow Fever, is no doubt considerable, but it diminishes to some extent as one's acquaintance with the terms used by the writers on the subject increases.

All the writers believed that the types of fever common on the Coast were variants from a single stock, and that the less severe types could under certain conditions be transformed into those of a graver character.

When the fever is described as "intermittent," we can hardly be wrong in concluding that malaria is to be understood; when again, at the other end of the scale, the terms "malignant," "pernicious remittent," "pernicious malignant," "the severe form of typho-malarial or yellow fever" are employed, there can be little doubt that the disease may have been Yellow Fever, but it may also have been Malaria of the pernicious æstivo-autumnal type. The real difficulty arises over the meaning to be attached to the terms "remittent fever" and "bilious remittent fever." This point is discussed in detail in a later section of the Report. The latter term was, no doubt, frequently used to describe attacks of Yellow Fever, some of which proved fatal, whilst others ended in recovery, but it was also applied to cases which, with an equal degree of certainty, we may conclude to have been due to Malaria. An example of this will be found on page 15 of the Second Report, in the following extract from the Annual Report from the Gold Coast for 1849:— *Vide* p. 163.

> "Nineteen cases of seasoning or remittent fever occurred amongst newly arrived Europeans. Of these, six, who received no medical attendance, died, and thirteen, who were treated with large doses of quinine, all recovered. In the most obstinate cases the fever was checked within twenty-four hours."

In Appendix I. of this Report an interesting observation by Dr. Chacin Itriago, of Venezuela, will be found on the beneficial effect of intramuscular injections of quinine on the course of cases of Yellow Fever in the subjects of Malaria.

A consideration of the following extracts from the "Annual Medical Report for 1869 on the troops stationed at Sierra Leone" renders it difficult to avoid the conclusion that the author, Staff-Surgeon Gore, regarded "Remittent Fever" as a manifestation of the presence of a poison which, according to its degree of virulence, produced either Remittent Fever or Yellow Fever:—

> "Two varieties of these [epidemic visitations] have visited the Colony of Sierra Leone at uncertain intervals of time. The first, such as *yellow fever* or *malignant remittent*, is principally confined to

the Europeans, whereas the second class, such as variola, varicella, dengue or broken bone fever and dysentery, have been almost altogether felt in their severity by the native."

"The earlier years of Colonial existence, especially 1807, 1809, 1812, 1815 and 1819, appear to have been ones of extreme unhealthiness from the severity of the *endemic remittent*, but this fever has always had up to the present time seasons of exacerbations, during some years assuming a very mild form, at others a most severe, the mortality increasing with the latter. It also has not infrequently occurred that a prevalence of severe remittent was a warning of the approach of its more deadly sister, *or extensively prevailed whilst the latter was epidemic.*"

"On the previous December* (1822) an isolated case of malignant fever, with coffee ground vomit, ended fatally. The individual had come from on board a ship in harbour, timber vessels, the crews of which at the time were very unhealthy, several having died in hospital from the *endemic remittent.*"

"In 1825 a large body of white troops arrived at Sierra Leone: the sickness and mortality amongst them was so great as to approach the character of an epidemic. During the second quarter of the year *remittent fever* of a virulent and fatal form set in. Out of 902 attacked, 263 succumbed to the disease, which only differed from yellow fever in having no coffee ground vomit at its termination. In several the occurrence of yellow suffusion and bleeding from the gums took place a few hours before dissolution."

"In February and May, 1837, epidemic yellow fever again broke out in Sierra Leone. On this, as on other similar occasions, the epidemic outbreak was not sudden, but was preceded, so far back as the month of January, by several suspicious cases of the *ordinary endemic remittent* or country fever. These cases were of great severity, two of them proving fatal."

"Of this epidemic it is related that 'it greatly ceased by almost imperceptible and indefinable lines, *merging into the ordinary endemic remittent*, the cases occurring at its termination nearly all recovering.'"

"During July, August and September of 1839 a severe form of *remittent fever* caused six deaths in Tower Hill Barracks. With one exception, every officer belonging to the Royal African Corps suffered in greater or less degree; seven naval officers and thirteen seamen also died of the disease."

"In 1845 *remittent fever* prevailed to a great extent amongst the squadron at Sierra Leone, causing several deaths: one, occurring in the quarter ending September 30th, was an unequivocal case of *malignant remittent or yellow fever*, with coffee ground vomit; two other cases also occurred in civil practice."

"The '*Eclair*' left the Colony in this year on July 23rd; upwards of 60 of the crew perished during the voyage from yellow fever."

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* "The first really severe epidemic of yellow fever" is said to have occurred in 1823.

These extracts are sufficient to prove that the author of this Report considered that the fevers variously named therein were manifestations of one and the same disease, and that it was a question of degree and not of kind.

SECTION III.

DIFFERENT PERIODS ON THE COAST.

In considering the prevalence of Yellow Fever on the West Coast of Africa it will be convenient to divide the years under review into the following periods:—

(*a*) The periods of unrestricted slave trade and of maritime blockade up to the date of the more or less complete suppression of the slave trade, about the year 1850.

(*b*) From the abolition of the slave trade (circ. 1850) to 1900.

(*c*) From 1900 to the date of the appointment of the Commission in January, 1913.

(*d*) From January, 1913, to December, 1915.

SECTION IV.

THE PERIODS OF UNRESTRICTED SLAVE TRADE AND OF MARITIME BLOCKADE UP TO THE DATE OF THE MORE OR LESS COMPLETE SUPPRESSION OF THE SLAVE TRADE, ABOUT THE YEAR 1850.

In attempting to estimate the influence of the slave trade upon the spread of Yellow Fever, and on the occurrence of epidemics of that disease in the Dependencies of the West Coast of Africa, it is important to bear in mind that this traffic was essentially an export trade. The slaves were obtained from the interior and were shipped for transmission to the West Indies and elsewhere.

The following extracts are from "the Annual Report to accompany the return of sick and wounded of the troops stationed at

Sierra Leone for the year ending 31st December, 1869," by Staff-Surgeon Albert A. Gore, M.D., Principal Medical Officer:—

"In 1434 Antonio Gonzales shipped slaves from Western Africa, and is said to have visited Sierra Leone in 1441."

"Sir John Hawkins landed at Sierra Leone 8th May, 1562, returning to England 3rd September, 1563. He subsequently made three voyages to Africa, bought slaves and sold them to the Spanish settlements in America."

"In 1588 Queen Elizabeth was induced to grant patents for carrying on the slave trade from the North of the Senegal to 100 leagues below Sierra Leone."

"During 1697 the slave trade was sanctioned by the English Parliament."

"In 1752 an Act of Parliament (23 Geo. II., Cap. 31) was passed, making the slave trade free to all His Majesty's subjects, provided a sufficient number of negroes were supplied at a reasonable rate. By this Act the settlements upon the West Coast were vested in the company of African merchants."

"In 1764 this Act was repealed, the officer and servants on the coast being prohibited from exporting negroes on their own account."

"In 1787 Sierra Leone passed from the hands of the Portuguese into those of the English, who colonised it by the importation of 342 settlers from England."

"On the 1st July, 1791, the Sierra Leone Company was established on the condition of their not dealing in or employing slaves."

"Sixteen vessels arrived at Sierra Leone in 1792, having on board 1,131 Nova Scotians. The original intent was to make the Colony a home for free Africans, hoping thereby to raise Colonial produce without slave labour. Of the 100 Europeans who composed the first settlement, 57 died during the first rainy season; 800 blacks were also attacked with fever."

After various fruitless efforts in Parliament from 1792 to 1806, a Bill was passed in the latter year to put an end to the British slave trade for foreign supply, and to forbid the importation of slaves into the Colonies won by the British arms in the course of the war.

In 1807 a Bill was passed for the abolition of the slave trade.

This Act was habitually violated, and in 1811 an Act was passed declaring the traffic in slaves to be a felony punishable with transportation. This Act proved effective and brought the trade to an end, so far as the British dominions were concerned.

In 1826 a convention was entered into between Great Britain and Brazil, but it was habitually violated in spite of the English cruisers.

By the connivance of the local administrative authorities 54,000 Africans were annually exported.

In 1850 the trade is said to have been decisively put down.

Dr. Alexander Bryson, a naval surgeon, was appointed,* probably in 1845, by the Lords' Commissioners of the Admiralty "to go over the whole of the returns received into the Admiralty since the year 1820, and to embody in a report the greatest amount of information regarding the diseases contracted on the African Station, the localities most injurious to health, the precautions which might be taken to avert or diminish fever, and the mode of treatment regarded most effectual; embracing also the diseases most prevalent amongst the captured slaves." The report covers the period from 1820-1845.

REPORT ON THE CLIMATE AND PRINCIPAL DISEASES OF THE AFRICAN STATION BY ALEXANDER BRYSON, M.D., SURGEON, R.N., 1847.

The report commences thus:—

> "During the first ten years of the period included in this report (*i.e.*, 1820-9) the traffic in slaves was vigorously prosecuted under the flags of several nations on different parts of the coast from the Gambia on the north to Benguela on the south of the equator, while from certain anomalous clauses in the treaties then in existence, as the right of capture did not extend to vessels sailing to the south of the line under Brazilian colours, *where for the sake of security they were generally assumed*, the operations of the British cruisers were principally although not entirely confined to the northern latitudes between the parallel of Cape Verd and the equator."

The report of Dr. Bryson necessarily deals chiefly with "Fever," but the author recognised only remittent and intermittent fever of various grades of severity, and he gives no clinical descriptions by which the various types of fever might be differentiated. Yellow Fever is not mentioned, and in the section of the report devoted to the diseases most prevalent amongst the captured slaves, that disease does not find a place.

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* The report is dated 1847.

"The diseases from which negro slaves suffer most severely on board the vessels destined for their transportation are dysentery, fever, small-pox, ophthalmia and diarrhœa." (p. 255.)

Craw-craw, guinea worm and yaws are also described as being very prevalent amongst the slaves.

The following extracts deal with the diseases prevalent amongst the sailors of ships of the Navy engaged in the suppression of the slave trade and particularly with Sierra Leone (p. 7):—

Bryson, p. 7.

"Sierra Leone, being by far the most important of our settlements * * * * * * has long been one of the principal resorts of the squadron * * * * * *. Spanish and Brazilian vessels captured by the squadron are also sent to Sierra Leone for adjudication in the Court of mixed Commission, each with a prize crew on board consisting of from ten to twenty white men and a few blacks * * * * * *."

"Whether this Colony is more detrimental to the European constitution than other localities of the Coast it would be difficult to determine, but that a far greater proportional amount of disease is contracted here by the naval force than upon any other part of the station is clearly evident, at least since Fernando Po has been abandoned. * * * * * * native Africans * * * * * * are happily, though natives of a different part of the continent, exempt from the diseases which prove so fatal to Europeans." (p. 7.)

"It appears, however, that the officers and men who navigate prize vessels to Sierra Leone suffer most severely. They generally arrive worn out by excessive labour, broken rest and exposure by night and day upon the deck of a small vessel, probably crowded with slaves in a loathsome state of misery and disease." (p. 9.)

"They take up their quarters in a building in the town * * * * * * denominated 'the Barn.' Many, while they still inhabit the Barn, are seized with fever, and are taken to the military hospital; others escape for a time, and apparently enjoy good health until they embark either in their own vessel or some other, which may in the meantime opportunely arrive; but in either case it generally happens that *they are attacked with the disease within two weeks from the date of joining.* Few entirely escape the danger of this ordeal, even if they be of the most orderly and temperate habits." (p. 9.)

The duration of the period of freedom from disease—two weeks from the date of joining—does not point to Yellow Fever infection occurring whilst on board the slave ship.

The Extent of the Slave Trade.

The extent of the traffic in slaves is seen from the following tabular statement* contained in the "Report of the Lords of the

* Evidence of Mr. Norris. Part II.

Committee of Council appointed 11th February, 1788, for the consideration of all matters relating to trade and foreign relations, particularly concerning the present state of the trade to Africa and particularly the trade in slaves."

"The whole of the very extensive coast of Negroland supplies the following numbers yearly :—

Gambia	700
Isles de Los and the adjacent rivers	1,500
From Sierra Leone to Cape Mount	2,000
Cape Mount to Cape Palmas	3,000
Cape Palmas to Cape Appollonia	1,000
The Gold Coast	10,000
Quilta and Popoe	1,000
Wydah	4,500
Porta Nova Eppee and Kidagry	3,500
Lagos and Benin	3,500
Bonny and New Calabar	14,500
Old Calabar and Cameroons	7,000
Gabon and Cape Lopez	500
Loango Melimba and Cabenda	13,500
Majumba Ambies and Miasonla	1,000
Loango St. Paul's and Benguilla	7,000
	74,200

Of these the British purchase about ...	38,000
,, ,, ,, French ,, ,, ...	20,000
,, ,, ,, Dutch ,, ,, ...	4,000
,, ,, ,, Danes ,, ,, ...	2,000
,, ,, ,, Portuguese ,, ,, ...	10,000
	74,000

The Slave Trade in Relation to Yellow Fever.

The "Virginia Medical Monthly" for April, 1875, contains an article entitled "Researches on the relations of the African Slave Trade in the West Indies and Tropical America to Yellow Fever," by Joseph Jones, M.D., Professor of Chemistry and Clinical Medicine in the Medical Department of the University of Louisiana.

In a letter to a member of the Commission the author is described, by one well able to judge, as "a remarkable man, born out of due time and place."

The following extracts are from this article:—

"If the history of yellow fever in the Western hemisphere be considered in a general way, it will be found that the accounts and dates of its origin vary with the extent and character of the information of the writers in different localities and in different nationalities. Thus, some have referred the origin of the disease to the crowded African slavers, with their freights of suffering and enslaved humanity.

"Within a few years after the discovery of the West India Islands by the Spaniards the mild and unsuspecting natives had, for the greater part, perished. Millions of them were swept from the face of the earth by reason of the cruelty and avarice of desperate, immoral and murderous adventurers from the West."

"When the Spaniards found how rapidly the aboriginal population of the West India Islands perished under the system of forced labour, and beneath the tyranny of their rule, the expedient of introducing negro slaves from Africa was resorted to. The example of the Spaniards was soon followed by the Portuguese, Dutch, French and English: companies for the traffic were formed, monopolies granted. Before the close of the sixteenth century the African slave-trade was carried on by natives of nearly all the maritime States of Europe, and, in after times, with great vigour by the United States of America, the great majority of the 'slavers' from this country being fitted out, equipped, provisioned and manned in the ports of the Northern and New England States. For three centuries the most civilised of the European nations prosecuted a sanguinary traffic in human beings on the coast of Western Africa, dragged into bondage upwards of 25,000,000 of her unfortunate children.

"The following observations embrace the most important facts developed by our researches, established with the design of determining the connection of yellow fever with the African slave-trade.

"In the year 1442, while the Portuguese* were exploring the coasts of Africa, Anthony Gonsalez, who, two years before, had seized some Moors near Cape Bojardi, was, by Prince Henry, ordered to carry his prisoners back to Africa. He landed them at Rio del Oro, and received from the Moors in exchange ten blacks and a quantity of gold dust, with which he returned to Lisbon. The success of Gonsalez not only awakened the admiration, but stimulated the avarice of his countrymen, who, in the course of a few succeeding years, fitted out no less than thirty-seven ships in pursuit of the same traffic. In 1481 the Portuguese built a fort on the Gold Coast, another some time afterwards on the Island of Arguin, and a third at Loango Saint Paul's, on the coast of Angola: and the King of Portugal took the title of Lord of

* "Hist. Brit. Colonies: West Indies." Edwards. Vol. II, pp. 239—262.

Guinea. So rapid, however, was the decrease of the unfortunate natives as to induce the Court of Spain, a few years afterwards, to revoke the orders issued by Oriando, and to authorise by royal authority the introduction of African slaves from the Portuguese settlements on the coasts of Guinea. In the year 1517 Emperor Charles V. granted a patent to certain persons for the exclusive supply of 4,000 negroes annually to the islands of Hispaniola, Cuba, Jamaica and Puerto Rico. This patent having been supplied to some Genoese merchants, the supply of negroes to the Spanish American plantations became from that time an established and regular branch of commerce.

"In 1637, after the English had begun their settlement of plantations in the West Indies, negroes were in such demand as to induce the formation of a new company for the prosecution of the African slave-trade: and King Charles I. granted to sundry merchants the exclusive right to enjoy the sole trade to the coast of Guinea, between Cape Blanco and the Cape of Good Hope, together with the isles adjacent, for thirty-one years."

"What has been quoted is sufficient to demonstrate that the Portuguese established the slave trade before the discovery of America by Columbus; that as early as 1502 the Spaniards began to employ negroes in the mines of Hispaniola; and that a regular traffic in slaves had been established so early as the year 1564 by several nations, as the Portuguese, Spaniards, French and English."

"Of the diseases developed amongst these miserable people, whilst confined in the slave marts of the African coast, and upon the crowded and filthy slavers during their horrible passage across the Atlantic we have only imperfect accounts. *In 1669 a fatal epidemic fever prevailed in St. Domingo, and its introduction was ascribed to slave ships from the coast of Africa, and the local authorities passed ordinances to prevent the introduction of contagious and malignant fevers by means of slaves. (Moreau de Jonnes, p. 58-59.)*"

"We extract the following observations upon the conduct of the slave trade and the diseases of the negroes in the West India islands, from the valuable work of Bryan Edwards. (Hist. West Indies, Vol. II., p. 328, 1791):—

"In sickness the invalids are immediately removed to the captain's cabin, or to a hospital built near the forecastle, and treated with all the care, both in regard to medicine and food, that circumstances will admit; and when, fortunately for the negroes, the ship touches at any place in her voyage, as frequently happens, any refreshment that the country affords, as cocoa-nuts, oranges, limes and other fruits, with vegetables of all sorts, are distributed among them: and refreshments of the same kind are freely allowed them at the place of their destination, between the days of arrival and sail."

"At the ports of Montego Bay, in Jamaica, the negroes imported between the 18th day of November, 1789, and the 15th of July, 1791, were 9,993, in 38 ships; the mortality at sea, exclusive of the loss of 54 negroes in a mutiny on the coast, was 746, which is somewhat under 7 per cent. of the whole number of slaves. This, though much less,

I believe, than the average loss which happened before the regulating law took place, is, I admit, sufficiently great: and had it prevailed in any degree equally on the several ships concerned might, perhaps, have been considered as a fair estimate of the general mortality consequent on the trade, notwithstanding the peculiarities and provisions of the regulating act. On examining the list, I find that eight of the thirty-eight ships were entitled to, and actually received, the full premium; two others received the half premium, and one other (a schooner that sailed from Jamaica to the coast before the Act took place) returned without the loss of a single negro. Of the 746 deaths, no less than 328 occurred in four ships only, all of which, with five other vessels, comprehending the whole number of ships in which three-fifths of the mortality occurred, came from the same part of the coast, the Bight of Benin: a circumstance that gives room to conclude (as was undoubtedly the fact) that the negroes from that part of the country brought disease and contagion with them from the land: *an epidemic fever and flux generally prevailing on the low marshy shores of Bonny during the autumnal months, which sometimes proves even more destructive on shore than at sea.*" (pp. 332-333.)

"It is difficult to determine from this description whether the epidemic contagious fever and flux, here alluded to as prevailing on the low marshy shores of the Bonny Rivers, attacked the natives, or only those Europeans engaged in the slave trade. It is well established that the negroes are not, as a general rule, subject to Yellow Fever either upon the coast of Africa or in the tropical regions. They have suffered, however, to a certain extent from this disease in some epidemics, and it is possible that they may have suffered from this fever when subjected to the foul atmosphere of the slaver. It appeared in evidence before the House of Commons that before the passage of the regulating Act, a ship of 240 tons would frequently be crowded with no less than 520 slaves, which was but allowing ten inches of room to each individual. The consequence of this barbarous avarice was ofttimes a loss of 15 per cent. in the voyage and 4½ per cent. more in the harbours of the West Indies. previous to the sale, from diseases contracted at sea."

"Bryan Edwards makes no mention of Yellow Fever amongst the diseases of the negroes in the West Indies, thus he says:—

"Among the diseases which negroes bring with them from Africa, the most loathsome are the *cacaba* and the *yaws*: and it is difficult to say which is the worst." (Hist. West Indies, Vol. II., p. 352.)

"The testimony of Abbé Raynal in his "*Philosophical and Political History of the Europeans in the East and West Indies,*" with reference to the diseases of the negroes in the West Indies, corresponds with that of Edwards.

"Thus he says that the African slaves in the West Indies 'are particularly subject to two diseases, the yaws and that complaint that affects their stomach.'"

"M. Dalzille, in his valuable and elaborate work, '*Observations sur Maladies des Nègres,*' refers the diseases of the Europeans in the

West Indies chiefly to the effects of heat and the stagnant marshes, and associates their production with the causes which favour the development and multiplication of animalculæ. In his observations upon the fevers of the negroes of the West Indies and more especially of St. Dominique, contained chiefly in Chap. I. of Vol. I., under the head of *fievres putrides*, describes the various forms of *malarial paroxysmal fever*, and fails to mention Yellow Fever.

" Dr. William Hillary, in his '*Treatise on such Diseases as are most frequent in or are peculiar to the West Indies or the Torrid Zone*,' whilst recording accurate descriptions of these diseases as the yaws and leprosy, peculiar to the negroes, makes no allusion to the prevalence of Yellow Fever amongst them, nor to the importation of this disease from Africa. Thus in the chapter on '*The Putrid Bilious Fever, commonly called the Yellow Fever*,' he says that :—

" From the best and most authentic accounts that I can obtain, as also from the nature and symptoms of the disease, it appears to be a fever that is indigenous to the West India Islands and the continent of America, which is situated between or near the tropics, and most probably to all other countries within the torrid zone."

" Dr. Benjamin Rush, who edited the works of Dr Hillary, in commenting upon the preceding statement, observes :—

" We have here a testimony against the non-contagiousness of the yellow fever by an eminent physician, who resided many years in one of those islands from which the disease has been said to be exported. It is probable, in the few cases in which the fever was said to be contagious, there was a mixture of the jail or ship fever with it : or the yellow fever may have been so protracted as to generate that matter which has been called ' contagion of excretion.' "

" The testimony of Dr. Hillary is of importance, especially as he has given one of the most accurate descriptions of Yellow Fever extant.

" Dr. Lind, in his treatise on the Jail Distemper, says, with reference to the diseases of the slave-ships :—

" The poor wretches are crowded together below the deck as close as they possibly can be, with only a small separation between the men and women. Every night they are shut up under close hutches, in a sultry climate, barred down with iron to prevent an insurrection : and though some have been suffocated by this close confinement in foul air, though they are subject to the flux, and suffer from a change of climate, yet an infection is scarcely known among them : or if an *accidental* fever, occurring from the change of climate, should become infectious, it is generally much more mild than in the opposite situation." (" On Preserving the Health of Seamen," Sec. Ed., p. 317-318.)

" Dr. Thomas Trotter, who was himself surgeon to a slave ship, says :—

" The situation of the African negroes confined during the middle passage, in the slave rooms of a Guineaman, has been mentioned by

Dr. Lind. The confinement of so many irrational creatures in a small space deservedly attracted the animadversions of a physician investigating the sources and progress of contagion. *But contagious fevers, we find, are not their diseases.* We can well believe that if the negroes were clothed that filth and uncleanness might generate infection: the excessive quantity of perishable matter emitted from the surface in a high degree of heat would soon accumulate, and adhering to linen or woollen cloths might at least propagate forms of disease. But the matter being daily washed from their skins, and the rooms kept clean, nothing offensive or of an animal origin is allowed to undergo the final decomposition, which it would do in nasty and unventilated clothing. Thus also the poor inhabitants of warm countries are free from the diseases of those in colder regions." ("Medicina Nautica: An Essay on the Diseases of Seamen," Second Edition, Vol. 1., p. 184.)

"Dr. Garden, in a letter to Rev. Stephen Hayes, D.D., dated Charlestown, South Carolina, March 24th, 1756, after mentioning the Guinea slave-ships arriving there, adds:—

"I have often gone to visit these vessels on their first arrival, in order to make a report of their state of health to the Governor and Council: but I never yet was on board one that did not smell most offensive and noisesome: what from filth, putrid air, putrid dysenteries (which is their common disorder), it is a wonder that any escape with life." ("Hale's Treatise on Ventilators," Second Part, p. 95.)

"Dr. Edward Nathaniel Bancroft gives the most decided testimony against the origin of Yellow Fever in the African slaves. Thus he observes:—

"Dr. Lind, influenced as he was by the commonly received opinions, mentions an infection (meaning a fever) as being scarcely known in the slave-ships, instead of asserting, as he might have done with truth, that it is *never known;* for, after very extensive inquiries, I am fully convinced that fever of any kind rarely occurs on board these vessels, and *contagious fever* never: though great mortality has frequently happened from other disease, and more especially from dysentery." ("Essay on Yellow Fever," London, 1811, p. 128.)

"We conclude, therefore, from the preceding researches, *that Yellow Fever is not a disease of the African race, in tropical climates, and that the origin and propagation of the disease in Insular and Central America cannot be traced to the African slave-trade.*"

The researches of Dr. Jones do not lend much support to the view that the West African slave-trade was responsible to any considerable degree for the transmission of Yellow Fever, at any rate across the Atlantic. It is of interest to note, however, that in the only instance mentioned in which Yellow Fever may have been the disease which caused a high mortality on board the slave ships, the slaves had come from the Bight of Benin, which is precisely the part of the coast most likely to have been infected.

It will be remembered that in the Second Report, p. 89, extracts were given from the journal of the "*Bloodhound*," 1861 and 1862, by Mr. W. J. Eames, Assistant Surgeon in charge, from which it is clear that at that date "the rivers" were an infected area. "*The rivers seem to have suffered in more than an ordinary degree, the River Bonny in particular. The epidemic made its appearance in March, 1862, and raged with unabated violence for three months; out of 160 white inhabitants 130 died in that time. It was equally fatal amongst the natives.*"

Again in 1862 and 1863 "the rivers" are mentioned in the Journal.

> "*Arriving off the River Benin* on the night of the 3rd August we came to an anchor and remained there twenty-three days. It is much to be regretted that no medical man was in the river whose opinion on the nature of this disease which had made such havoc amongst the residents could be depended upon, but from a statement made to me by a resident there, a Mr. Henry, who had studied medicine, I have no doubt the disease was *the same that had depopulated all the other rivers in the Bights—Yellow Fever.*"

It does not of course follow that because Yellow Fever prevailed extensively in "the rivers" in 1862, it was there in 1791, but it is not in the nature of this disease, when firmly established, to lose its hold entirely, if all the surrounding conditions remain unchanged.

We have quoted at length from Dr. Jones's paper as its author was eminently qualified to deal with the question which he discusses, and had obviously studied the literature of the subject with care.

His general conclusions as to the nature of the diseases prevalent on the slave ships are partly borne out by the evidence of surgeons on slave ships given before the Committee of Council and the Committee of the House of Commons in 1789. Thus Surgeon Isaac Wilson states that in a voyage on a slaver of 370 tons "flux prevailed," and out of 602 slaves carried 155 died of that disease, "the slaves had no other very fatal disorder."

Dr. Falconbridge (House of Commons Committee), however, states that the most prevalent disorders were "fevers and dysenteries," but does not mention Yellow Fever.

As bearing upon the question of the liability to disease of the European crews of the slave ships the evidence of the Reverend Mr. Clarkson before the Lords Committee may be quoted. It contains an account of the muster rolls of 88 slave vessels that returned to

Liverpool in 1786, and up to the month of September, 1787, of which the following is a summary: —

			Similarly of 24 Bristol ships.
Numbers of original crews which sailed from England or were taken in at Africa	3,170	...	910
Of these there returned to England ...	1,428	...	455
Died or were lost	642	...	216
Discharged on voyage either in Africa or the West Indies, or deserted ...	1,100	...	239

Other figures are given by the witness, who was one of the leaders of the Anti-slavery party, to show that the mortality amongst the crews of vessels engaged in other trades was far less than that on the slave ships, but he does not attempt to prove that the very high rate of mortality was due to any particular disease.

As bearing on the mortality amongst Europeans resident on the West Coast of Africa at and about the same date, the following figures, which are given in a return to the Lords Committee (1788), are of interest.

The return is headed thus: —

> "An account of the number of persons in a civil and military capacity who have been admitted into the service of the Company of Merchants trading to Africa since the year 1751, when the forts and settlements were surrendered by the Royal African Company to the Committee by Act of 23 of George the Second, together with the number of such persons who died the first year after their arrival in Africa or at any future period, and of those who quitted the service and took their discharges in Africa or returned to Europe."

1751 to 1788.

	Died in 1st year.	Died subsequently in Africa.	Total Deaths.	Took Discharge.
Civilians, 352 ...	94	320	653	369
Soldiers, 728 ...	239			

The above figures give a mortality in the first year of 30·8 per cent., and a total mortality of 60·4 per cent., the inference being that if this enormous death rate was due to Malaria that disease was then much more often fatal than it now is in Africa, or that other

diseases, and amongst them possibly Yellow Fever, were partly responsible for the large number of deaths.

CONCLUSION.

We fear that we cannot claim that our own study of the literature of the subject has been more successful than that of Dr. Jones in throwing light upon the connection between the slave trade and the spread of Yellow Fever beyond Africa; probably there was little or no connection between them.

SECTION V.

FROM THE ABOLITION OF THE SLAVE TRADE (CIRC. 1850) TO 1900.

The Second Report of the Commission contains an account of what is known as regards the incidence of Yellow Fever during these years.

It would not, in the opinion of the Commission, serve any useful purpose to repeat in this section all that is there stated under the various Dependencies; any one who is interested in the subject can readily obtain an impression of the state of affairs, as regards Yellow Fever, on the coast as a whole during these years, from the descriptions given under each Dependency.

Moreover, this period includes the year 1862, of which a very complete and detailed account is given in the Second Report, *vide* p. 83. It may be remembered that this year was selected for such treatment, as it was the year during which the disease prevailed most extensively upon the coast.

SECTION VI.

FROM 1900 TO THE DATE OF THE APPOINTMENT OF THE COMMISSION IN JANUARY, 1913.

During the first ten years of this period the existence of Yellow Fever in the British Dependencies on the West Coast was barely recognised, and any Medical Officer who ventured upon such a diagnosis might possibly have found that his official superiors

regarded him as an alarmist, and would be better pleased if, in future, such cases were returned either as "Malaria" or "Bilious Remittent Fever."

We have, however, already seen that the events which happened in 1910 rendered this attitude no longer possible.

The Second Report (*vide* p. 108) contains a general survey of the position as regards Yellow Fever on the West Coast of Africa immediately preceding and at the time of the first outbreak in May, 1910, at Freetown, and it is there shown that in 1910 the disease was present at various places distributed over a very wide area in West Africa.

The epidemics of 1910 at Freetown, at Seccondee and at Lagos; of 1911 at Accra and at Bathurst; of 1912 at various places on the Gold Coast, have been already described and analysed in the Second Report of the Commission, and it is unnecessary to traverse again the ground therein covered.

We shall therefore in this section deal chiefly with the earlier years of the period under review and only refer to the epidemics just mentioned in order to bring out points of importance not already dealt with.

The Commission adopted the following system in classifying suspected cases. After a careful examination of the whole of the available evidence the cases were placed in one of the following four classes: —

Yellow Fever.
Probable Yellow Fever.
Possible Yellow Fever.
Negative (where the evidence was insufficient for classification or some other disease was indicated).

In any instance in which there was a difference of opinion among the members of the Commission as to the classification this fact is stated.

This classification has one very great advantage, in as much as it approaches as nearly as possible to certainty, when a confident opinion is expressed, *i.e.*, "Yellow Fever."

The absence in Yellow Fever of any eruption, of any absolutely pathognomonic sign or symptom, and of any bacteriological test, or "reaction," renders the clinical problem very difficult, and greatly enhances the importance of the opinion of the medical attendant, assuming that he is competent, as to the nature of the disease from which the patient suffered.

When therefore cases, of one of which it is stated, "Although all the symptoms were mild it was undoubtedly a case of Yellow Fever, and the patient recovered," and of another, "he died undoubtedly of Yellow Fever," are classed as "Possible Yellow Fever, no sufficient evidence," the limitations of any conclusions as to the prevalence of the disease based upon this classification are at once obvious.

Sierra Leone.

1900–1909.

No case of Yellow Fever is recorded as having occurred at Sierra Leone between the years 1900 and 1909, but it is possible (*vide* Second Report, p. 108) that the death of a Syrian in 1908 and of a European in 1909 may have been really due to that disease.

1910.

The epidemic which occurred at Freetown in this year is analysed in the Second Report of the Commission (pp. 110-115), and the quarters of the town in which the patients lived are shown in the map appended to that Report. Although from lack of sufficient evidence or from the absence of a post-mortem examination, seven of the 21 cases constituting the epidemic were not classified by the Commission as Yellow Fever, there can, we think, be little doubt as to their real nature. In only two cases not included amongst the foregoing, was the local diagnosis thought to have been erroneous, and the duration of the epidemic is not affected thereby, as it was closed by two fatal cases.

1911–12–13.

There is no record of the occurrence of Yellow Fever in Sierra Leone in the years 1911–12–13.

Senegambia, Senegal.

1900–1913.

In the following table the incidence of the disease in Senegambia so far as it is known during the period under review is shown. It

has not been thought necessary to give the localities as they are mentioned in the Second Report: —

Year.	Cases.	Deaths.
1900	416	225
1901	10	5
1902	—	—
1903	—	—
1904	Dakar declared infected.	
1905	2	1 ?
1906	?	21
1907	—	—
1908	—	—
1909	—	—
1910	7 ?	7 ?
1911	Dakar and Rufisque infected.	
1912	33	25
1913	—	—

GAMBIA.

1900–1913.

1900.

The epidemic which occurred in the Gambia in this year is described in the Second Report (pages 57–60).

1901.

A very suspicious case of "Bilious Remittent Fever" in a Commissioner, who was travelling at the time, ended fatally.

A death from "Pernicious Malarial Fever" took place in port; the disease was contracted outside the Colony.

1902–1910.

In 1903 a member of a French Catholic Mission recently arrived from Senegal, died from a severe attack of "Bilious Remittent Fever."

In 1905 a death occurred in hospital from Malignant Fever with Hyperpyrexia.

In 1906 in a case of Malignant Remittent Fever with Hyperpyrexia it is recorded that "intra-muscular injections of quinine produced an immediate beneficial effect upon the course of the fever, causing an uninterrupted convalescence to set in."

Assuming the statement to be accurate it is clear that the case was not one of Yellow Fever.*

In the years included, but not mentioned, there is no evidence of the presence of Yellow Fever, but it is recorded under 1909 that the 151 Europeans all used mosquito nets at night, or lived in mosquito protected houses. Four Europeans, however, died as the result of malarial infection.

1911.

The epidemic at Bathurst in this year is recorded and analysed on pp. 121–124 of the Second Report, and a map is appended showing the position of the houses in which the cases occurred.

Of the 15 cases constituting the epidemic and locally diagnosed as Yellow Fever, the Commission, following the strict rules as to classification which they have imposed upon themselves, confirmed this opinion in six cases, all of which were fatal. Five cases, of which three recovered and two died, were classed as "Probably Yellow Fever," and three cases, of which one recovered and two died, as "Possibly Yellow Fever." One fatal case was classified as "negative," as there was no sufficient record and no post-mortem examination was made.

On reference to the Second Report it will be seen (p. 124) that cases 50, 51, 52, 53, and 54 "were friends and often together in the engineers' quarters" (where the outbreak commenced). The following table shows the results of the classification of these cases.

Case No.	Classification.	Result.
50	Yellow Fever	Died.
51	Yellow Fever	Died.
52	Probable Yellow Fever	Recovered.
53	Negative	Died.
54	Probable Yellow Fever	Recovered.

In dealing with cases of Yellow Fever it is obviously easier to be certain as to the fatal cases, and more particularly those in which a post-mortem examination is made, than as to those which recover, and the reason for classifying No. 53 as "Negative" was that no record

*The observations of Dr. Cachin Itriago, referred to on p. 31, have a bearing upon this point.

was available, and no post-mortem examination was made. On epidemiological grounds, however, it is as nearly certain as possible that all these patients suffered from one and the same disease.

Of case 57 it is stated that he died with "Most marked symptoms"; classification, "Probable Yellow Fever, evidence insufficient"; but he was nursed by "case 60," with whom he lived, and at a later date "case 60" was found concealed, but screened. He was to have been put on board a steamer and smuggled away, but was removed to Hospital, where he died. Classification, "Probable Yellow Fever, details insufficient."

Case 58, a Syrian, who recovered, is similarly classified and for the same reason, but he lived in the same house as case 61, who died of "Yellow Fever."

In none of the cases which occurred in this epidemic is it probable that the local diagnosis was other than correct.

Anyone who is disposed to analyse the record of the Freetown epidemic of 1910, and of the other epidemics included in this period, from the same point of view, will have no difficulty in pointing to similar results, and lest it should be attempted to use the classification as a basis for criticism of the opinions formed by the medical officers in actual contact with the cases it is desirable, in justice to them, that this should be made clear.

This single example should, therefore, suffice to relieve us from the necessity of a further detailed examination of the records of the epidemics which are dealt with in the Second Report.

1912–1913.

There is no record of any case of Yellow Fever occurring in the Gambia in these years.

Portuguese Guinea.

1900–1913.

No information, other than that given on page 64 of the Second Report, is available as to the presence of Yellow Fever in this Colony during the years under review.

In discussing the possible sites of "endemic areas" and "endemic foci" (*vide* p. 241) a reference will be found to Portuguese Guinea.

FRENCH GUINEA.

1900–1913.

No further information is available.

SOUDAN.

1900–1913.

The possibility of an endemic area existing in the French Soudan is considered on pp. 65-67 of the Second Report of the Commission.

LIBERIA.

No further information has been received.

IVORY COAST.

1900–1913.

It will be noticed in reference to this Dependency* that the outbreaks have been frequent during recent years, and it is more than probable that if the whole of the facts were known it would be clear that in the intervals the absence of the disease was more apparent than real.

GOLD COAST.

1900–1913.

From 1901 to 1913 there is a continuous record of the presence of Yellow Fever in the Gold Coast Colony, although (*vide* Second Report, page 75) not at one and the same place in each year.

In the analysis of the sporadic cases which have occurred since the appointment of the Commission reference will be found to the occurrence of two cases in nursing sisters at Accra in June, 1913 (*vide p.* 66).

TOGOLAND.

1900–1913.

An impartial review of the history of this Dependency as regards Yellow Fever can lead to no other conclusion than that the disease has been present there continuously during the whole of this period, and that the German Government of the Dependency has certainly in one case deliberately concealed its existence in order to escape the necessity of quarantine (*vide* p. 68).

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* *Vide* Second Report of Commission, p. 68.

Togoland has been without doubt an endemic area in the past and a source of danger to the neighbouring Dependencies.

It is to be hoped that its future history will present a cleaner record.

Dahomey.

It is known that Yellow Fever was present in this Dependency in 1905 (Second Report, p. 79), but there is no evidence of a later date available.

Nigeria.

1900–1913.

From the Historical Retrospect contained in the Second Report it is clear that at various periods, and especially from 1860 to 1864 Yellow Fever prevailed extensively upon the coast of what is now the Southern Provinces of Nigeria (*vide* p. 85 *et seq.*). The places specially affected were Benin, Bonny, Calabar, Lagos and "all the rivers in the Bights," but from that date onwards we have no record of the continued presence of the disease in those regions.

It is interesting to note that during the epidemics of 1910, 1911 and 1912 Southern Nigeria escaped, and when the Commission were called upon to select the places to which their special Investigators should be sent, it was decided (*vide* First Report, p. 3) that: "13. As no cases of Yellow Fever had been reported from Southern Nigeria during those years, and as the Principal Medical Officer reported that no suspicious cases of fever had since occurred, no Investigators should be sent there;" yet the Commission had hardly set to work when an unexpected epidemic at Lagos rendered that place the most important field for their operations. This epidemic is described and analysed in the "Report on certain outbreaks of Yellow Fever in Lagos, 1913, and January and February, 1914," by Dr. T. M. Russell Leonard, contained in Volume I. of the Investigators' Reports, pages 207–316. Reference to this Report shows that the disease was not really absent from Southern Nigeria during the year 1910, but the true nature of two cases which occurred in natives was not realised at the time. "At Lagos, in Nigeria, there were two suspicious and rapidly fatal cases in natives. These were not reported as Yellow Fever, but from the clinical and post-mortem appearances were very

probably cases of true Yellow Fever" (*vide* I.R., Vol. I., page 207). Accompanying Dr. Leonard's report is a plan of the town of Lagos, showing in *yellow* the areas which were "declared," and in which quarantine was imposed, in *blue* the areas which were considered to be suspicious, and in *red* the European quarters. Where the letter S in *green* occurs on that map it indicates the presence there of *Stegomyia* mosquitoes and larvæ.

The Lagos Epidemic of 1913 *and* 1914.

The first outbreak occurred on May 12th and lasted until the 28th, 1913, and consisted of six cases of which one, in a European, was fatal. Four mild cases occurred in natives and one of a similar character in a European, the subject of Malaria.

The second outbreak occupied the period from 16th July to 1st September. Seventeen cases occurred, of which six were in Europeans and the remainder in natives. Of the Europeans two died, of the eleven natives all recovered.

The third outbreak began on September 19th and continued up to December 25th. There were four cases in natives, all of which recovered; and eight cases in Europeans of which four proved fatal.

This gives the following totals:—

	Died.	Recovered.	Totals.
Europeans	7	8	15
Natives	—	20	20

Note.—It should be stated, however, that the Commission were not unanimous in accepting the local diagnosis of Yellow Fever in a certain proportion of these cases.

French Gaboon.

1909.

The Commission have received information shewing that Yellow Fever was prevailing at Phillipville in July, 1909.

SECTION VII.

FROM JANUARY, 1913, TO DECEMBER, 1915.

In this section we shall first give a brief account of the sporadic cases which have occurred since the appointment of the Commission. They present many points of great interest, which repay careful study, and they indicate clearly that the disease is widely distributed in almost every Dependency.

Each sporadic case is a potential epidemic, and that they should have been so numerous whilst the epidemics have been so few, is really a tribute to the success which has attended the measures taken in each case to limit the spread of the disease.

(*A*)—ANALYSIS OF SPORADIC CASES.

(1) NIGERIA—SOUTHERN PROVINCES.

1913.

(*a*) ABEOKUTA.

Abeokuta, the capital of Egbaland, lies 7° 10′ N., 3° 23′ E., and is situated to the north of Lagos town and island. It is enclosed by the districts of Ibadan, Ikorodu, Lagos, Badagri and Meko. The area is approximately 3,420 acres, and the population is about 51,255. The town is 62 miles by railway from Lagos, and 65½ miles from Ibadan. Badagri is 72 miles, and Ikorodu 50 miles distant by road.

The case of Mr. Brooks, of Abeokuta, was one of the first to be investigated by the Commission, and on account of its importance a special enquiry was ordered, and was efficiently carried out by Dr. E. J. Wyler, whose report will be found in Volume I. of the Investigators' Reports (page 3). As the facts of the case are given in detail in Dr. Leonard's Report (Investigators' Reports, Vol. I., page 216), it will be sufficient to state here that the patient, a European trader, aged 28, had been continuously resident in Abeokuta for three months prior to his death, with the single exception of a visit to

Lagos in February, 1913. He was taken ill on Saturday, May 10th, 1913, on the evening of his arrival at Lagos, where he had gone for a change, having been out of sorts for three days previously. He was admitted to the Lagos Hospital on May 12th, and died there from Yellow Fever on May 14th. It is clear that this patient must have been infected in Abeokuta, but the disease was not known to be present there, and the investigation did not reveal the occurrence of suspicious cases of fever amongst the natives shortly before the patient's illness.

The number of Europeans resident in Abeokuta in May, 1913, was 32. No suspicious cases of illness had occurred amongst them during the preceding twelve months. Six of them may possibly have been immune to Yellow Fever, as they had previously resided in regions where Yellow Fever is endemic, before coming to West Africa, although, as none of them had suffered from that disease, it is not very likely that they were insusceptible; the others had been in West Africa for periods varying from 40 months to two months.

Abeokuta forms part of the Egba native state, and the sanitary conditions in the town are apparently very defective. *Stegomyia* larvæ were found in most of the water tanks examined. This patient's house was surrounded by native compounds. The European community, although small in numbers, was quite sufficiently large to have afforded evidence of the presence of an active endemic focus of Yellow Fever had such existed for any lengthened period, more especially as there was no European reservation. The only evidence of the possible existence of such a focus is furnished by the fact that in February, 1912, and in July, 1912, two Europeans, recently arrived at Lagos from Abeokuta, were admitted to Hospital suffering from illness diagnosed as Malaria, but presenting features of a suspicious character (*vide* I.R., Vol. I., page 13, table 3, Dr. Wyler's Report No. 1). In both these cases albuminuria was present. In the first the pulse on admission to hospital was 50, there was marked tenderness in the epigastrium, the liver and spleen were palpable; there is no record of the condition of the blood. In the second, the pulse on admission was 72, the spleen was palpable, Widal negative; the temperature was not reduced by quinine; no parasites were found in the blood. Recovery followed in each case after an illness in hospital lasting 13 days.

The virus may have been introduced into Abeokuta from Lagos, distant 64 miles, and reached by rail in a journey of from three to four hours. The average number of natives travelling daily between Abeokuta and Iddo (the railway terminus for Lagos) during March, April and May, 1913, was found to be 110. It is stated that such passengers usually carry with them as much baggage as the regulations permit.

That Lagos was a possible source from which infection was carried to Abeokuta follows from the fact that, shortly after this patient's death, cases of Yellow Fever began to be noted amongst natives in Lagos (*vide* cases 2, 3 and 4, I.R., Vol. 1, page 223). One of these patients (case 2) was taken ill on May 7th; a second on May 9th, and a third on May 10th. In each case recovery followed after an illness lasting from 15 to 17 days. Such cases may have been occurring previously, as until the death of Mr. Brooks, attention had not been drawn to the presence of Yellow Fever. Lagos must therefore be regarded as having been in May, 1913, an endemic area, and capable of acting as the source from which infection could be conveyed to Abeokuta. Dr. Wyler investigated the possibility of the disease having been introduced into Abeokuta viâ the Dahomey-Nigeria boundary. There is constant traffic between Dahomey and Abeokuta, and at all the important towns, where traders would be most likely to stop, *Stegomyia* were found in abundance, but his enquiries did not elicit any facts of importance. Whether the disease was endemic in Abeokuta or was introduced shortly before the occurrence of Mr. Brooks' illness cannot be decided, but it is evident that it did not die out immediately, as Dr. Wyler was informed by the Father Superior of the French Catholic Mission at Abeokuta some weeks subsequently to his visit, that another undoubted case of Yellow Fever had occurred there, the patient being a Syrian.

This case is described in Dr. Wyler's Third Report (I.R., Vol. I., page 36), from which it appears that: —

(1) The illness began on July 31st. On the seventh day there was a measles-like rash over the face and body, petechial in places.

(2) The patient had not been away from Abeokuta for many months, except to visit Lagos about the end of April, and Ibadan about the middle of June.

(3) No suspicious cases had occurred at Abeokuta since that of Mr. Brooks.

(4) The patient had not been inside a native house for at least two years.

(5) He lived alone and had no servant.

(6) Two months before his illness another Syrian trader came to stay with him and remained for three months, being in good health all the time. This man's luggage consisted of a small handbag containing clothes.

(7) The patient's house was in a thickly populated part of the town, surrounded by native compounds.

It would appear that in this case, as in that of Mr. Brooks, the infection must have come from a native source.

It is possible that the illness from which the three natives suffered whose cases are described in Dr. Wyler's Third Report (I.R., Vol. I., page 39) was Yellow Fever, but the details given are insufficient to support a definite diagnosis, and the cases were not observed by a medical man. They occurred on July 1st, August 6th, and August 10th, all were cases of fever attended with albuminuria, which disappeared at the end of the illness.

(*b*) OGBOMOSHO.

Ogbomosho, a town in the Oshogbo Sub-District of the Southern Provinces of Nigeria from which it is distant some 43 miles, lies 8° 8′ N., 4° 15′ E. It is 62 miles from Ibadan, and has a population of 80,000.

On August 22nd, 1913, a patient was admitted to Lagos Hospital L. 54.
whose case formed the subject of a special inquiry by Dr. E. J. Wyler (I.R., Vol. 1, p. 30, Report No. 2).

At that period all passengers arriving at Lagos by train were subjected to medical examination with a view to the detection of cases of fever, especially Yellow Fever. The patient, a male native, aged 20, was found to have a temperature of 103° F., and was therefore detained. He suffered from an illness which, in the opinion of the majority of the Commission, was an attack of mild Yellow Fever ending in recovery.

This patient had come to Lagos from Ogbomosho, which is described as a large and dirty town of about 80,000 inhabitants,

situated on an extensive lofty plateau about 180 miles from Lagos and 30 miles from the nearest railway station.

He had been in Ogbomosho for one month prior to setting out for Lagos, to which place he travelled viâ Oyo, Fiditi and Ibadan (three days). He remained there overnight and left on the following day by train for Lagos (about seven hours' journey).

Dr. Wyler's enquiries at Ogbomosho, Oyo, Fiditi and Ibadan failed to elicit any evidence of the existence of present or past suspicious cases of fever, or of a suspicious high mortality among native adults or children. An American Baptist Medical Missionary who had resided at Ogbomosho continuously for two and a half years, and carried on a dispensary there, had not met with any cases of the kind. No suspicious cases amongst Europeans had occurred at either Ogbomosho or Oyo. At the former place there were three European non-officials, and at Oyo twelve. All the Europeans at Ogbomosho live in one household.

The patient on admission to hospital was considered from his symptoms to be in the third or fourth day of the disease (5th day, Dr. Wyler's Report, p. 33). In that case he must have been infected at Ogbomosho.

Commentary.

This case is of great importance both in its epidemiological and clinical aspects.

The following points are worthy of notice: —

(1) The patient was a native, and had been resident for one month in a large native town, which was not known to harbour the disease.

(2) No suspicious cases amongst either the natives or Europeans had been observed in that place or in any other town visited by the patient.

(3) He was, although a native, not immune to the disease, but the attack was not of a severe type, and the illness ended in recovery.

(4) He was sufficiently well to be travelling on business, and on admission to hospital did not complain of more urgent symptoms than headache and pains in the limbs.

(5) The patient was the subject of malarial infection, as so often occurs in native cases.

(6) Lastly, it is almost certain that had it not been for the quarantine examination at Ebute-Metta the case would have escaped recognition.

(*c*) LAGOS.

The following is classified by the Commission as a case of "Possible Yellow Fever." It is given in detail in Dr. Wyler's Report No. 1, Appendix 3 (*vide* Vol. I., I.R., p. 27), and is mentioned there as of "special interest" as illustrating the difficulty attending medical investigation among the natives in the "bush."

"APPENDIX III.

"The patient was a woman æt. about 20 years, the illness had began with frontal headache and vomiting after food. When first seen she had been ill six days; there was no headache, but she felt, and looked, very ill.

"Temperature normal.

"Pulse 80.

"No jaundice.

"Tongue clean.

"Spleen not enlarged.

"Bowels open normally.

"No frequency of micturition.

"No œdema.

"Heart and lungs normal.

"Urine: Thick cloud of albumen and bile present.

"*On the following day.*

"Slight yellowish tinge of conjunctiva.

"Urine: Albumen less in amount: no bile.

"General condition better. No pyrexia.

"*Next day.*

"Conjunctival tinge of jaundice as before.

"Urine: Albumen lessening.

"General condition much improved.

"*Commentary.*

"The record of this case investigated in the 'bush' is necessarily incomplete. I have no doubt that it was not a case of renal disease or of malaria, and I quote it because it appears to come into line with the cases mentioned in my Commentary in Appendix I."

(*d*) CALABAR.

In the following case the Commission were unable to arrive at a positive diagnosis of Yellow Fever, from defects in the evidence.

It is classified as "Probable Yellow Fever."

The patient, a Russian Finn, aet. 21, a fireman on board the ss. "Monrovia," was admitted 26th October, 1913, to the Calabar Hospital. He was unable to speak either English, German or French, and no interpreter was available. The illness commenced suddenly on Sunday, 26th October, 1913, with fever (T. over 105° F.), and severe bilious vomiting. On admission face flushed; eyes injected; frontal and occipital headache; pulse 80, low tension; epigastric tenderness. Liver not enlarged; spleen slightly so. No albuminuria; no malaria parasites.

"*27th October.*—Faget's sign noted: no vomiting, no albuminuria: bile pigment in urine.

"*28th October.*—Albumen slight: quantity of urine diminished: jaundice slight.

"*29th October.*—No albumen: jaundice persists.

"*30th October.*—Albumen again present: whitish bile-stained fluid vomited.

"*31st October.*—Albumen disappeared: jaundice still present. Four observations of the pulse varied from 62 to 64.

"Convalescent."

The local diagnosis was "Yellow Fever."

(*e*) WARRI.

1913.

An outbreak of Yellow Fever which occurred at Warri in May and June, 1913, was investigated by Dr. E. J. Wyler, and forms the subject of Section I. of his 4th Report (I.R., Vol. 1, p. 44).

Commentary.

The points of interest in connection with this outbreak are as follows:—

(1) Both the patients were Europeans engaged at a store, living in the same house in the compound of the firm in whose employment they were.

(2) The first case, which terminated fatally, occurred on 22nd May, 1913. The second, which ended in recovery, occurred on June 10th.

(3) No evidence was obtained after a most exhaustive inquiry of the occurrence of any cases of Yellow Fever, or even of suspicious cases of fever, in the town of Warri, or the district in which it is situated, or amongst the Europeans (4), or native employees (40) of the firm, and no exceptional mortality had occurred in the district.

(4) The first case (L.26) had not been away from Warri for three months prior to his illness; the second case (L.34) had not been away for one month.

(5) Case L.26 had always used a mosquito net, but on the night of May 26th—five days before he became ill—he slept on the verandah without a net, and was so much bitten by mosquitoes that in the morning his face and arms were swollen. Case L.34 always slept under a mosquito net, but occasionally arose at daybreak and lay outside the net upon a sofa.

(6) Case L.26 (fatal) was in his first tour, and had been on the coast for eighteen months. The patient who recovered (L.34) had been some years in West Africa, and was in the sixth month of his tour.

(7) After the removal to hospital of Case L.26, the second patient (L.34) worked in the evening in the store—which was infested with mosquitoes—in which the first patient had previously worked, and as he was taken ill twenty days later, it is probable that he was infected by mosquitoes which had bitten the first patient.

(8) No cases of Yellow Fever or of any disease resembling it occurred at Warri subsequent to those here described.

Conclusion.

The conclusion to be drawn from the occurrence of these cases is that Warri was at that time an endemic focus of Yellow Fever, and that no definite evidence of the fact was manifest until a European became infected.

Dr. Wyler investigated the clinical and post-mortem records at Warri from January, 1911, to October, 1913, with a view to ascertain if any mild or typical cases of Yellow Fever had been mistaken for cases of Malaria. Two cases which occurred on March 6th and 7th, 1912, are described in the Report, and the temperature charts are given. In each of these cases albuminuria was present, and it is stated that "the pulse-rate was suggestive," but no record of the pulse appears in either case.

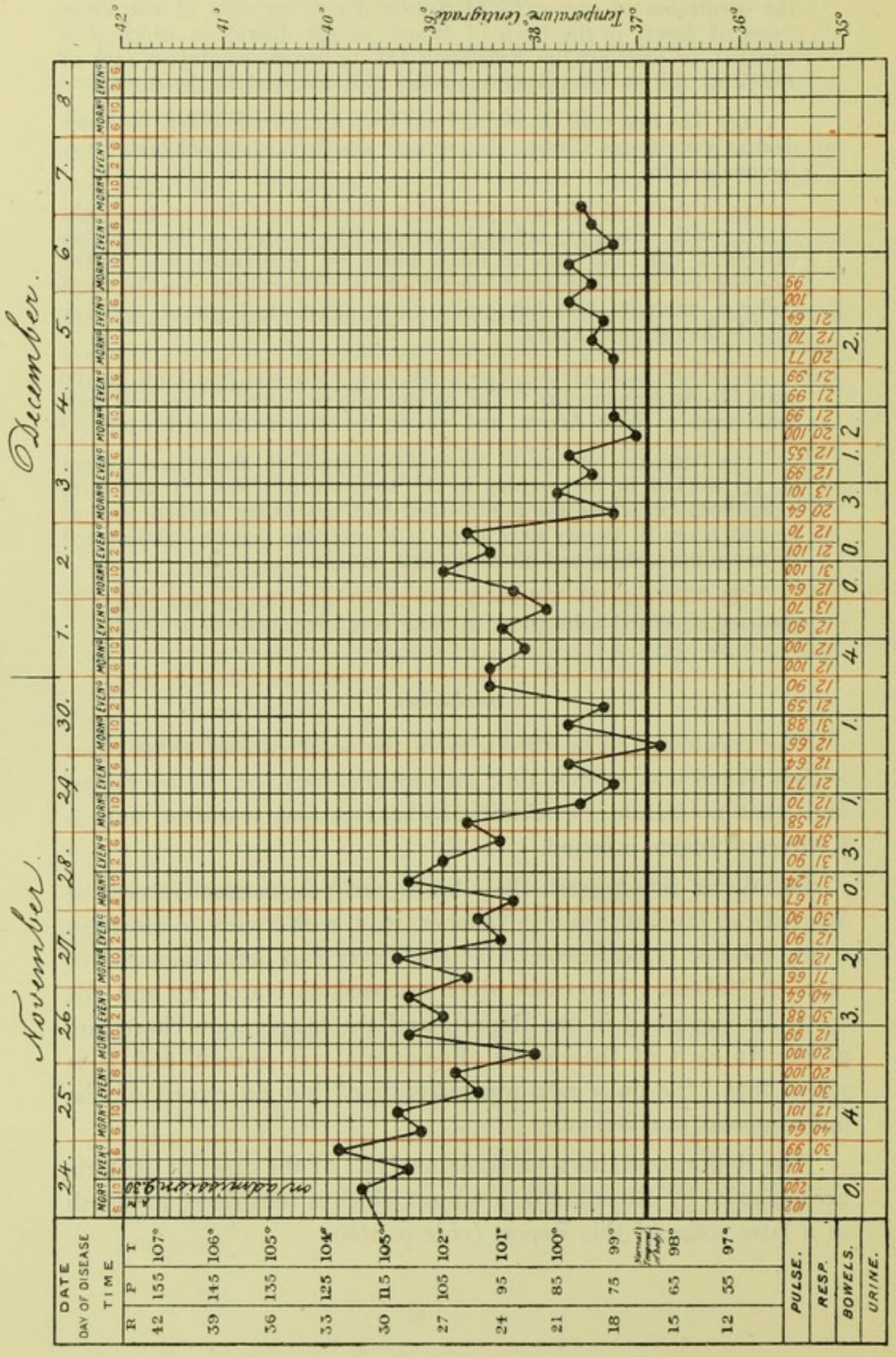
The Report contains a valuable analysis of the cases of Malaria accompanied by albuminuria, a subject which is considered at length at a later stage of this Report (*vide* p. 168).

NIGERIA—CENTRAL PROVINCE

1913.

ONITSHA.

The following case was classified by the Commission as "Possible Yellow Fever."



"ONITSHA—CENTRAL PROVINCE.

"7th December, 1913.

"*Report on a suspicious case of Yellow Fever.*

"On the 24th November, 1913, a case was admitted into the Native hospital, and believed by me to be an ordinary case of Malarial Fever, and for two days was treated as such, when the cause of the disease began to diverge widely in point of character from Malaria, and eventually turned out to be what, in my opinion, was Yellow Fever.

"Male native, apparent age 25 years, a native of Itbobo behind Asaba, a man who had recently been appointed as gang-driver to the Onitsha Prisons.

"Admitted to hospital 24th November, 1913. T. 103·4° F., P. 102. Headache and bodily pains. He was given 10 grains of quinine immediately, phenacetin, caffein, and an aperient, and nursed as usual.

"It was not until the evening of the 26th that my attention was particularly called to his case when, in spite of 15 grains of quinine a day having been taken, and other treatment, his temperature remained up, but apart from physical signs his bodily distress was greatly accentuated. T. 102·6° F., P. 6, Resp. 40. Tongue covered with thin whitish-grey fur, but clean all round the edges, and markedly tremulous; his limbs were tremulous, his skin was dry, hot and pungent. On examination of the urine, I found well-marked albuminuria. The eyes were normal in colour. The liver was apparently normal; the bowels had reacted to an aperient, but were otherwise constipated. I injected intra-muscularly 10 grains of quinine, but just as quinine had failed to improve matters before, this also failed. His chest was normal on stethoscopic examination. He dozed or slept a good deal, and was always a little delirious in his sleep. The fever was of the asthenic type when quite awake, and he preferred sitting up in bed, was very restless, and constantly the limbs shook.

"The chart, which was faithfully kept throughout, shows no morning or evening rise or fall, neither do I think the temperature or symptoms were very much affected at any time by the exhibition of quinine or any other drug. It is certainly the first case of its kind I have ever seen, and on instigating a thorough enquiry, I elicited the following facts:—

"The patient says that:—

"He has never had the disease (himself) before but he knows it quite well, and after repeated sifting of the evidence he was emphatic about its differing entirely from ordinary Malarial Fever, and that it is never associated with any bowel or lung, or ordinary well-known complaint of everyday occurrence.

"The cases in his district, Asaba, had occurred about every three years, and about six or eight people only had suffered at the time.

"The native doctors know a remedy which I tried to find out, but failed to do so.

"To-day, December 7th, 1913, albuminuria is still present, but not so well marked as yesterday, and to-day I applied Gmelin's test for the bile pigments.

"The test gave a much blacker reaction in the presence of the HNO_3 than is usually obtained, *i.e.*, a darkish purple, and I am not convinced therefore of the reliability of my experiment. The patient is rapidly approaching convalescence, and for several days his appetite has been very good.

"I should like an expression of opinion on this case.

"Every prisoner has been under observation since, every man being personally examined, and every possible precaution has been taken to avoid infection. No other case has come under my notice since.

"M.O., Onitsha.

"7th December, 1913.

"P.S.—Other points of interest suggested by the Provincial Medical Officer and replied to herein:—

"*Frontal Headache.*—Yes, this was present in a most marked degree.

"*Epigastric Distress.*—Was not marked, but the patient lay for some days coiled up during the asthenic stage in a manner suggestive of abdominal pain.

"*Vomiting.*—Yes, vomiting was present, not coffee-ground, but of a darkish green tint.

"*Conjunctivæ.*—No ferret-eyed appearance obtained, but a jaundiced appearance supervened as the disease neared its termination.

"*Deafness.*—I did not ask.

"*Pulse rate.*—The chart speaks for itself.

"*Malarial Fever.*—The question was not eliminated by the microscope. Quinine in large doses and hypodermically did not influence the temperature or disease.

"*Albuminuria* has now ceased.

"The patient is now convalescent and about to be discharged.

"Medical Officer, Onitsha."

(II) GOLD COAST.

(*a*) ACCRA.

1913.

Accra, the headquarters of the Gold Coast Government, is situated on the coast, and lies 5° 32′ N., 0° 57′ W.

On reference to the Second Report of the Commission (p. 119) it will be seen that an outbreak of Yellow Fever occurred at Accra in 1911. There is no record of the reappearance of the disease there in 1912.

CHRISTIANSBORG, ACCRA.

1913.

Two "Probable" cases of Yellow Fever occurred in Government House, Christiansborg, in March, 1913. Both ended in recovery. The first was of a moderately severe type; the second of a mild type. They do not call for any special comment. Both patients were "new-comers," having arrived in the Colony on December 26th, 1912.

Five cases of a mild type subsequently occurred at Accra in the same month in natives; all ended in recovery.

ACCRA.

March, 1913.

The following case in a native boy which occurred at Accra was classified by the Commission as "Probably Yellow Fever."

Case 3.—March 31st, 1913. Quey, male, aet. 5, native of Accra, was seen by a local native practitioner in a comatose state after a few hours' illness, dying shortly after. A post-mortem was held, which showed signs highly suspicious of Yellow Fever, but failing a history and previous symptoms it was not accepted as such, although the premises were fumigated, and the other residents kept under observation for six days. No other cases of pyrexia occurred here. Diagnosis, probably Yellow Fever.

"Patient's name, Quey. Age, five years. Male. Ill five days. Onset with chill, afterwards skin very hot. Slight vomiting, but no description of vomited matter. Great restlessness. Did not stay in bed. Bowels constipated. Did not take food.

"Very slight greenish yellow tint of sclerotics.

"Post-mortem rigidity absent.

"Congestion of tissues on section.

"*Lungs* congested, but no areas of consolidation. Patechiæ on pleuræ.

"*Heart*, white clot in ventricle (left). Patechiæ on pericardium.

"*Liver* congested and yellowish brown.

"*Spleen* not markedly enlarged. 'Sago' appearance on section.

"*Kidneys* very intensely congested. Capsule stripped easily.

"*Stomach.*—Submucous hæmorrhages on greater curvature at pyloric end. Stomach empty.

"*Intestines.*—Submucous hæmorrhages in first part of duodenum, rest of intestine normal in appearance. Intestinal contents not red or black (greyish yellow). Two *Ascaris lumbricoides.*

"*Brain* congested.

"*Bladder* empty.

"*Smears.*—*Brain* smear (pia arachnoid): No parasites, no pigment.

"*Liver* smear: Hepatic cells intensely fatty. Connective tissue cells with pigment. No parasites.

"*Spleen* smear: No parasites, slight amount of pigment. No plague bacilli.

"I consider that Yellow Fever was the cause of death."

Two cases of Yellow Fever occurred in June, 1913; both the patients were nursing sisters, residing in the Wesleyan Girls' School. One case terminated fatally, the other in recovery, after a severe illness. The patient who died had only arrived from England 14 days before the onset of her illness; the other was in her second tour of service, of which she had completed 10 months.

(*b*) CAPE COAST.

1913.

This case was classified by the Commission as "Possible Yellow Fever."

One reason for mentioning it here is to illustrate the type of case which has been included under that heading.

The patient was a native official aet. 58.

The illness was of a sudden onset with rigor, pyrexia, nausea, headache and moderate epigastric tenderness. The patient looked ill on admission to hospital, and the conjunctivæ were deep yellow. The finger nails also showed a light tinge of yellow. It will be remembered that this latter sign was present in a marked degree in the case of Dr. Lundie (*vide* p. 72). Albumen was present in the urine on the third day, and persisted until the 8th or 9th day. No malarial parasites were found, and quinine had no effect upon the temperature. On the 4th day there was vomiting "once of strings of mucus tinged with fresh blood and glistening yellow particles." Faget's sign was not present, and the pulse was quick. Typhoid was negatived by the examination of the blood.

Recovery took place after an illness lasting from June 19th to July 12th. The pulse rate was 100 on his return from a holiday after the illness.

(*c*) ABOKOBI.

1913.

Abokobi is a native village, situated about 13 miles from Accra; it lies 5° 42′ N., 0° 20′ W.

A fatal case of Yellow Fever in a European was reported from here in May, 1913. The patient was a German, a member of the Basel Mission. He had been in the country since January, 1913; is said never to have had fever, and to have taken quinine regularly. He was taken ill on May 10th, and died with typical symptoms on May 15th.

No further cases occurred, and the source of the infection was not discovered. The movements of the patient preceding the onset of his illness are not recorded.

The following are taken from a list of deaths of Europeans at Abokobi since 1856, which contains 22 names, of whom 7 are infants.

No.	Name.	Age.	Died.	Cause of Death.
8	John Uric Luthy ...	29	1869	Climatic Fever.
11	Fred. August Ehmer	33	1878	Gall Fever.
14	C. Berck	32	1883	Gall Fever.
15	Johannes Schmid...	25	1885	Stroke after preceding Fever.
17	Lydia V. Serger ...	31	1888	Bilious Fever.
18	Emmanuel Serger...	2	1891	Fever complicated with sunstroke.

(*d*) QUITTAH.

1913.

Quittah is a station on the seaboard of the Gold Coast. It lies 5° 55′ N., 1° 0′ E., and is situated on a long strip of land of two to three miles in width which separates the lagoon from the sea.

Case 1.—The patient, Quarshie Kpoha, age 19, was a native who had always been resident at Quittah, but was in Lome, Togoland, for two days. The illness began on May 9th, two days after his

return home. He lived in a part of the town called Alata, under the wall of the Bremen Sisters' house. Recovery followed after a mild attack, lasting eleven days. All the inhabitants were kept under observation, but no other suspicious case occurred immediately.

In June, however, the disease reappeared and proved fatal in *Case* 2, a clergyman, aet. 27, the head of the Bremen Mission School. This patient visited Anyako on June 21st, and remained there until June 23rd, when he returned to Quittah. The illness commenced on June 29th, and death took place on the evening of the fourth day.

A careful investigation of the circumstances was made, but the direct connection between this case and the preceding was not made out.

It is stated in the report that "in the compound in which the case of the missionary occurred 29 natives resided and 294 boys attended school daily." The compound itself lies in the midst of a congested native quarter.

Twenty-nine adult Europeans were resident in Quittah in June, 1913.

The following further extracts from this report are worthy of record: —

> "The Government of Togoland (German) placed Quittah and the ports of Denu and Addah in quarantine, and established a cordon on the frontier, beyond which no one was allowed to pass until he or she had been kept under surveillance for five days, in buildings erected for the purpose."
>
> "It seems hard that this Colony should be thus penalised for being honest enough to declare a case of Yellow Fever, when there is no reason to suppose that the disease is any less endemic across the border than it is here, and in this connection I invite attention to the attached description by Dr. Le Fanu (Appendix V.) of a case of Yellow Fever which occurred in Lome in May last, and was not reported to this Government."

"APPENDIX V.

"SENIOR SANITARY OFFICER,

"Mr. Mahuken, an agent for A. Kulenkamp, in Keta, gave me the following history of his illness in May, 1913:—

"Left Anecho May 14th; he arrived Lome same day. Left Lome Thursday, May 15th, and arrived Atakpanu same day. Taken ill Monday, 19th May; very ill Tuesday; proceeded to Lome on Wednesday; seen by Dr. Kruger on Thursday, 22nd, who immediately had him removed to hospital; *locked Mr. Mahuken's room, and said no one was to enter it until it had been fumigated.*"

"*Illness*: *19th May.*—Headache and fever. Headache described as 'strong rush of blood to the head.'

"*20th.*—Feeling very ill. Headache, fever, and rigors.

"*21st.*—To Lome. Condition no better. Jaundice and vomiting.

"*22nd.*—To hospital. Marked jaundice. Vomit getting very dark until it was described by Dr. Kruger as bluish-black-brown. Urine contained cylinders (casts). The pulse became very slow, at one time sinking to 32. At the onset of the illness there was much diarrhœa, which ceased as the vomiting became copious.

"Patient, while in hospital, was isolated in a mosquito-proof room. He was not then, or later, informed of the nature of his illness, but is certain it was Yellow Fever.

"I think there is little doubt that his surmise is correct.

"G. E. H. Le Fanu.

"*22nd July*, 1913."

It will be seen that Quarshie Kpoha was in Lome on May 7th. Mr. Mahuken was probably infected either at Anecho or at Lome, at both of which places he was on May 14th. There was therefore a focus of Yellow Fever at one or both of those places at that date.

This case, the existence of which would not otherwise have been revealed, is of great importance and almost certainly proves that the native Quarshie Kpoha was infected in Lome, and that the Government of Togoland were concealing the existence of the disease.

In a memorandum by the Senior Sanitary Officer dated May 21st, 1913, the case of Quarshie Kpoha is thus referred to:—

"It will be interesting to see the report. This looks like a case of *Atridi asara*, variously translated by the natives as bilious fever and yellow fever—probably true yellow fever. There are a number of records of death from it in the cemetery register at Abokobi, to which I have called the attention of the Investigators."

The Cemetery Register of Abokobi.

A copy of this Register has been obtained, and proves to be a document of some interest. The Commission are indebted to Mr. H. S. Newlands, Private Secretary to the Governor of the Gold Coast, for undertaking the translation of it from the German, in which a large number of the entries were made. In cases in which the native names of the diseases were used, these have been translated by the Chief Dispenser, an educated native. In the copy furnished to the Commission the entry "Atridi" occurs eight times in the years 1882, 1883, and 1884, and it is only during those

years that the entries are given in the native language (Ga). The entry "Atridi asara" does not appear in the copy, but when these words occur in the original it seems that they have been translated "Bilious Fever," as we are informed that "Yellow Fever" is a translation of an entry "Gelbfieber." Also, that when the word "Atridi" stands alone it should be translated "Malaria," and in the years just mentioned the eight entries appear in the copy thus: "Atridi (Malaria)," but that "Atridi asara" may be translated either "Yellow Fever" or "Bilious Fever." It is suggested that entries were made in the German, and also in the native language, because the Register was kept at the Basel Mission, and some of the missionaries may not have known the European equivalent for the native names, or possibly, the Register may have been from time to time in charge of a native. It appears to be doubtful whether the entries were made by a medical man.

The Register covers a period of 50 years, *i.e.*, from 1865 to 1914, and contains 338 entries.

In the year 1874 sixteen deaths were registered, the largest number in any one year; none of these, however, were due to "Yellow Fever." That disease appears to have been present in the following years, viz., 1893, 1894, 1895, 1896 and 1913, in each of which a single death is recorded from it.

The following are given as examples of the entries. The names and parentage have been omitted: —

1886.

	Age.	*Date.*	*Cause of death.*
1.	About 5 years ...	May 27 ...	Fever.
2.	29 years, 8 months	April 17 ...	Fever preceded by childbed.
3.	About 73½ years ...	May 22 ...	Fever.
4.	Age omitted ...	Aug. 5 ...	Bilious Fever.
5.	„ „ ...	„ 19 ...	Bilious Fever.
6.	About 46 years ...	Sept. 19 ...	(Cause omitted.)
7.	15 years, 10 months	Nov. 17 ...	Sunstroke.

1888.

	Age.	*Date.*	*Cause of death.*
1.	31 years	Jan. 6 ...	Bilious Fever.
2.	6 years, 10 months	April 22 ...	Bilious Fever.
3.	2 years, 18 days ...	July 12 ...	Bilious Fever.
4.	7 months, 2 days...	Nov. 7 ...	Bilious Fever.
5.	56 years, 5 months	„ 12 ...	Rheumatic Fever.
6.	Age omitted ...	July (?) ...	Madness.

1893.

	Age.	*Date.*	*Cause of death.*
1.	Age omitted ...	Feb. 18 ...	Fever.
2.	About 65 years ...	June 19 ...	Strong Fever and Dropsy.
3.	„ 48 „ ...	„ 24 ...	Yellow Fever.
4.	„ 13 „ ...	July 24 ...	Fever complicated with cramp or sunstroke.
5.	„ 57 „ ...	„ 27 ...	Fever.
6.	„ 3 „ ...	„ 28 ...	Fever.
7.	„ 63 „ ...	Sept. 28 ...	Bilious Fever.
8.	„ 4 „ ...	„ 29 ...	Fever.
9.	„ 4 „ ...	Oct. 12 ...	Fever and Dysentery.
10.	„ 25 „ ...	Nov. 16 ...	Belly-ache.
11.	„ 28 „ ...	„ 30 ...	Bilious Fever.
12.	„ 3½ „ ...	Dec. 10 ...	Dysentery.

The following table gives the total number of entries of certain febrile diseases: —

Climatic Fever	1
Yellow Fever	5
Fever	30
Bilious Fever	29
Atridi (Malaria)	8
Dysentery	27

Such entries as "Strong Diarrhœa" and "Bowels complaint" are of frequent occurrence.

It is a curious fact that 13 deaths are attributed to Sunstroke.

The incidence of Tuberculosis does not come within the scope of this enquiry, but as the possible increase of that disease of late amongst the natives is often under discussion it may be of interest to mention that in this Register 24 deaths are attributed to it.

We are clearly not justified in regarding this Register as containing an accurate statement of the facts as to the causes of death during the last fifty years of the persons whose names appear therein, but taking the evidence for what it may be considered to be worth it would appear: —

1. That during the years 1893, 1894, 1895, 1896, and 1913 Yellow Fever was present there, *i.e.*, 17 years prior to the outbreak at Sierra Leone in 1910, which drew attention to the fact of its existence on the Coast and led to the appointment of the Commission.

2. That diseases known as "Fever" and "Bilious Fever" were much more prevalent over the whole period of fifty years.
3. That the words "Atridi asara," in the Ga language, may be correctly translated as either "Bilious Fever" or "Yellow Fever."
4. That the word "Atridi" standing alone, signifies "Malaria" and appears much less often than "Atridi asara," signifying either "Yellow Fever" or "Bilious Fever."
5. That at least three types of acute febrile disease were recognised, but that whether they differed in kind or only in severity cannot be determined.
6. That in one and the same year "Yellow Fever," "Bilious Fever" and "Fever," are often found in association, *i.e.*:—
   1893. Yellow Fever (1), Bilious Fever (2), Fever (7).
   1894. Yellow Fever (1), Bilious Fever (2), Fever (4).

(*e*) BOLE.

1913.

Bole, a town in the Northern Territories of the Gold Coast, is situated some 12 miles from the Black Volta river, which in that region separates the Northern Territories from the neighbouring French possessions. It lies 90° 2′ N., 2° 25′ W.

Two, and possibly four, cases of Yellow Fever occurred there in September and October, 1913.

One member of the Commission, who was not present at the meeting at which this and the following case were classified as "Yellow Fever," subsequently on reading the reports dissented from that view.

The first patient, Dr. Lundie, West African Medical Staff, had been stationed at Bole for seven months, and had been well most of the time. He had been out for three tours. His illness commenced on September 6th, 1913, and after a prolonged attack ended in recovery on September 27th. Dr. Lundie's case was remarkable for the deep yellow pigmentation at the root of the finger nails of both hands. He showed great fortitude of mind during the illness, and for five days was assiduously

attended by Mr. Sherriff, the Assistant District Commissioner, who carried out the treatment suggested by the patient.

The second case was that of Dr. R. Mugliston, West African Medical Staff, who was instructed to proceed to Bole on the receipt of the news of Dr. Lundie's illness. On September 18th he made a forced march of 70 miles to Bole to attend Dr. Lundie. He had to negotiate several swamps and rivers and was drenched by tornadoes, being wet most of the time on that march.

On October 4th he was taken ill, and suffered from a severe attack of Yellow Fever lasting 13 days; recovery was followed by a slow convalescence.

Both these patients were undoubtedly infected at Bole. Dr. Lundie stated on his return that the natives knew of the disease as a fatal one, and avoided his bungalow during his illness.

He also mentioned that there was much traffic on the road from Bole to Kintampo and on to Coomassie.

Dr. H. S. Coghill, one of the Investigators of the Commission, was sent to Bole to investigate the cases of Dr. Lundie and Dr. Mugliston.

He left Seccondee on October 12th and arrived at Kintampo on October 23rd, eight days after the death from Yellow Fever of Mr. B., a European.

He was unable to find *Stegomyia* larvæ or pupæ in nine bottles collected for his examination at Kintampo, and was informed that from a former record of mosquitoes no *Stegomyia* had ever been reported as being found in Kintampo.

The following extracts are from Dr. Coghill's report:—

> "On Sunday, October 26th, I left for Bole, arriving there on Friday, the 31st, in time to see the two patients, Drs. Lundie and Mugliston, before they started for Seccondee, having been invalided by the Medical Officer in charge.
>
> "The same day a constable brought in word to the Commissioner that fifteen natives had died at Larabanga, a village some four days' march upon one of the main roads from Bole.
>
> "Dr. Telfer, the Medical Officer, and myself therefore left to investigate this on the following Sunday.

" Upon arriving at the village we were informed by the Chief that there had been no deaths there for some months, and no sickness for six weeks. A thorough inspection of the village was carried out by us, including a visit to the burial ground, where no evidence of any recent internment was forthcoming.

" Larvæ were collected, but no *Stegomyia* were found amongst the number.

" Meanwhile, a messenger had been sent into Bole to bring back the constable who had brought in the report.

" Upon his arrival he was interviewed, together with the Chief. As both persisted in their original statements, and having procured all the information possible, we returned to Bole, bringing in the Chief for the Commissioner to deal with.

" In Bole itself the native village is situated some 350 yards from the European quarters.

" Between these and about 200 yards from the latter are housed the constabulary and their families. No natives except personal servants are nearer the Europeans. All native compounds and houses have been visited by us in the hope of discovering any cases of sickness, which might not have been reported to the Medical Officer.

" This was all the more necessary owing to the fact that the number of patients attending the dispensary does not average two a day. Several cases of dysentery were discovered, and one of pneumonia, but all the others were of a surgical nature.

" From a record of those attending the hospital here, and from information gathered from the dispenser and others, two cases of a suspicious nature were said to have attended hospital in August and September of this year.

" Both cases were marked as suffering from fever.

" No further notes of their illness could be found, but by means of their names the cases were traced to two native policemen, who fortunately were still in Bole.

" The Commissioner kindly had them brought to the hospital, thus enabling the attached details of their illness as furnished by themselves and the dispenser to be taken down in writing.

" It seems a pity that one has to be content with details of their symptoms as gained above, but as Dr. Lundie first complained of being unwell on the 8th September, and his was an undoubted case of Yellow Fever, I think one is justified in surmising that these two cases were also due to Yellow Fever, and that in all probability the source of Dr. Lundie's infection originated from them.

" Thus Policeman Imoru Grunshi (Case No. 1), after an absence of nine days, arrived back in Bole from the Wa Road on the 24th August, and felt unwell the same evening.

" The following morning he saw the Medical Officer in charge.

" On the 5th September Policeman Ali Grunshi (Case No. 2) reported himself sick. On the 8th September Dr. Lundie went down with Yellow Fever, and on the 1st October Dr. Mugliston, who

arrived in the station on the 18th September, was the last to be attacked with this disease. There has been no rain in the station now over a month, and no further cases have occurred.

"I had intended on the 24th November to visit and make an inspection of the villages in which Policeman Imoru Grunshi slept prior to his return to Bole, hoping thus to still further trace the source of the outbreak, and to furnish details of the same in this report.

"Word has, however, come to-day (22nd November) from Tumu that a European is suffering from a disease which is thought to be Yellow Fever. I am therefore setting out for that station on the 24th, and as I shall be passing through Wa I still hope to be able to inspect and make inquiries at these villages: this means that all the villages on the main roads in the Bole district will have been investigated."

"*CASE No.* 1.

"Imoru Grunshi, Policeman No. 409, native of Gyfasi, Northern Territories, Gold Coast.

"Has been in Bole five months.

"Is now in perfect health.

"History of case as obtained from patient himself on the 19th November, 1913:—

"Patient first fell ill on the 25th August, 1913, and reported himself sick the same day to the doctor.

"He first complained of frontal headache, associated with a marked rigor, following by a feeling of heat—'his skin live for hurt him.' Photophobia was also an outstanding feature.

"Epigastric pain and tenderness then became marked, and on the second day of illness vomiting set in, especially after drinking. (He was unable to take any form of solid food).

"This was at first of a bilious nature, but soon took on a very black character, lasting four days.

"His motions were normal in frequency, rather fluid and mixed with very black matter, finally becoming black altogether.

"His urine soon took on a light reddish appearance, but never black. No bleeding from gums was noticed.

"No record of jaundice, temperature, pulse, examination of blood or urine could be found.

"No further details of case could be ascertained from the patient himself.

"Patient was discharged cured on the 5th September, 1913."

"*CASE No.* 2.

"Bole, 20th November, 1913.

"Ali Grunshi, Policeman No. 306, native of Nortori, Northern Territories, Gold Coast.

"Has been in Bole $3\frac{1}{2}$ months. Is now in perfect health.

"History of case as obtained from patient himself on the 18th November, 1913:—

"Patient first felt ill on the 5th September, 1913, and reported himself sick to the doctor the same day.

"He first complained of a rigor, cold, following by hot feeling all over.

"This was associated with marked frontal headache and photophobia. Pains in the back and down the legs followed, but no epigastric pain or tenderness; vomiting set in the following day, at first bilious, but gradually becoming quite black in character.

"He noticed that his gums bled about the same time.

"His motions were of a dark colour, becoming almost quite black. His urine soon became of a light red colour, but never dark red or black.

"The hot condition of his skin lasted until the day before he was discharged, that is six days, and remained constant during this period.

"No record of jaundice, temperature, pulse, examination of blood or urine could be found.

"No further details of case could be ascertained from the patient himself.

"Patient was discharged cured on the 12th September, 1913."

These cases at Bole are of special interest, as they may illustrate how the disease is kept in being. If Dr. Lundie had not been infected, it is certain that nothing would have been heard of the attacks from which the two native policemen suffered in the previous September. Both these earlier cases in natives were, in the opinion of the Commission, "Probably Yellow Fever," of the type which is not uncommonly met with in such patients.

I.R. Vol. II., p. 696. (Case No. 4).

The following case in a native also occurred at Bole, in 1913:—

CASE 1.—*Edi, Hausa.—Native* (*Unknown*).

"*Movement of patient.*—It has proved somewhat difficult to obtain definite information concerning the movements of this patient. He was said to have been in Bole about seven, and at most ten, days ere his death, and had come from Kintampo, where he had resided for some time. In Bole his movements had been quite obscure, sometimes the patient having passed the night in one hut and moving to some other place the following night.

"Patient first attended hospital on 8th December, 1913, as an out-patient, and complained of constipation ('No fit go latrine'), anorexia, and epigastric pains, which, on questioning him, seemed to be of a dyspeptic nature.

"Pulse and temperature were normal, and at no time had he suffered from pains in the head or diarrhœa. There was a complete absence of photophobia, bleeding from buccal mucous membrane, and any icteric tinging of the conjunctivæ. Mist. alba was prescribed, and he was told to come to hospital the following morning, 9th December, 1913. Whilst in the dispensary he vomited about one-and-a-half ounces of fluid, which on examination proved to be of simple gastric origin. According to his own statement he had never vomited before this date.

"From the foregoing symptoms, and also the examination of the patient, there was nothing to make one even suspicious that it might be Yellow Fever, and I had nothing to justify me in detaining him or regarding him as such.

"The following morning, 9th December, he did not appear at hospital, and on the morning of 10th December I was informed by the dispenser that the patient who had visited me on the morning of 8th December was very ill and unable to come to hospital.

"I had the patient at once brought into hospital in my hammock, and the following is a Report on his condition when admitted:—

"Patient was in a moribund condition; there was some clotted blood on the lips, and on examination the gums were oozing freely, and the conjunctival reflex was gone. The scleras were of a well-marked icteric tinge and injected.

"Axillary temperature was 101·4° Fahr., and the pulse imperceptible. About half an hour after admission to hospital the patient vomited about one ounce of fluid, black in colour, and containing blood which had evidently been acted upon by the gastric juice.

"The patient never recovered from his comatose condition, and died about one-and-a-half hours after being admitted to hospital.

"The axillary temperature was taken about fifteen minutes after death, and registered 104·6° Fahr. The above symptoms being rather suggestive of Yellow Fever, and sanction to perform a post-mortem having been obtained, an autopsy was performed soon after death.

Post-mortem.

"The body is that of a young man whose bodily nutrition is fair. The lips and oral mucous membranes are covered with clotted blood.

"The scleræ are of a marked yellow colour.

"Post-mortem rigidity present.

"On cutting through the dark epidermis and reaching the cutis vera, it is found to be of a lemon colour. On opening the abdomen the abdominal visceræ are injected and of a very faint lemon colour.

"The great omentum was very markedly congested.

"*Thorax.*—On opening through, the pericardical sac is found to contain about half an ounce of pale straw-coloured pericardical fluid.

"*Heart.*—The heart is pale in colour, normal in size, and flabby in consistence. On section the heart muscle is pale in appearance and shows at one or two points petechial hæmorrhages.

"Fatty degeneration is also present.

"*Lungs.*—The lungs are slightly larger than normal, and are markedly congested.

"On section they present a congested appearance, slightly emphysematous, and numerous enlarged peribronchial glands. The bronchi contain a small amount of mucoid secretion.

"*Parietal pleuræ.*—The parietal pleuræ have numerous small subparietal hæmorrhages.

"*Liver.*—The liver is larger than normal.

"Glisson's capsule somewhat adherent, and here and there deeply injected. The walls of the gall bladder show considerable hypertrophy, and the bladder itself contains about two drachms of inspissated bile. No biliary calculi present.

"On section the liver is pale in appearance, friable, and the hepatic cells are swollen.

"*Spleen.*—This organ is three times the normal in size, of a dark slate colour, and very friable. On section it is markedly congested and very friable.

"*Kidneys.*—Both kidneys are of normal size.

"Capsules strip easily. On section they present a congested appearance, especially marked in the pyramids.

"*Gastro-intestinal tract.*—The stomach is markedly congested. On opening into the stomach it is found to contain about two ounces of fluid, dark in colour, and containing digested blood.

"The rugæ of the stomach are markedly injected, and swollen.

"The mucosa is swollen, injected, and coated with a thin semi-gelatinous film, to which adheres semi-digested blood. The above pathological condition is general in this viscus, but more marked towards the pylorus.

"*Intestines.*—The duodenum presents the same pathological condition as the stomach, and the contents are mingled with blood.

"*Small intestine.*—The small intestine is injected, but to a lesser degree than that found in the stomach and duodenum. The contents here are darker in colour, and contain blood.

"*Large intestine.*—There is nothing pathologically worthy of note to be found in the large intestine.

"The contents here are quite black and characteristic of melæna. No other pathological lesion sufficient to cause death was found.

"*Urine.*—The bladder being empty no urine could be obtained for analysis.

"*Blood.*—Thick and thin blood smears were taken.

"*Summary.*—From the symptoms of this case and the pathological lesions found post-mortem. I regard this case as having been one of Yellow Fever.

"Medical Officer, Bole."

(*f*) KINTAMPO.

1913.

Kintampo is situated in Northern Ashanti, lying 8° 3′ N., 1° 41′ W.

The patient was a European official in his fourth tour of service. He landed at Seccondee on 23rd September, 1913, and travelled viâ Coomassie, leaving that town on 2nd October. He slept for the first three nights in native houses, in the villages between Coomassie and Chichewera, and the remaining three nights he slept in the rest-houses for Europeans, which are situated some little distance away from the villages. He arrived at Kintampo on October 8th, and was taken ill on October 16th. He died from Yellow Fever on October 19th.

(*g*) TUMU.

1913.

Tumu is a town in the North Western District of the Northern Territories of the Gold Coast. It lies 9° 54′ N., 1° 58′ W., and is only some eight miles from the northern boundary. The patient was the District Commissioner, Northern Territories; he was taken ill on 15th November, 1913, and died from Yellow Fever on November 22nd.

ANALYSIS OF SPORADIC CASES IN 1914.

(III.) SIERRA LEONE.

BOIA.

1914.

This case was classified by a majority of the Commission as one of "Yellow Fever," the others were disposed to class it under the heading "Probable."

The patient was a European, æt. 32, on his third year of service in Sierra Leone. He was taken ill on March 9th, 1914, at Boia, a station on the main line of railway at its junction with the branch line to Makump, distant about 60 miles from Freetown. Boia contains five bungalows for Europeans, a mud built rest-house and

a reservation for railway employees and labourers; about eight Europeans are stationed there. The patient was removed to the Nursing Home at Freetown on March 13th and recovered after a moderately severe attack of Yellow Fever, which is fully described in Appendix D., page 574 (I.R., Vol. II.).

The patient had not spent a night away from Boia for some months previous to his illness, and his duties did not carry him up or down the line for any distance. No other cases occurred amongst the Europeans, and no suspicious cases of fever were found amongst the sick natives of the surrounding villages, who were specially sent to Boia for examination during the visit of the Investigator appointed to report upon the case in question. It is of interest to note that the report states that not a single *Culicine* larva was discovered or a mosquito of any kind seen in the villages within easy reach of Boia, although a few *Anopheline* larvæ were found in a stream of running water in a valley below the railway.

The case of Yellow Fever occurred in a double bungalow occupied by the fitter and foreman platelayer on the railway. The mosquito nets in the house were in holes and quite unfit for use. The native reservation at Boia is placed at about 800 yards from the nearest European bungalow.

It may be noted as a point of clinical and pathological interest in connection with this case that granular casts stained yellow were present in the urine on six examinations. The importance of this sign is mentioned in the chapter on the "Diagnosis of Yellow Fever," by Dr. Hamilton P. Jones in Augustin's "History of Yellow Fever" (page 1,157), and the attention of Investigators had been specially directed to it by the Commission.

This case is another example of the difficulty experienced in discovering the source of infection in sporadic cases occurring in the interior of the country.

(IV) GOLD COAST.

(*a*) QUITTAH.

1914.

Amongst the fever cases investigated during the months of March and April, 1914, by Dr. G. E. H. Le Fanu there are some of special interest.

The history of Quittah in relation to Yellow Fever, as known at the date of the Second Report of the Commission, is as follows (*vide* Second Report, page 70, *et seq.*):—

"1888.

"There was one case of sporadic yellow fever. Deaths also occurred from 'Ardent Remittent Fever.'"

"1893.

"'Bilious remittent fever' was general in the towns on the Gold Coast.

"The incidence of disease at Quittah was so excessive that among the community there was a state which I venture to call 'fever panic.'"

"1894.

"Three Europeans ill with malarial fever, one of the so-called bilious, the other of the 'remittent type.' On the basis of classification adopted by the Commission a case which occurred at Quittah in this year is classified as 'Yellow Fever.'"

From the above it is clear that at the dates mentioned Quittah was an endemic focus of Yellow Fever.

April, 1914.

The case No. 26 (I.R., Vol. II., page 589) has been classified by the Commission as one of Yellow Fever after receiving a report from Dr. A. C. Stevenson of the Wellcome Research Bureau.

The patient was a native, female, aged 28, who died in Hospital at Quittah on April 6th, 1914, of Yellow Fever, after an illness lasting nine days.

No history was obtained of the patient's movements prior to the illness. She led an irregular life and probably lived in Quittah.

No other cases occurred at the time.

May, 1914.

In the following case the Commission were divided in opinion:—

CASE OF KPESU.

Commentary by the Commission.

(1) The onset was very sudden, with severe rigor, pains and frontal headache.

(2) A remission occurred on the fourth day, when there was marked epigastric tenderness, considerable albuminuria and jaundice.

(3) Prostration is described as "marked" on the following day. Faget's sign was present: the pulse rate having fallen from 140 to 76.

(4) Granular casts were found in the urine on the fourth and sixth days.

(5) After a period of gradual improvement, during which no quinine was given, and no malarial parasites were found in the blood, the patient recovered, and was discharged from hospital.

(6) Two days later, May 30th (*i.e.*, the eleventh day since the onset), the patient returned, stating that he felt cold and ill "and that he got ill." The spleen was now enlarged, and the blood was found to contain tertian parasites. The temperature was 100° F. and the pulse 100. No quinine was taken until prescribed for the malarial attack on May 30th.

(7) The Medical Officer reporting on the case said:—"Three pigmented leucocytes were found in four thick films on 23rd and 24th May, after examination totalling one and a half hours. I attach no diagnostic importance."

(8) The above facts are certainly consistent with a diagnosis of mild Yellow Fever in a native already the subject of malarial infection.

June 1914.

In the following case the Commission were divided in opinion as to the classification:—

CASE OF KOFIE.

Commentary by the Commission.

(1) The onset was sudden, with severe rigor, violent headache and pains in the loins.

(2) There was marked prostration; the eyes were strongly injected, fiery and red; there was violent frontal headache and the urine was scanty; albuminuria was present. Jaundice and epigastric tenderness were absent on admission; both appeared later.

(3) Faget's sign was marked. The pulse fell from 102 to 56.

(4) The albumen gradually disappeared from the urine.

(5) A stool contained eggs of *Ascaris lumbricoides* at a period of the illness when the temperature was 103° F. or 102° F. and the pulse 92 to 83.

(6) No parasites or pigment were found in the peripheral blood.

(7) The above symptoms are consistent with the diagnosis of a moderately severe attack of Yellow Fever in a native.

(*b*) SALTPOND.

May, 1914.

The following case was classified by a majority of the Commission as "Probable Yellow Fever."

"Clinical notes on case of Mr. H. B., six months on Coast, first time abroad, age 23 years, assistant, Basel Mission Factory, Saltpond.

"I was called to see patient at 11.30 a.m. on the 27th May; he had been ill since the morning of the 25th May, and that his temperature had been over 39 centigrade on both days, he had passed 12 dark watery motions, and just before my arrival had vomited a little greenish fluid.

"During the two days he had taken 12 grains of powdered quinine.

"29th May. On examination:—

"Face flushed, frontal and occipital headache, tongue clean, no liver or abdominal tenderness, had slept badly. Temperature 101°, pulse 77.

"Ordered liquid quinine, 10 grains, Aspirin 10 grains, took blood smears.

"6 p.m. Temperature 101°, pulse 75, had vomited once after taking some soup. Skin moist. Urine clear, light coloured, Sp. gr. 1030, acid, no albumen. Ordered quinine 10 grains to be given in the morning. No parasites found in blood.

"30th May:—

"8 a.m. Temperature 101°, pulse 72, slept badly. Bowels moved once, light coloured, no vomiting, headache, urine—no albumen.

"12 o'clock. Temperature 101·4°, pulse 70. Bowels opened, loose dark motion. Gave quinine 7 grains hypodermically.

"6 p.m. Temperature 102·6°, pulse 74. Conjunctivæ yellow. Complained of pains in stomach. Nausea—felt tired. Ordered Sternberg's mixture hourly. Hot pack over stomach.

"31st May:—

"1 a.m. Temperature 102·4°, pulse 70. Restless. Taking mixture well.

"6 a.m. Temperature 102°, pulse 68. Skin and conjunctivæ lemon coloured, nausea, no vomiting, has passed no urine for 12 hours. Slept badly. Bowels opened once, liquid dark coloured. Took brandy 1 ounce twice.

"10 a.m. No change. Temperature 102°, pulse 68.

"2 p.m. Passed urine 4 ounces, light coloured, heavy with albumen. Hot pack to loins, very restless.

"6 p.m. Temperature 101·2°, pulse 66. Urine 3 ounces.

"10 p.m. Temperature 101·4°, pulse 66. Slept a little.

" 1st June :—

" 2 a.m. Temperature 100°, pulse 64.

" 6 a.m. Temperature 100·4°, pulse 68. Slept badly, restless, took fluids well. Champagne 2 ounces.

" 10 a.m. Very yellow. Temperature 100·6°, pulse 66. Said he felt well.

" 2 p.m. No urine passed, looked bad. Breath sounds sighing. Hot pack continued.

" 6 p.m. Temperature 100·4°, pulse 60. Urine 8 ounces. Albumen nearly solid. Complained of discomfort about the stomach, some tenderness.

" 10 p.m. Temperature 100·4°, pulse 64. Felt tired.

" 2nd June :—

" 2 a.m. Asleep.

" 6 a.m. Urine, albumen heavy, slept for three hours in the night. Temperature 100°, pulse 66.

" 12 o'clock. Temperature 100°, pulse 64. Not inclined to take nourishment. Taking Sternberg's fairly well, very yellow.

" 3 p.m. Temperature 100°, pulse 64. Very dull.

" 6 p.m. Had two hours' sleep.

" 10 p.m. Passed urine 10 ounces, very dark. Temperature 100°, pulse 60.

" 3rd June :—

" 3 a.m. Temperature 99·4°. Had some sleep.

" 6 a.m. Temperature 99°, pulse 64. Slept.

" 10.30 a.m. Urine 14 ounces, very dark, bile pigment present. Albumen heavy.

" 2 p.m. Slept; felt better. Temperature 90·4°, pulse 66. Taking more liquids.

" 6 p.m. Temperature 98·6°, pulse 62. Had two hours' sleep. Passed urine, vomited clear fluid at 5.30.

" 10 p.m. Bowels opened. Stool light coloured.

" 4th June :—

" 2 a.m. Temperature 98°, pulse 64.

" 6 a.m. Temperature 98°, pulse —. Slept well.

" 10 p.m. Temperature 98° all day, pulse 64. Took nourishment well. Passed 12 ounces urine, bile pigment. Albumen less, still heavy.

" 5th June :—

" 7 a.m. Temperature 99°, pulse 60. Slept well.

" 12 o'clock. Temperature 99·4°, pulse 62. Passed urine, albumen.

" 6 p.m. Temperature 100°, pulse 62. Says he feels well. Passed urine, albumen.

" 6th June :—

" 6.30 a.m. Temperature 100°, pulse 64. Had a good night.

" 10.30 a.m. Temperature 99°, pulse 62. Albumen less in urine, bile pigment present, urine increasing in quantity.

"3 p.m. Temperature 98·4°, pulse 74. Passed urine; taking liquids largely. Brand's beef juice, Benger's food in small quantities.

"6 p.m. Temperature 98°, pulse 64.

"7th June:—

"6.30 a.m Good night. Passed 26 ounces urine, dark in colour, no albumen. Still jaundiced. Temperature 80°, pulse 62.

"3 o'clock. Comfortable.

"6 p.m. Temperature 98°, pulse 66.

"8th June:—

"8 a.m. Temperature 98·4°, pulse 68. Slept well. Bowels open. Urine 23 ounces, no albumen."

(*c*) TAMALE.

1914.

Tamale, which lies 9° 22′ 30″ N., 0° 51′ W., is a town in the Southern District of the Northern Territories of the Gold Coast. The patient was a native of Calabar, and had been working in the Northern Territories for some time. He had been ill about three days when seen on August 20th at Tamale, where he had gone for treatment.

The Commission were divided as to the classification of the case.

Commentary.

The points of interest in this case are:—

(1) The swelling of the submaxillary glands. These glands and the parotid have been noted as enlarged in a small percentage of cases of yellow fever.

(2) Albumen appeared in the urine on the fourth day, increased markedly on the fifth, diminished on the sixth and disappeared on the seventh day.

(3) Faget's sign was marked; the pulse falling to 40 and rising again, but only to 62.

(4) Absence of Malaria parasites.

(5) Marked headache and photophobia.

On December 3rd, 1914, two other cases of Yellow Fever were reported from Tamale.

The records of these cases have not reached the Commission.

(*d*) BOLE.

May, 1914.

The patient was a native boy, æt. 11 years, who was taken ill on April 30th, 1914, and died in Hospital at Bole of Yellow Fever on May 4th. A post-mortem examination was made and characteristic lesions were found.

(e) AXIM.

1914.

Axim is situated on the seaboard of the Gold Coast, and lies 4° 52′ N., 1° 13′ W.

The following fatal case occurred on July 19th, 1914. The patient was Mr. C., a European official.

In this case, locally diagnosed as Yellow Fever, the Commission were divided in opinion.

"MEDICAL REPORT ON THE ILLNESS AND DEATH OF MR. C.

"On the forenoon of the 13th I was called in to see Mr. C., and found him in a rather collapsed condition, with pale, pinched features and conjunctivæ markedly injected. He was vomiting a considerable amount of bilious matter. He had slight headache, slight tenderness over the epigastrium, slight enlargement of the liver, but no tenderness, no tenderness over the gall-bladder, and no tenderness over the rest of the abdomen or back. The tongue was coated with a white fur, and he was badly constipated. His temperature was 99°, pulse 84.

"He informed me that he had had a slight go of fever on Saturday, but had taken some quinine and felt all right in the morning. On Monday he went down to the office feeling rather out of sorts, and about 10 a.m. had a rigor which lasted for one hour, when he began to vomit. The vomit at first was sour-tasting liquid containing half-digested food, then became green in nature.

"He spent a very bad night, vomiting all the time, and passed seven or eight motions.

"On the 14th he became jaundiced and the conjunctivæ quite green. The tongue was also coated with a green fur. He complained of no pains anywhere. Temperature 100°, pulse 94. He was admitted to hospital at once. There were no signs of skin rash, hæmorrhages, or bleeding from the gums now or any time during the illness. He continued vomiting all day a greenish liquid with black masses in it and mucus, and could keep nothing in his stomach. He also passed three motions which were very black and soft in nature and also green slimy fluid. No urine was passed separate to the motions, so I was unable to test it.

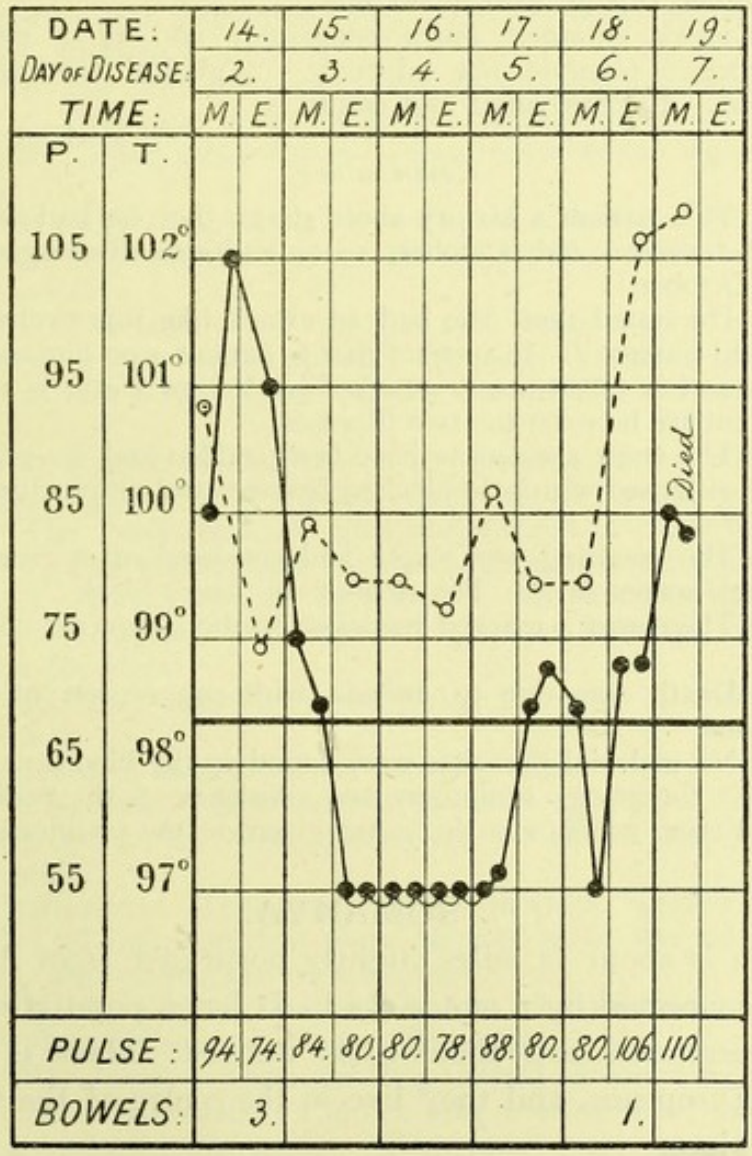
"His temperature was now 102°, pulse 94, and remained so all day. He had an injection of morphia at 5 p.m. and slept from 6 p.m. to 5 a.m. next morning.

"15th.—His temperature had now fallen to 98°, pulse 84. He continued much the same all day, continually vomiting, still very jaundiced, passed no urine. Microscopic examination failed to show any signs of malarial parasites in the blood.

" 16th.—Patient had a fairly good night, and was looking much better, the icterus much reduced, vomiting much reduced and no black material in it. Temperature 97°, pulse 80. Passed no urine all day. He was able to take a little chicken broth and retained it.

" 17th.—Passed fairly good night; slept from 11 p.m. to 5 a.m. Temperature 97·4°, pulse 80. He had very slight vomiting. No urine passed.

" 18th.—Passed very good night. Temperature 98·4, pulse 80. He passed one motion, which was very liquid and brown in colour, but not smelling badly. No urine was passed. He was much brighter himself, but he wandered at times, and his mind seemed to be a blank at times. His temperature in the evening was 98°, but his pulse had increased to 106. He slept till 4 a.m., when his temperature had risen to 100°, pulse 110, and he had uræmic convulsions. He passed out of these into a state of coma and continued in this condition till 7.30 a.m., when he expired.



"*Treatment.*—Champagne was the only liquid he could keep down. He was given this in equal quantities of soda water.

"Mag. Sulp., Bismuth, and Ac. Hydrocyan. dil. were given the first day, but he could not keep them down. Calomel was tried and Ac. Nit. Hydrochlor. dil. was tried when he came into hospital, with same result. He was then put on Sternberg's solution, 1½ ounces hourly, and morphia to stop the excessive vomiting. Cocaine was tried first with *nil* results.

"The anuria was treated with hot fomentations, salines, blistering, hot packs, and pilocarpine, but with no response.

"*Post-mortem.*—Lungs were very pale and anæmic, otherwise normal. Heart normal.

"Stomach: mucosa congested and bile-stained; fluid contained bile pigment and albumen and a lot of debris.

"Pylorus and upper part of jejunum was also congested.

"Spleen slightly enlarged and congested.

"Liver slightly enlarged and congested, and stained with bile. Gall-bladder full of semi-liquid bile.

"Kidney enlarged, much congested, and of a mottled grey appearance. Capsule not adherent. Tubules standing out very prominent. Bladder small and empty.

"Medical Officer."

Commentary.

(1) This patient's history sheet shows that he had an attack of malarial fever on 28th October, 1911, and was discharged recovered on 31st October.

(2) He stated that "he had an attack like this twelve years ago in British Guiana." It appears that a patient who has suffered from Malaria and is subsequently attacked by Yellow Fever is usually able to differentiate between the two illnesses.

(3) The onset appears to have been sudden and severe, as he was "rather collapsed with pale pinched features and conjunctivæ markedly injected."

(4) The vomiting was severe and consisted of a greenish liquid with black masses in it. The stools were "very black."

(5) There was a marked remission in the symptoms on the fourth day.

(6) Death was due to uræmia with suppression of urine and convulsions.

(7) No malarial parasites were found in the blood.

The foregoing symptoms are consistent with a diagnosis of Yellow Fever, which was the cause given on the certificate of death.

(*f*) SOMANYA.

Somanya is about 52 miles slightly north-east from Accra, with which it is connected by a motor road. It has a population of four European merchants and about 4,000 natives. There is no segregation for Europeans, and they live in the centre of the town near the market-place.

In the following case, locally diagnosed as Yellow Fever, the Commission were divided in opinion: —

"REPORT ON ILLNESS AND DEATH OF E. H. H., SOMANYA.

"1. Mr. E. H. H. has been five-and-a-half years on the West Coast.

"In November of last year (1913) he was treated for pleuro-pneumonia, and was confined to bed for ten days.

"In December of the same year (1913) he developed phlebitis, and was invalided home in February, 1914.

"He came back to the Coast in May, 1914, and again developed phlebitis. In July he was able to walk about quite fit until I saw him in his last illness.

"2. On the 13th of August, 1914, I was called to attend Mr. H., who was suffering from what he termed bilious vomiting and persistent hiccup.

"3. On examination I found the tongue was furred and the temperature was subnormal, 96·5°, and his pulse 99, urine contained trace of albumen.

"4. His skin and conjunctivæ showed slight icterus.

"5. Over the epigastrium he complained of very severe pain which on palpation seemed to be localized over the region of the gall bladder.

"He also complained of constipation, but put this down to the fact that he had nothing to eat for the previous three days, as he was very liverish.

"6. The vomit was on the 15th composed of mucus, but he informed me previous to my visit the vomit contained bile.

"7. His blood on microscopic examination showed no abnormal changes.

"8. I again visited him on the morning of the 16th, and found that the epigastric pain was more pronounced, as also was the hiccup.

"The vomit remained clear and mucoid in character.

"9. The temperature remained subnormal, 95°, and the pulse was 101. In the evening of the same day, about seven o'clock, the vomit was composed of a brownish grumous material, which gave the reaction for blood.

"10. This vomit persisted during the night at intervals of about two hours.

"He died at 4.30 on the morning of the 16th.

"*Treatment.*—Hot fomentations were applied to the epigastrium. Calomel grains iii. were given, and a mixture was prescribed for the vomiting.

Post-mortem Appearances.—Post-mortem rigidity set in very quickly; all the dependent parts, back of neck, and all posterior part of body showed marked ecchymoses.

"Black, inky fluid was coming out of the mouth.

"The skin showed slight yellow tinge.

"*The Lungs.*—The right lung showed old-standing cavity at base with pleural adhesions. The left lung showed small pea-like foci of necrosis scattered throughout. Both lungs were congested.

"*Heart.*—The heart showed small punctiform hæmorrhage, otherwise normal.

"*Liver.*—The liver was normal in size, and of a pale brownish colour. The gall bladder contained a small quantity of bile.

"*Stomach.*—The stomach contained black, inky fluid. The stomach wall was inflamed, and showed small punctiform hæmorrhages. The small intestines were uniformly of a black colour and contained inky fluid. The intestinal wall and mesentery of small intestine were very friable. The large intestine was not so much affected as the small. There were punctiform hæmorrhages throughout.

"The kidneys were congested.

"The bladder was normal.

"The urine contained albumen.

"The spleen was normal in size, and slightly congested.

"*Diagnosis.*—Yellow fever.

"Medical Officer,
"Akuse."

There were no further cases.

(v.) NIGERIA—NORTHERN PROVINCES.

JEBBA.

1914.

Up to the date of the occurrence of the following case, Yellow Fever had not been known in Northern Nigeria. The case was classified by the Commission as "Probable Yellow Fever." The patient was employed on the Nigerian Railway. Death took place on the train between Jebba and Zungeru. The facts of the case, so far as known, are as follows. At the inquest the Medical Officer of the district stated:—

"On Saturday, 10th July, I received a wire at 8 a.m. from Mr. W, at Jebba Island, asking me to come up and see one of his assistants who was having continuous fever. I caught a light engine going to Jebba, and arrived Jebba about noon. As soon as possible I crossed the river and saw the patient; he was in a grass hut with cement floor. I examined him and found his temperature 105·2° and pulse 102 fairly strong, furred tongue, and had been vomiting, usual in malarial fever. I gave the patient five grains calomel and five grains phenacetin and hot drinks; he seemed in fairly good condition, his pulse gave me no anxiety. I stayed with him for two hours; I then went to see another patient at Jebba South, Driver M, N.R., who had a temperature over 105°. Before leaving I gave instructions to Mr. W.'s assistant to look after the patient with directions. I returned at 6 p.m. when I found Driver M.'s temperature falling; I found Mr. D.'s temperature had dropped to 103·2°, his pulse was quick but

fairly strong; during the night I stayed with the patient, seeing him frequently, his pulse remained about 103 all night, his urine was normal and there were no physical signs pointing either to heart failure or blackwater fever. As I had another serious case at Jebba South I found it absolutely impossible to give the attention I considered necessary to both patients. I therefore asked Mr. W. to have Mr. D. taken to Zungeru Hospital, which, in my opinion, was the best thing to do for the patient, and to be sent in charge of Mr. W.'s assistant, to whom I gave full instructions. I proceeded to Jebba South to see Driver M., and was informed by telephone message that the patient had left at 10.30. At about noon, Mr. W. arrived and informed me that the patient had not left. I immediately went to the island and saw the patient; his temperature was 103° and fairly quick pulse; the patient seemed quite comfortable, and at 2 p.m. I saw him into the train with Mr. W.'s assistant when they left for Zungeru."

The report on the post-mortem examination is as follows:—

"The post-mortem examination was made on the morning of 13th July, about seven hours after death had occurred.

"The deceased died on the train during transit from Jebba to Zungeru. History given by a non-medical man was of high fever for three days, followed by collapse with apparent suppression of urine, and in the last few hours with black vomit.

"*Appearance.*—Post-mortem lividity was well marked. The conjunctivæ were distinctly yellow.

"*Thorax.*—Lungs congested but containing air: right, 11½ oz.; left, 10 oz. Heart rather flabby, otherwise normal. Weight, 11 oz.

"*Abdomen.*—No free fluid present. Stomach contained a small quantity of thin fluid black with altered blood. Mucous membrane of stomach, duodenum, and first part of jejunum showed numerous small petechial hæmorrhages. The remaining part of the intestine showed nothing abnormal. Liver was distinctly yellow in colour. It was dry, had retained its shape, and was of fairly firm consistency; weight, 2 lbs. 10½ oz. Spleen was enlarged and rather soft. It was distinctly pigmented; weight, 7½ oz. Kidneys showed some congestion, but little, if any, comparative swelling of the cortex; right, 5 oz.; left, 5½ oz. Bladder contained no urine.

"*Brain.*—Some congestion of meninges. No malarial pigmentation of capillaries.

"*Blood examination* (from jugular vein).—Corpuscles rather degenerated, and staining therefore irregular. Fairly numerous subtertian malaria parasites were present.

"*Spleen smear.*—Pigment in spleen cells, but not in excessive quantity. Some malaria parasites were recognizable in the erythrocytes.

"In view of the comparatively mild malarial infection present, the jaundice, the condition of stomach, liver and kidneys, and the absence of urine from the bladder, the post-mortem findings decidedly suggest that *death was due to Yellow Fever.*

"Acting Senior Medical Officer.

"14th July, 1914."

Italics in original.

The results of the microscopical examination of the tissues were as follows: —

"*Spleen.*—Congested.

"*Liver.*—Congestion. Outline of lobules lost. Great destruction of hepatic cells and marked fatty degeneration.

"*Kidneys.*—Glomerular tufts swollen and showing hæmorrhages. Vessels generally engorged. Marked necrosis and desquamation of lining cells of all the tubules. Lumen of tubules filled with débris.

"MINUTE BY THE DIRECTOR OF MEDICAL AND SANITARY SERVICES.

"C.S.

"There is no doubt in my mind that Mr. D. died of Yellow Fever.

"Director Medical Service.

"22nd July, 1914."

(VI.) NIGERIA.—SOUTHERN PROVINCES.

(*a*) EBUTE-METTA (LAGOS).

1914.

L. 128. In the following case the Commission were divided in opinion: —

"REPORT.—YELLOW FEVER. L. 128.

"Name: A. O'C.

"Sex: Male.

"Age: 27 years.

"Nationality: British.

"Date of admission: 8th March, 1914.

"Date of discharge: 20th March, 1914.

"Diagnosis: Yellow Fever.

"Result: Recovery.

"*History.*—Patient has only been out for three weeks of his first tour of service in Nigeria. Previous to coming to Lagos, he had been for three months in Sierra Leone.

"He states that he first got ill on the 5th March with a severe frontal headache, followed by rigors and pyrexia. He also had severe pains in the back and extremities. Temperature was raised and was 105 that night. He was seen by the Medical Officer at Ebute-Metta and treated. Next day, the 6th, he was much the same, with severe headache and temperature of 104°. On the 7th, his temperature was still high and he noticed that his urine was diminished, and on examination, was found to contain albumen. He was sent into hospital on the 8th and admitted at 1 p.m.

" Patient states that he had been taking quinine regularly during the illness, but previous to that very irregularly. Vomiting was present on the 6th, with epigastric pain and discomfort, and on the 7th he had no vomiting but nausea was distressing.

" *On admission.*—Patient seemed in distress. Face was flushed. Eyes shining. Conjunctivæ injected and red. Pain in the eyes also present. Temperature was 103·8°, pulse rate 88. Complained of severe frontal headache and pains in the back and extremities.

" *Alimentary System.*—Tongue was pointed with furred dorsum and red tip and edges. Bowels have been constipated. Vomiting had been present at the commencement of the illness, but nausea is now present. Epigastric pain and discomfort present. Liver and spleen are both normal, no tenderness on palpation.

" *Circulatory System.*—Heart sounds are normal. Pulse rate is 88.

" *Respiratory System.*—Lungs were normal. Respirations were 22.

" *Urinary System.*—Urine is diminished in quantity and high coloured. On examination : Acid reaction. Sp. gr. 1025. Albumen present. Tube casts also present.

" *Blood examination.*—Few subtertian malaria parasites present. Leucopenia present. Differential count : Polymorph., 54·8 per cent. ; lymphocyte, 24·8 per cent. ; mononuclear, 16·2 per cent. ; transitional, 4 per cent. ; mast cells, 2 per cent.

" 8 p.m. Temperature was 102·6°, pulse rate 100.

" 9th March.—Patient had a fair night, headache was severe, also pains in the back and extremities. Temperature at 8 a.m. was 101°. Bowels were opened after the calomel. Urine was diminished, and only three ozs. passed in the 12 hours. Very high coloured and containing albumen. Acid reaction. Sp. gr. 1020. Epigastric pain and discomfort still present.

" 10th March.—Patient had a better night. Headache and loin pains not so severe. Passed no urine at all during the past 24 hours. Passed about one oz. at 10 p.m. Albumen present. Sp. gr. 1030. Acid reaction. Headache was increased towards the afternoon. Temperature at 8 a.m. was 99·4°, pulse rate 76, and at 8 p.m. it was the same, with a pulse rate of 64. Scleræ were tinged with yellow.

" 11th March.—Patient had a good night and slept well. Urine passed but still diminished. Albumen present. Acid reaction. Sp. gr. 1025. Scleræ are yellow. Bowels opened. Headache and loin pains have gone. Slight epigastric discomfort still present. Temperature at 8 a.m. was 99°, pulse rate 64, and at 8 p.m. 98·4°, with pulse of 54.

" 12th March.—Patient had a good night and feels very much better. Scleræ are very yellow. Urine has increased in quantity. On examination is acid in reaction. Sp. gr. 1030. No albumen

present. Bile has now appeared. Appetite is improving. Temperature at 8 a.m. 97·4°, pulse rate 54, and at 8 p.m. 98·4°, with pulse of 60.

"13th March.—Patient feeling very much better. Had a good night. Appetite improved. Bowels opened. Urine normal and increased in amount. Jaundice well marked. Temperature normal, pulse still slow. Patient continued to do well. Jaundice disappeared on the 18th, and the patient was discharged cured on the 20th March."

The blood count was as follows:—

	8th March. Subtertian rings.	9th March. Subtertian rings.	10th March. o
Polymorphonuclears	62·2 per cent.	54·8 per cent.	43·8 per cent.
Lymphocytes ...	23·0 ,,	24·4 ,,	28·2 ,,
Mononuclears ...	12·0 ,,	16·2 ,,	20·8 ,,
Eosinophiles ...	0·2 ,,	— ,,	1·4 ,,
Transitionals ...	2·2 ,,	4·0 ,,	5·8 ,,
Mast cells	0·4 ,,	0·2 ,,	—

(*b*) CALABAR.

L. 133. The following case, diagnosed locally as Yellow Fever, occurred on the s.s. "Yola," on April 22nd, 1914. The details are incomplete, and the Commission were divided in opinion as to its nature.

The patient was a Russian sailor, æt. 27.

The following report contains all that is known of the case:—

"Report on a case of Yellow Fever occurring at Calabar on s.s. 'Yola.'

"I boarded s.s. 'Yola' on the 25th April, 1914, and then saw F. Tomsen, A.B. He was then apparently suffering from malarial fever, having a temperature of 101°, a pulse of 90, no epigastric pain or any vomiting or jaundice. He had been feverish since the 22nd April, 1914. He subsequently died at 2.30 p.m. on the 25th April, 1914, but his death was not reported to me until about 9 a.m. on the 26th April, 1914. I went on board the s.s. 'Yola' again and elicited the fact that when Tomsen died his temperature was 109°. The history I then obtained was as follows:—

"22nd April, 1914. Headache. Temperature 105° in morning.
Temperature 101° ,, evening.

"23rd April, 1914. Temperature 98·4° in morning.
Temperature 104° ,, evening.

"24th April, 1914. Temperature 98·4° ,, morning.
Temperature 98·4° ,, evening.

"25th April, 1914. Temperature 98·4° in morning, 6 a.m.
Temperature 101° at 10 a.m.
Temperature 105° ,, 12 noon.
Temperature 108° ,, 1.30 p.m.
Temperature 109° ,, 2.30 p.m.

with convulsions and death.

"The body was already coffined at 10 a.m., 26th April, 1914. I had the coffin opened and found the body in a rapidly advancing stage of decomposition, but showing purplish blotches on chest and penis. I had the body removed to the mortuary, where I made a post-mortem examination; post-mortem report attached.

"Medical Officer.

"*Post-mortem Report.*

"Body that of a male, bloated, and decomposition advanced. Purple staining on chest and neck and slightly of scrotum and penis, bloody fluid oozing from mouth. Abdomen was opened; stomach removed, and on opening found to be filled with black coffee-ground material. Mucous membrane intensely injected. Liver enlarged, soft, does not show to naked eye any fatty change.

"Spleen large and very friable and engorged.

"Kidneys both large, and show small petechiæ under capsule and also white patches.

"Bladder contained a small amount of cloudy urine, and on examination was found to contain albumen.

"Stomach and contents, portions of liver, spleen, and kidneys removed, and smears taken of liver, kidney, and spleen; specimens sent to Medical Research Institute for report.

"Medical Officer."

(*c*) BURUTU.

1914.

Burutu is situated about five miles up-river from Forcados in the Warri Province of the Southern Provinces of Nigeria, and was at one time the transport station for the Northern Nigeria Government. The Niger Company has a large shipping depôt, together with extensive engineering shops there, and a slipway which is capable of taking fairly large craft. Usually there are about 20 Europeans at Burutu. The native population is about 1,480. Burutu lies 5° 19′ N., 5° 34′ E.

ON BOARD SS. "ASHANTI."—OCTOBER, 1914.

In this case the opinion of the Commission was divided. The local diagnosis was Yellow Fever.

The patient was a European sailor, æt. 22, on board the steamship "Ashanti." Death occurred at Burutu. He was taken ill on October 17th with fever and headache, which continued for two days, followed by a remission on the third day, when the patient felt much better. This was followed by a further rise of temperature, and death occurred on the sixth day with delirium and hyperpyrexia. On the fifth day there was profuse epistaxis. Ten grains of quinine were given three times daily on October 17th, but without effect upon the temperature.

On the 18th at 4 p.m. ten grains of bi-hydrochloride of quinine were injected intramuscularly. There was a fall of temperature on the following day, but on the 22nd it rose from 99° to 103°, 105° and 107°, when death occurred.

"*Post-mortem Examination.*

"Yellow tinge of skin: conjunctivæ tinged. Lividity of neck, trunk and back, hæmorrhage from nose. Small hæmorrhages in pericardium. Small hæmorrhagic spots in lungs.

"Mucous membrane of stomach injected with patchy swellings, no hæmorrhage into cavity. Duodenum and a patch in jejunum show congestion. Liver brownish in colour, soft, appearance of fatty degeneration. Spleen 13 oz., dark and practically diffluent and much engorged.

"Kidneys, cortex and medulla congested, R. 6 oz., L. 6 oz.

"*Post-mortem Diagnosis and Conclusions.*

"Death due to hyperpyrexia. The history of the case, length of fever with its remission on the third day and subsequent rise accompanied by nasal hæmorrhage and the light yellow staining of the skin, together with the post-mortem findings, point to the conclusion that the hyperpyrexia was due to Yellow Fever.

"24th October, 1914."

ON BOARD SS. "NEMBE," 1914.

A. 131. The patient was a European, æt. 14 years, a member of the crew of a steamship lying at the wharf at Burutu. The date of the onset of the illness is uncertain; death occurred from Yellow Fever on March 26th, 1914, and the diagnosis was confirmed by post-mortem examination.

The movements of the ship were as follows:—

Station.	Arrival.	Departure.	Remarks.
Sierra Leone ...	February 24th	February 24th	—
Bonny	March 3rd	March 4th	—
Port Harcourt ...	March 4th	March 11th	Alongside wharf, and in contact with ss. "Degema" from 4th–6th; and in contact with ss. "Egwanga" from 8th–11th. *Deceased was ashore.*
Calabar	March 12th	March 17th	Alongside Government wharf from 13th–17th; but not in contact with any vessels. *Deceased did not go ashore.*
Forcados	March 19th	March 22nd	In contact with ss. "Hartley" in mid-stream from 19th–22nd. No person on board went ashore.
Burutu Channel ... (stuck ashore on mud bank.)	March 22nd	March 24th	—
Burutu	March 24th	March 27th	—
Quarantine Station, Forcados ...	March 28th	—	—

No further cases occurred and no cases of a suspicious nature were reported.

The ss. "Hartley" was inspected on arrival at Lagos, but no cases of illness were found on board.

(*B*)—EPIDEMICS IN 1914.

(1) NIGERIA.—SOUTHERN PROVINCES.

(*a*) WARRI.

In Appendix D. (I.R., Vol. I., p. 307) of Dr. T. R. Russell Leonard's "Report on Certain Outbreaks of Yellow Fever in Lagos, 1913, and January and February, 1914," one case diagnosed as of Yellow Fever on board the ss. "Arnfried" at Koko, Warri,

and four other cases of fever of a doubtful nature, which occurred at the same time and in the same ship are mentioned. Of these cases Dr. Leonard states:—

> "From the above report Case No. 1, in my opinion, is undoubtedly a mild infection of Yellow Fever. In Cases 2 and 3, although malaria parasites were found to be present, the signs and symptoms as a whole do not present a picture of simple malarial infection, and should be regarded as distinctly suspicious. In Cases 4 and 5 there is very little doubt of their being ordinary cases of subtertian malarial fever. The reports are very meagre of details. Faget's sign is undoubtedly present in Case No. 1, and to a less extent in Cases 2 and 3, while absent in Cases 4 and 5."

(*b*) LAGOS.

L. 121.
L. 122

Two cases of Yellow Fever occurred at Lagos in February, 1914 (*vide* I.R., Vol. I., p. 312). One patient (Case 1, Lagos L. 121) was an engineer of a vessel lying at Iddo Wharf in Lagos. The other patient was an assistant in a trading firm (Case 2, Lagos, L. 122). In August, 1913, Case No. 18 had occurred at the same factory as Case 2, and was treated in Lagos Hospital.

Lagos was put in quarantine on the occurrence of the second case.

L. 121.

As the Commission were divided in opinion on the first case. it may be desirable to state it in full in this Report:—

> "*Name*: Mr. C.
> "*Age*: 30 years.
> "*Sex*: Male.
> "*Nationality*: European, British.
> "*Occupation*: Engineer, s.s. 'Porto Novo' from Forcados, 24th January, 1914.
> "*Date of admission*: 12th February, 1914.
> "*Date of discharge*: 27th February, 1914.
> "*Diagnosis*: Yellow Fever.
>
> "*History.*—Patient states that he first felt ill on the 9th February with rigors, followed by severe frontal headache and fever. There was no vomiting, but nausea was present. Patient took quinine that night and also next day, but felt no better. On the 11th, he again had rigors and a high temperature, accompanied by severe frontal headache and aching pains in the extremities. This morning he was seen by Dr. Maples, and as his temperature was 104°, he was sent to the hospital. Patient has only been out five months and this is his first tour on the Coast. He has taken quinine regularly.
>
> "*On admission.*—Patient complained of very severe frontal headache and pains in the eyes. Conjunctivæ were red and injected. Eyes shining. Temperature was 104·2°, pulse rate 88 per minute.

"*Alimentary system.*—Tongue was furred, with clean red tip and edges. Bowels were constipated. Gums red and swollen Nausea and epigastric discomfort present, increased on pressure. Patient had no vomiting, but severe retching had been present on the day before admission. Liver and spleen were both normal in size with no tenderness on palpation.

"*Circulatory system.*—Heart sounds were normal. Pulse very slow, 88 per minute.

"*Respiratory system.*—Lungs were normal. Respirations were hurried, 36 per minute.

"*Nervous system.*—Severe frontal headache and pains in the eyes. Aching pains in the extremities. Reflexes were normal.

"*Urinary system.*—Patient stated that the urine was diminished in quantity and high coloured. On examination: Acid reaction. Sp. gr. 1010. Albumen present.

"*Blood examination.*—Few young ring forms of subtertian malaria present. *Paraplasma flavigenum* present. Differential count: Polymorphon. 72·6 per cent.; lymphocytes, 17·2 per cent.; mononuclear, 8·4 per cent.; transitionals, 1·8 per cent.

"9 p.m. Patient passed 10 ozs. of urine, none having been passed during the day. Nausea and retching were troublesome. No vomiting. Bowels were opened after the calomel. Temperature 103·6°, pulse rate 80.

"13th February. Patient had a restless night and only slept after a draught. Bowels were opened twice in the morning. Urine was passed, 22 ozs., and on examination was acid in reaction. Sp. gr. 1022. Albumen had increased in amount. Temperature at 8 a.m. was 100·8°, pulse 84. Nausea and epigastric discomfort still present. Scleræ are tinged with yellow. Headache and muscular pains still persist. Temperature at 8 p.m. was 99·8°, pulse rate 64.

"14th February. Patient had a better night and feels better this morning. Nausea and epigastric discomfort still present, but much lessened. Bowels were opened. Urine passed in increased quantity. On examination: Acid in reaction. Sp. gr. 1025. Albumen present. Scleræ yellow. Temperature at 8 a.m. was 99·4°, pulse 70. At 8 p.m. it was 101·2°, pulse rate 60.

"15th February. Patient had a restless night, temperature rose to 102·4°, pulse rate 88 per minute. At 8 a.m. temperature was 101°, pulse 84. Nausea still present. Jaundice now well marked. Urine still diminished, 33 ozs. passed in the twenty-four hours, and contains albumen. Bowels opened twice. Temperature at 8 p.m. 98·4°, pulse 72.

"16th February. Patient had a good night. Appetite returned. Jaundice more marked. Urine is acid in reaction. Sp. gr. 1,022. No albumen present. Temperature subnormal, pulse rate 64. Bowels opened. Patient continued to progress favourably. Appetite returned. Bowels regular. Urine returned to its normal quantity. Jaundice gradually disappeared on the 21st February, and the patient was discharged cured on the 27th February."

The results of the blood examinations were as follows:-

	Feb.12th.	13th.	15th.	16th.	17th.	18th
Parasites	Subtertian rings	Subtertian rings	0	0	0	0
Polymorphonuclears	72·6	57·4	62·2	43·2	49·8	49·2
Lymphocytes ...	17·2	26·4	25·2	30·4	31·0	30·4
Mononuclears ...	8·4	11·8	7·0	13·4	11·0	10·6
Transitionals ..	1·8	4·0	4·8	7·4	4·2	5·6
Mast. cells	—	—	0·8	0·2	—	—
Eosinophiles ...	—	0·4	—	5·4	4·0	4·2

Some blood films from this case were examined by Dr. C. M. Wenyon, Director of Research in the Tropics to the Wellcome Bureau of Scientific Research, who found them to contain subtertian malaria parasites, some of which were small and had a curiously compact structure.

The second case was classified as "Probable Yellow Fever": --

"*Name*: Mr. M.

"*Sex*: Male.

"*Age*: 27 years.

"*Nationality*: European, German.

"*Occupation*: Trader, in the employ of Messrs. W. and B.

"*Date of admission*: 14th February, 1914.

"*Date of discharge*: 27th February, 1914.

"*Diagnosis*: Yellow Fever.

"*History*.—Patient states that he felt ill yesterday, the 13th, in the morning, with chills and frontal headache. Got gradually worse during the day, and at night his temperature was 104°, with very severe headache and pains in the extremities. He was seen by his medical attendant, Dr. Maples, who gave him an intramuscular injection of quinine. He had a bad night but felt better early next morning. During the day the temperature again rose, headache became severe, nausea and epigastric discomfort was present. No vomiting until he made himself vomit to relieve the nausea. In the evening his temperature was 104°, conjunctivæ were injected and red, headache very severe and his urine on examination was albuminous. So he was sent to the hospital at 7 p.m.

"*On admission*.—Temperature was 101·8°, pulse rate 98. Conjunctivæ very injected. Complained of severe frontal headache and

aching pains in the loins. Patient has only been out eight months of this, his first tour. Has taken quinine regularly.

"*Alimentary system.*—Gums red and swollen. Tongue, white dorsum, with red tip and edges. Bowels constipated. Liver and spleen both normal, no tenderness. Nausea and epigastric discomfort present. Great thirst present.

"*Circulatory system.*—Heart sounds normal. Pulse slow, 90 at 8 p.m.

"*Respiratory system.*—Lungs normal. Respirations hurried.

"*Nervous system.*—Severe frontal headache present. Aching pains in the loins. Reflexes normal

"*Urinary system.*—Urine passed on admission. Very high coloured. Acid reaction. Sp. gr. 1030. Albumen present, high percentage. Quantity has been diminished.

"*Other systems.*—Skin sweating. Face very flushed. Conjunctivæ injected. Eyes shining. Photophobia present.

"*Blood examination.*—No malaria parasites present. *Paraplasma flavigenum* present. Differential count: Polymorphon., 61 per cent.; lymphocytes, 27·4 per cent.; mononuclear, 8·4 per cent.; transitionals, 2·8 per cent.; mast cells, ·4 per cent.

"15*th February.*—Patient had a fair night, but was restless in the early part. Bowels moved after the calomel. Urine passed but diminished in quantity, only 7 ozs. passed in the previous twenty-four hours. Highly albuminous. Temperature at 8 a.m. was 99·4°, pulse rate 88. Tube casts present in the urine. During the day, the temperature rose, and at 4 p.m. was 103·6°, pulse 100. Patient very excitable, complained of great thirst. Face very flushed and conjunctivæ were very injected. At 8 p.m. temperature was 102·4°, pulse 96.

"16*th February.*—Patient was very restless last night and only slept after a draught. Conjunctivæ very injected. Nausea troublesome. Urine still diminished and contains albumen. Patient is very nervous and complains of great thirst. Temperature at 8 a.m. was 101·6°, pulse rate 88. At 8 p.m. temperature rose to 102·8°, pulse rate 90.

"17*th February.*—Patient had a better night and slept. Is feeling much improved this morning. Temperature at 8 a.m. 100·6°, pulse 100. Headache still present, also loin pains. Urine is still diminished and contains albumen, Sp. gr. 1030, acid reaction. At 8 p.m. temperature rose to 102·4°, with pulse of 90. Thirst is lessened. Conjunctivæ still injected.

"18*th February.*—Patient had a good night and is feeling very much better. Bowels opened. Urine passed in increased quantity,

and on examination still contains albumen. Conjunctival injection passing off. Scleræ are now tinged with yellow. Temperature is 99°, with pulse rate of 100.

"19*th February*.—Patient is much improved and had a good night. Temperature still 99°. Bowels opened. Urine examined and found to contain bile, but no albumen. Scleræ are now decidedly yellow. Nausea and epigastric discomfort have passed off. Appetite is returning. Urine has not yet reached the normal. Headache quite gone.

"Patient continued to gradually improve, jaundice slowly disappeared on the 24th, and patient was discharged cured on the 27th February."

Daily examinations of the blood were made until the patient was discharged, but no malarial parasites were found.

It is stated in the Notes that mosquitoes prevailed in the patient's residence, chiefly *Stegomyia*.

(11) GOLD COAST.

(*a*) SALTPOND.

Saltpond is situated on the seaboard and lies 5° 12′ N., 1° 7′ W.

Case 1.—The patient was a European, aged 30 years, the agent of a Trading Association. He was in his fourth tour of service and had been out for seven months. He had resided at Saltpond for seven weeks.

The illness commenced on 7th January, 1914, and ended fatally on 12th January.

Case 2.—On the same day, a European, aged 29 years, an agent for another trading company, was taken ill with Yellow Fever and recovered after an attack lasting five days. His bedroom was in a house 70 feet from the first case, but to windward of it. Both rooms were near a dilapidated Kroo-boy house.

Case 3.—On January 15th a European trader aged 45 years, who had been at Saltpond for seven months, was taken ill with symptoms suggestive of Yellow Fever and recovered on the fifth

day. His pulse on that day was 56. This case was classified as "Possible Yellow Fever."

In a report by the Senior Sanitary Officer, the following occurs:—

> "10. Inquiries made with a view to discovering the source of infection have not so far met with any success. There does not seem to have been any unusual ill-health amongst the native population, adults or children. It may have originated from an infected person living in a very dilapidated building which lies between the German West African Trading Company and the African Association. This building is inhabited by Kroos. The suspicions would seem to be more or less justified by the fact that at no time recently had the second case ever visted the African Association building, and the presumption is that the infected mosquitoes must have come from a common source."

No further cases occurred and Saltpond was declared to be free from infection on the 2nd February, 1914.

GOLD COAST, ASHANTI.

(*b*) AYENIM.

Ayenim is a mining camp three miles from Obuasi in Ashanti and ninety-five miles from the Coast. It is described as being "in a very bad state of neglect." The native village, close by, under charge of the Government doctor, was in a satisfactory state.

Case 1.—The patient was a European, aged 44, who had completed several tours on the Coast. Until April 19th, 1914, he lived at Obuasi; on that date he removed to Ayenim. On April 25th he visited Ayenim village and again on April 29th. His illness commenced on May 4th, and death occurred on May 10th. A post-mortem examination revealed lesions typical of Yellow Fever.

The occurrence of this case led to the knowledge of other cases.

Case 2.—The patient was a European engaged at the mining camp. He accompanied Case 1 to the native village on April 25th

and 29th, and was taken ill on the same day as Case 1. Recovery followed after a mild attack lasting fifteen days.

The Provincial Medical Officer and the Medical Officer of Health investigated this outbreak and reported as follows upon a death which occurred at Ayenim earlier in April, 1914: —

> "*Case* 3.—I have little doubt that H————, who died in April, was a case of Yellow Fever."—*Provincial Medical Officer.*
>
> "In my opinion the outbreak dates back to April this year. On the 12th March a European, H———, arrived out from England. He lived in Bungalow A (distant 60 yards from Bungalow B, where Case 4 occurred). He took sick on April 1st, and complained of headache and gastric trouble. Next day H——— came in to Obuasi and said that he was better. He was ill again on the following two days, but did not consider himself ill enough to send for the doctor, and did not stop work. He felt much better on the 5th (Sunday), and on the morning of the 6th went to work as usual. In the afternoon he felt much worse, and died that evening. I was told by a European that after death dark blood came from H———'s nose and mouth. I believe this to have been a case of Yellow Fever."—*Medical Officer of Health.*

The cause of death was returned by the mine doctor as "heat stroke" and he maintained that opinion. The Commission were divided in opinion as to the nature of this case; it was ultimately classified as "Negative" by a majority.

After the death of this patient, Case 1 left Obuasi, on April 19th, for Ayenim, and slept in the same room that H——— had occupied. Case 2 occupied the other room in that bungalow.

Case 4.—A European, T———, was found by the medical officers to be ill when they visited Ayenim. He lived in Bungalow B, distant 60 yards from Bungalow A.

> "He had symptoms very suspicious, in my opinion, of a mild attack of Yellow Fever, and was accordingly isolated in hospital with Case 2."—*Medical Officer of Health.*

(*c*) TAMALE.

The following are the rather scanty details of these cases: —

> "CASE 1.
>
> "Carpenter, Public Works Department. There was much frontal headache; pain in the joints was a prominent symptom. Vomiting occurred once, on the day of admission to hospital. Epigastric tenderness was present; albumen appeared in the urine on the second day of the illness and disappeared on the following day. The urine

was very small in quantity and contained a few blood corpuscles and hyaline casts on the second day only. The pulse rate did not fall when the temperature dropped. The liver and spleen were not enlarged. The temperature on admission was 104° F., rose in the evening to 104·5° F., fell on the second day to 101° F., and became normal on the third day. No malaria parasites were found in the blood.

"CASE 2.

"Private, Northern Territories Constabulary. There was frontal headache and photophobia, very slight jaundice in the scleræ. Epigastric tenderness and a good deal of vomiting both on the first and second day of illness. Albumen was large in amount on the first day of illness, and diminished on the second and disappeared on the third day. There were a few blood corpuscles seen in the urine on the first and second days of the disease, also hyaline casts. Tongue was very furred at the back but clean at the edge. Malaria parasites were not found.

"There was no hepatic enlargements, Faget's sign was absent, but the pulse rate fell to 58, when the temperature dropped. Hyaline casts were present in the urine on both days of examination.

"The temperature on admission was 104° F., and fell to normal on the second day. Pulse 100 on admission, 58 on the second day."

Two other cases of a suspicious character but with less marked symptoms occurred about the same time.

None of these cases have been classified by the Commission.

(*C*)—OUTBREAKS IN 1915.

NIGERIA.—SOUTHERN PROVINCES.

(*a*) BURUTU.

A fatal case in a native, locally diagnosed as Yellow Fever, was reported by telegram on September 23rd, 1915.

(*b*) ONITSHA.

On September 13th, 1915, a fatal case in a native prisoner, locally diagnosed as Yellow Fever, was reported by telegram.

On September 16th a second case was reported from Onitsha, also in a native.

In consequence of these two cases Onitsha town was declared infected on September 16th. On October 9th, no fresh cases having occurred, Onitsha was declared to be free from Yellow Fever.

(c) ENGENNI RIVER.

On October 13th, 1915, five cases of Yellow Fever in natives were reported by telegram to have occurred at a camp known as "Engenni Concessions," on Engenni River, twenty miles from Degema.

The place was declared to be infected, and the necessary precautions were taken.

The Engenni River during the period of the year in which these cases occurred is a highway between the River Niger and Oguta, to Degema and Bonny; steamboats are then able to travel up and down the river.

The Labourers' Camp, where the two deaths took place, is situated on the right bank of the river, three miles below the village of Abumi, below its junction with the Egboribiri creek, twenty miles distant from Degema. Communication with other places is by canoe, dense forests and swamps preventing overland traffic.

None of the labourers had been away from the camp since the 16th August, 1915, with the exception of going into the uninhabited forest to fell trees; no fresh labour was imported into the camp between 16th August and 26th September.

No unusual disease was known to be prevailing at the camp before the 26th September. The history of the two fatal cases was obtained by Dr. T. R. Beale-Browne, the Medical Officer at Degema, who visited the camp immediately on the receipt, on October 8th, of information from the agent for the timber concession that two labourers had died under peculiar circumstances, and that three or four other labourers were ill.

"CASE 1.

"Akorisa.—Came to the concession as a labourer, having left Newi district at the beginning of August, and arrived on or about August 16th.

"On 25th September he was said to have been quite well, and was at work.

"On the morning of September 26th he did not look well, felt ill, and was told to rest in the camp.

"About 11 p.m. on that day he was reported to be vomiting blood and died comparatively suddenly shortly afterwards. His only complaint was of a violent headache.

"There was no history of fever, but in the report it is stated that 'all accounts are most meagre.'"

"CASE 2.

"Chukuma.—Came to the camp on the same day (August 16th) and from the same district. He was ill for three days before death. All that could be ascertained was that he was taken ill on or about the 3rd October.

"He had fever and diarrhœa and felt weak, but did not vomit. Just before death he had a convulsion. Death occurred on 5th October."

Two of the following cases were taken ill about October 6th, two about October 7th, and one on or about October 9th. All, with the exception of one, Obi (Case 6), a native of Kwali, who arrived at the Camp in January, 1915, were natives of the Onitsha district and arrived in camp on 16th August, 1915.

"CASE 3.

"*Name*: Obi Yasobili.

"*Age*: 20 (about.)

"*Occupation*: Labourer.

"*Tribe*: Ibo.

"*Previous history*: Recruited from the Onitsha district (Newi) at the beginning of August, and arrived at the timber camp about the middle of the same month, where he has been ever since.

"*History of present attack*: Became unwell on the evening of 9th October; complains of great pain in back and head; a general ache all over him.

"*Condition when seen*: A small youth of poor physique, seen on morning of 10th October; he was then suffering from severe pain in back, limbs, and head, seemed hardly able to move about. Eyes injected and puffy. Heart, lungs, spleen, and liver normal. Has passed only a little urine, and that very dark before visit; tongue narrow and red at edges but not much furred in centre. Temperature, 100·4°. Pulse, 120.

"11th October: Temperature, 103·6°. Pulse, 128; skin dry and hot, eyes still injected and yellowish. Passing only small amount of urine, the colour being very dark ('palm oil.'). This is acid in reaction—has a large amount of albumen in it and bile pigment. Has a peculiar smell.

"12th October: The symptoms are the same, violent pains, eyes are more yellow. Urine still passed, only in small amounts and very dark and albuminous.

"13th October: The peculiar smell, first noticed on 11th, is present, but not so noticeable.

"14th October: Temperature rose on this day to 101·8°; he seems no worse; urine is more freely passed.

"15th October: Temperature coming down again; urine still dark and contains albumen and bile pigment. Still has great pain in head.

"17th October: Is now much better; only a trace of albumen; says he feels all right."

"CASE 4.

"*Name*: Peter.
"*Age*: 23 (about).
"*Occupation*: Labourer.
"*Tribe*: Ibo.

"*Previous history*: Recruited at beginning of August in the Onitsha district and arrived in the timber camp about middle of same month, where he has resided ever since.

"*History of present attack*: Had pain in head and legs, also knees, about 7th October, the exact date is a little uncertain. The interpretation was very poor and much trouble in getting details.

"*Condition when seen*: Says he is better, but has a headache and pains in knees and lower parts of legs. The heart, lungs, spleen, and liver normal. Temperature, 100·4°. Pulse, 102. Eyes seemed normal, slight injection. On 10th October scleræ were yellowish. Urine was pale and clear—alkaline, trace of albumen.

"12th October: Seems to be quite well and feeling well. Complaining as he did, and seeing condition of his fellow sick, he was classed as Yellow Fever, but if seen by himself he would not have been so diagnosed."

"CASE 5.

"*Name*: Obashuru.
"*Age*: 22 (about).
"*Occupation*: Labourer.
"*Tribe*: Ibo.

"*Previous history*: Was recruited in the Onitsha district—near Newi—in the beginning of August, 1915. He arrived at the timber camp on or about 16th August. He gives no account of previous fever similar to what he is now suffering from.

"*History of present attack*: On or about 6th October he complained of pain in the back and legs and felt ill. He had fever. Bowels were not acting well, so had a dose of salts which acted well.

"*Condition when seen*: A poor, weak specimen. Complains of great aching pain in back and limbs, especially legs. His eyes are congested with a yellow tinge.

"Tongue is very narrow, rather dry—red at edges and the centre furred. Heart, lungs, liver appear normal. Spleen is a little enlarged. Urine, which was small in amount, is now being passed better. It is of a dark brown colour, like 'palm oil'; the froth is yellow. Reaction acid, albumen was present in large quantity. Bile pigment, also on 10th; the day after first seen his eyes were much yellower.

"This state of affairs continued—only the urine increased in quantity and less dark in colour till 16th October, when urine was normal. He was then feeling well but weak. Eyes still yellow, but fading.

"The symptoms that he most complained of were persistent headache. There was no vomiting: Faget's sign was not present."

"Case 6.

"*Name*: Obi.
"*Age*: 23 (about).
"*Occupation*: Labourer.
"*Tribe*: Ibo.

"*Previous history*: He came from the Kwali district in about January, 1915, and came to the timber camp, where he has been ever since, his work being to go into the forest to cut timber. He had no communication with the local natives, as the camp is isolated. Says he has never had, or seen people with an illness like what he has had.

"*History of present attack*: On or about 6th October, 1915, he became ill with severe pains in stomach, back, and head, but says he has not had fever (interpretation is bad).

"*Condition when seen*: Complains of great pain in stomach, chest, back and head. Tongue is red, but not the peculiar narrow red edged. Spleen normal. Heart, lungs, liver, normal; eyes are yellow and somewhat injected. The urine was small in amount, very dark, colour of 'palm oil'; loaded with albumen, and with bile pigment.

"12th October: The specific gravity of urine was 1015 (urinometer is questionable); acid, still dark, and containing albumen and bile, but only in small amount compared to previous samples. The symptom most complained of was frontal headache, otherwise he said he felt well.

"13th October: Said he felt all right, only a trace of albumen in the urine. Eyes have only a yellow tinge.

"15th October: No albumen in urine, says he feels all right."

"Case 7.

"*Name*: Obioko.
"*Age*: 22 (about).
"*Occupation*: Labourer.
"*Tribe*: Ibo.

"*Previous history*: Recruited in the Onitsha district (Newi) at beginning of August, and arrived in timber camp about 16th August, 1915. He has had no communication with the local inhabitants.

"*History of present attack*: Has been unwell since 6th or 7th October, with great pains in epigastric area and back. There is no history of vomiting. Has had a cough recently.

"*Condition when seen 9th October*: Complains of great pain in stomach and back and head. Conjunctivæ puffy and injected. Tongue narrow, bright red at edges, furred in centre. Heart, normal. Lungs, some râles and rhonchi. Spleen, slight enlargement; liver normal. Urine very dark ('palm oil'), acid; large amount of albumen and bile pigment.

"10th October: Lungs clear; urine the same, also symptoms. Temperature, 101·8°. Pulse, 95. Eyes yellowish.

"12th October: Eyes still injected but more yellow; albumen in the urine, also bile.

"13th October: Urine pale, acid; trace of albumen.

"15th October: Urine to-day was much darker and had a greenish yellow tinge; trace of albumen and bile pigment.

"18th October: Is now all right; feeling well, only a little weak."

The following extracts are from the Report of Dr. T. R. Beale-Browne, Medical Officer at Degema, to the Principal Medical Officer, Lagos. It is possible that owing to the prompt action taken the outbreak was prevented from developing into a serious epidemic, but before accepting it as proved that this was the case it would be necessary to know whether the labourers not affected had, by previous attacks, been rendered immune to the disease.

"Precautionary Measures Taken.

"1. Immediately it was appreciated that the illness was not an ordinary one, the huts were as efficiently stopped up as possible and sulphur candles burnt.

"Certain huts were apportioned to the sick, with orders that they lived by themselves, all the other labourers to keep apart.

"The sick were kept under mosquito nets; the difficulties of taking these apparently simple precautions were great. Rain pouring all day—for days—the camp being more or less under water. The only way to get about the camp was wading in inches of mud and water. The huts were of a very poor construction; added to this, the river was rising. This caused great trouble in the new camp formed three miles lower down the river.

"2. As the floors that were to be were under water quite soon, this necessitated raising the inside of the houses.

"3. As soon as the labourers who were well had made sufficient shelters to protect them from the rain in the new camp they all left. Then the huts they had occupied were burnt down.

"4. Leaving only the contractor's house, which the sick then occupied.

"5. In addition to these local precautions, more general ones were taken. The District Officer, Ahoada, arranged for traffic from his district not to go to the infected area; a patrol being set to stop canoes going down or up.

"6. At the Degema end all traffic was held up from down the Engenni as much as possible, but, for determined people, it was easy to evade the guard, as there are so many creeks; so the District Officer, Degema, called a meeting of all the Abonnema chiefs, and, with the Medical Officer, the whole matter was put before them, and the whole of Abonnema was divided up so as to have the whole place watched, and all canoes coming from Oguta way to either go back or land and be quarantined.

"All natives on their farms on the river were told that they must not go to the infected camp.

"There were very few people on these river farms as the water was so high."

* * * * *

"7. Insects.—In the old camp, mosquitoes were breeding everywhere. All the larvæ at first collected were *Culex* and *Anopheles*, and only a few of the latter. As time went on, and the ground began to dry, in the few places that escaped being paraffined, with few exceptions, the larvæ hatched out into *Anophelines*.

"Endeavours to find *Stegomyia* were fruitless; the mat roofing was disturbed and an entomological net waved to catch anything, but no mosquito was caught. Many of the ponds or puddles were treated with kerosene, but this was limited.

"The bush around was beaten and all flying things caught, but this was resultless as far as mosquitoes. Nevertheless as soon as evening approached the whole place swarmed with mosquitoes and sand-flies. Personally I only saw *Anophelines*, and I also always left the camp before sunset.

"Of other biting flies *Tabanidæ* are very common, and only a very few tsetse flies have been seen, and the latter near Degema."

The following extract is from the Report of the Principal Medical Officer to the Secretary, Southern Provinces, Lagos:—

"9. There is no evidence of the introduction of the disease from without.

"10. No further cases have occurred.

"11. In my opinion, these cases add further proof of the occurrence of Yellow Fever among the natives of Nigeria. Indeed, there can be no question of their immunity, the evidence of their

susceptibility is steadily increasing, though they may have it in a remarkably mild form."

These cases have not been classified by the Commission.

The following case, which occurred in January, 1914, is inserted here, as it acquires additional interest from the outbreak of Yellow Fever reported above.

It will be seen that whereas the pathological report states that there was evidence of advanced alcoholic cirrhosis of the liver, a complication of the most dangerous character in any case of Yellow Fever, yet the substance of the organ is stated in the post-mortem report to have been "soft and friable and flabby in the extreme." These conditions are hardly consistent with advanced alcoholic cirrhosis. It must, however, be remembered that decomposition may proceed very rapidly after death in the tropics.

The deceased was employed on the Engenni River, and had gone up the river from Degema.

"Report of a Case from Dr. Tipper, Onitsha.

I.R., Vol. I., pp. 311-312.

"The body of a European was brought into Onitsha at 11.30 p.m. on the 13th January, 1914, death having occurred shortly before, outside Onitsha, at Newi. A letter that accompanied the deceased stated that he had been suffering from 'bilious fever' for some days previously, and had been treated by the Medical Officer at Ogouta, and that quinine had been used.

"Autopsy was performed 16 hours after death.

"*Skin.*—Universally bright yellow in colour. Conjunctivæ showing hæmorrhagic injection at lower and outer corneo-sclerotic junction. Scleræ bright yellow. Undue post-mortem staining of the right arm and dependent parts of the back and legs. There was some dark red blood streaming from the angle of the mouth which had obviously been vomited.

"*Stomach.*—A bluish-black, semi-coagulated mucus covered the surface of the interior. Here and there was seen very dark coloured blood, similar to that found issuing from the mouth. The mucous membrane was of a black colour but mottled, the black portions alternating with the red patches. The rugæ were easily broken. The peritoneal surface was almost black, but dull red patches and ecchymoses occurred here and there.

"*Liver.*—A bright yellow ochre colour. The anterior parts of the under surfaces of the right and left lobes were black. On section, bright yellow. The substance of the organ was soft and friable and flabby in the extreme.

"*Lungs.*—These were universally black, soft and friable. On the lower lobe of the left lung there was a large patch of blood extravasation into the pleura. No pneumonic or other consolidation present. Sections floated in water.

"*Intestines.*—Dirty yellowish white in colour. Peritoneal surface showed subperitoneal hæmorrhages. Mucous membrane had a bruised appearance due to the blood within the interstices of the tissues.

"*Heart.*—The whole organ was flabby, fat was bright yellow in colour. Muscular fibres were deep red in colour. Valves were normal.

"*Spleen.*—Slightly enlarged, softer than normal.

"*Kidneys.*—Slightly enlarged, pale yellowish infiltration of the cortex.

"*Bladder.*—Empty, normal.

"*Brain.*—Congested, ventricles contained fluid of a light lemon colour.

"LABORATORY REPORT.

"*Spleen.*—Congested, some black pigment present.

"*Brain.*—Congested, round-celled infiltration present.

"*Liver.*—Advanced necrotic changes, fatty degeneration present.

"*Kidney.*—Epithelium of convoluted tubules necrosed and desquamated in parts; elsewhere showing cloudy swelling and marked fatty changes. Glomerular tufts swollen and congested. Lumen of tubules mostly blocked by desquamated cells and debris.

"*Previous history of the case.*—The deceased was employed on a survey of the Engenni River and had gone up the river from Degema. He left the vessel at Akara Queri on the 2nd January, and proceeded to Ogouta, where he arrived on the 6th. He got ill at Ogouta, and suffered from fever with vomiting. On the 9th he was seen by the Medical Officer, Owerri, who apparently formed the opinion that he was suffering from 'bilious remittent fever.' The Medical Officer was called away on the 10th, and on the 13th the patient seemed to have become delirious and was sent off in a hammock by the Agent at Ogouta to Onitsha Hospital, but patient died shortly before arriving there.

"The infection in this case was contracted at some point between Degema and Ogouta, possibly on the ship itself or at some native town where the deceased had stayed on the way up to Ogouta. No blood examination records, or any notes or temperature chart of the case are available."

NOTE BY COMMISSION.

"Pathological material from this case was examined by Dr. A. C. Stevenson, of the Wellcome Bureau of Scientific Research, who made the following report:—

"*Liver.*—Fairly advanced cirrhosis—lobules practically indistinguishable—areas of fatty degeneration. Other areas, larger, show

well-marked necrosis, some, no doubt, due to post-mortem change. No signs of acidophilic change. Pigment, malarial in appearance; soluble in acid alcohol.

"*Kidney.*—Advanced cirrhotic change; thickened capsule with fibrous tissue spreading from it between the tubules. Marked thickening of Bowman's capsule. Cloudy swelling of convoluted tubules towards the surface of the kidney. Straight tubules full of desquamated epithelial cells. In some parts of intermediate zone complete necrosis (? partly post-mortem). Desquamation in tubules of papillary region. Concretions in some tubules. Pigment, malarial in appearance, in Malpighian tufts; soluble in acid alcohol.

"*Spleen.*—Congested, excess of small round cells. Some fibrous increase and thickening of vessel walls. Malaria-like pigment.

"*Brain.*—? softening—many round spaces in some of which are bacteria which are also seen in blood vessels (? post-mortem). A fair number of concretions (psammomata). Capillaries mostly empty—small vessels engorged. In the endothelial cells of the capillaries small quantities of malaria-like pigment are seen.

"REMARKS.—No definite signs of Yellow Fever, but those of advanced alcoholism."

(*D*)—ANALYSIS OF EPIDEMICS.

(1) INCIDENCE ON EUROPEANS AND NATIVES.

We have analysed the various epidemics with which we are now concerned in order to illustrate the incidence of the disease, so far as the information is available, upon Europeans and natives. Two very important facts have, however, to be borne in mind in order to avoid erroneous conclusions from these data, viz.:—

(1) The probability of a case of Yellow Fever being recognised as such is infinitely greater in a European than in a native, and

(2) The European population in most of the large towns is, from a numerical point of view, almost negligible as compared with the native.

The greater case mortality in the Lagos epidemic of 1913 amongst the Europeans as compared with the natives is very striking, but only confirms what has been so often observed elsewhere.

That it does not obtain to anything like the same degree in the other epidemics is presumptive evidence that not nearly all the native cases were recognised: —

	Cases.	Deaths.
1910.		
Sierra Leone, Freetown:—		
Syrians	9	9
Europeans	7	5
Natives	4	2
Gold Coast, Seccondee:—		
Europeans	10	9
Natives	2	2
Hausa	1	1
Saw mills:—		
European	1	1
Axim:—		
European	1	1
Nigeria, Lagos:—		
Natives	2	2
1911.		
Gold Coast, Accra:—		
Europeans	7	7
Natives	3	0
Avrebroo:—		
European	1	1
Gambia, Bathurst:—		
Europeans	12	10
Syrians	3	2
1912.		
Gold Coast, Accra:—		
European	3	2
Native	1	1
Labadie:—		
European	1	0
Seccondee:—		
European	1	1
Axim:—		
Native	1	0
1913.		
Nigeria, Lagos:—		
Europeans	15	7
Natives	20	0
Syrians	3	2
1914.		
Lagos:—		
Europeans	2	0
Natives	0	0

(II.) INCIDENCE ON COAST TOWNS AND TOWNS OF THE INTERIOR.

Although it is true that all the epidemics of 1910-1911, 1912 and 1913 occurred in towns on the coast that fact is not necessarily of great significance, as with the exception of Coomassie nearly all the large towns in the West African Dependencies* are situated upon the coast, and it is only in a large town, and one in which there are a certain number of Europeans, that the occurrence of an epidemic is likely to attract attention.

In the Second Report (p. 135) under the heading "Epidemics of Yellow Fever of a severe type amongst natives" the following occurs:—

> "At the same time other and at first sight contradictory evidence is increasing, tending to show that amongst the natives living in regions either distant from the coast, or from the European settlements on the coast, epidemics of a disease which cannot be distinguished from Yellow Fever are of occasional occurrence, and that such epidemics are attended with a very high mortality."

Four examples of these are given, and they still remain the only outbreaks of the kind of which we are aware.

If these epidemics were really due to Yellow Fever, and no other disease capable of producing such a clinical picture is known, it would appear to be possible that the natives of Africa living in the interior possess a lesser degree of insusceptibility to the disease than those of the coast.

It is by no means improbable that this should be so, as the disease has, so long as we know something of its history, always prevailed upon the coast, and, speaking generally, any people which has been for many generations attacked at frequent intervals by an epidemic disease is likely to possess a higher degree of resistance to it than one not so circumstanced.

The large number of sporadic outbreaks which have been reported since the appointment of the Commission is, however, as already stated, clear proof of the wide distribution of the disease during that period, and it is extremely unlikely that they represent anything exceptional, save a wider recognition of the endemic presence of the disease.

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* Only one case is known to have occurred in the Northern Province of Nigeria.

(III.) INCIDENCE ON NEW-COMERS, EUROPEAN AND AFRICAN.

(*a*) From Outside Africa.

Yellow Fever is pre-eminently a disease affecting new-comers.

The first case in the Freetown epidemic of 1910 was a Syrian, and seven deaths occurred amongst Syrians between April 17th and May 25th. These were not all classified as "Yellow Fever" for reasons already given (*vide* p. 47), but there can be little doubt that they were all fatal from that disease.

In the commentary upon this epidemic (Second Report, p. 113) the following appears: —

> "(1) A knowledge of the movements of the Syrian (Case 1) for (say) six weeks prior to April 17th would be of interest, but there is no reason to believe that he landed from an infected ship. There is no evidence that the disease was imported. Six fatal cases had occurred amongst the Syrians before an Englishman was attacked; he had been 'long resident in Freetown.'
>
> "Europeans and Syrians, naturally, in West Africa constitute almost entirely the 'New-comer' class, but this is not tantamount to stating that they are all recent arrivals, as some of them may have been on the coast, with intervals of absence, for many years."

Several instances are mentioned in the course of this Report of two cases occurring about the same time and at the same place, one fatal, the other ending in recovery, in which the patient who died was a recent arrival, and the patient who recovered had been some time on the Coast.

(*b*) From the Hinterland to the Coast.

Freetown Epidemic, 1910.

One of the Syrians (Case 8) amongst whom this epidemic began had been travelling in the Protectorate before the onset of his illness, and may be considered as at the time a newcomer to the Coast.

Case 11, a Government official, was a new-comer in two aspects—firstly, as being without tropical experience, having only been six and a half months on the Coast, and, secondly, as having recently been travelling in the Protectorate. He was taken ill at Yonni in the Moyamba district, and is classed as an "ambulant" case.

In the Seccondee epidemic of 1910 Cases 28 and 29 were natives, but not resident in Seccondee.

At Accra in 1911, Cases 43 and 44 were non-native of Accra, but both patients had been in Accra for some months.

(*c*) From other Parts of the Coast.

In the Seccondee epidemic of 1910 it is possible that the disease was introduced from Accra.

In the same year the disease was probably carried from Seccondee to Axim, but no further case occurred there. In the same year after the outbreak at Seccondee was at an end, a patient who died from Yellow Fever was brought to that town from Saw Mills Camp, 12½ miles by rail, but there was no recrudescence of the disease at Seccondee.

In 1910 the disease was brought to Lagos from Ilesha by a native who died. Nine days later another negro died from the same cause at Lagos. Both these cases were classified as "Probably Yellow Fever."

In 1912 the disease was probably carried from Accra to Weshiang, but no further cases occurred.

(IV.) INCIDENCE ON SAILORS AND PEOPLE HAVING TO DO WITH SHIPPING.

In the outbreak at Warri in 1913 both the patients were employed on shore, and slept in their own quarters, but as they were agents of trading firms and worked in a store close to the beach, they are included in the class of people who have to do with shipping.

No light was thrown upon the source of infection in these cases, and neither of the patients had been absent from Warri for more than a month before the onset of the illness. There was no suspicion of the disease having been introduced by an infected ship, but in discussing these cases it is noted that "the facilities for conveyance of *Stegomyia* to the premises of the firm in question by water transport are considerable."

I.R., Vol. I., pp. 156–177.

In Section III. of Dr. E. J. Wyler's 4th Report the nature of 33 cases of fever on ocean-going vessels and dredgers in 1912 and 1913 is discussed at length. Six of these were natives of West Africa, the others were Europeans, all except one being sailors. Twelve of

these cases were diagnosed locally as Yellow Fever, the remaining twenty-one were not so diagnosed, but of them it is stated that whilst "some are characterised merely by certain suggestive features, others are undoubtedly highly suspicious."

(v.) EFFECT OF TRAFFIC BY LAND AND BY SEA AND CHANGES THAT HAVE TAKEN PLACE IN THE COURSE OF YEARS.

The introduction of railways has no doubt increased the possibilities of transference of the disease from an infected area to places distant and either at the time, and possibly hitherto, free from infection. The Abeokuta case (*vide* p. 54) was closely investigated from this point of view, and it appeared that the average number of natives travelling per day between that place and Iddo (the railway terminus for Lagos) during March, April and May, 1913, was 110. The journey occupies between three and four hours. It did not, however, appear that any suspicious cases or suspicious high mortality had occurred on the line of railway between those two places.

Dr. Wyler discusses the possibility of the disease having been introduced into Abeokuta viâ the Dahomey-Nigeria boundary, and shows that in the villages and towns which would most naturally be selected by a trader as stopping places *Stegomyia fasciata* are to be found.

The traffic between Dahomey and Abeokuta is constant, and the routes are various. If therefore Dahomey should prove to be an endemic area (*vide* p. 244) the occurrence of cases in Abeokuta ceases to be as astonishing as at the time it seemed.

(vi.) EFFECT OF THE SEASON OF THE YEAR.

The exceptional prevalence in West Africa of severe types of fever, variously named, at the time of "the rains" has long been observed. The following references to this fact occur in Dr. Lind's work, and are quoted in the Second Report (p. 17): —

> "I am informed by a surgeon who practised some years at Senegal that for several months of the year during the dry season the country was as healthy and pleasant as any in the world: but soon after the rainy season began a low malignant fever constantly spread itself among the Europeans."

"The most mortal epidemic, however, is that low malignant fever of the remitting kind which rages only in the rainy season."

The despatch of the Governor of Sierra Leone, quoted on p. 32 of the Second Report, begins as follows:—

"During the months of May and June the season of heavy rains sets in on this portion of the African Coast, after an almost uninterrupted period of drought of about five months' duration. Experience has shown that during the early period of this rainy season the malarious influences of the soil, which are at all times powerful, show a marked increase in activity and virulence. Cases of malarious fever become more than usually numerous, and the disease itself, in many instances, assumes a more than ordinarily severe form. The history of Sierra Leone shows that, at intervals, seasons have recurred which have been marked by exceptional unhealthiness and by the development of the ordinary malarious fever into fevers of a most malignant type."

It would seem, however, from what appears in a medical report enclosed in the same despatch that, at any rate, as regards Yellow Fever, this dependence upon the rains was not invariable, *e.g.*, "In 1823 Yellow Fever was epidemic, commencing in the earlier part of the year, the so-called healthy or 'dry season,' and running on through the early rains and ending with the 'heavy rains.'"

The epidemic of 1829 was stated to have been "most prevalent during the blowing of the westerly winds and the falling of the heavy rain."

In 1837 the disease "commenced amongst the Europeans in the month of April, but many very suspicious cases of endemic, remittent, and the so-called African fever, occurred during the month of January, and two cases died having distinct black vomit."

The following extracts are from Staff-Surgeon Gore's Report (*vide* p. 31):—

"The first case amongst the troops was on May 11th (1837). The violence of the disease declined with the maturity of the rains. The interval between the occurrence of new cases gradually decreased with the saturation of the ground and atmosphere with moisture, until it quietly ceased * * * * * *."

"In 1847 the disease appeared epidemically in Freetown during June, July and August: only 38·85 ins. of rain had fallen in these months, and hot dry days were of frequent occurrence."

"In 1866 when the heavy rains set in they succeeded in arresting the spread of the malignant fever, which during the early weeks of the quarter ending June 30th was so fatal to the inhabitants."

The following paragraph summarises and repeats the conclusions : —

> " While the rainy season (June, July, August, September) must be considered the most unhealthy and that during which, as a rule, the ordinary fevers are most prevalent and severe, particularly at its commencement and close, it is equally certain that when the rains are slight and intermittent, grave forms of disease frequently occur, more especially of the Malignant, Remittent or Paludal Yellow Fever. This disease has almost always been arrested by a heavy rainfall in Freetown. Isolated cases have been observed during the rains, but very rarely. The heavy rain usually causes it to merge into the ordinary remittents of the Colony, in some years exhausting itself in these forms ; in others only lying dormant and again appearing at the close of the wet season. The ships belonging to the naval squadron, isolated timber and other vessels have been occasionally visited by extraordinary outbreaks of remittent fever, although distinct from the malignant Yellow Fever which has at times prevailed epidemically in this Colony, have nevertheless occasionally almost rivalled that disease in its great characteristic of deadliness. They have always occurred at the close of the rainy season or immediately after."

It is probable that " an extraordinary outbreak of fever characterised by great deadliness " occurring in those days at Sierra Leone was really Yellow Fever.

In 1894, at Freetown, malarial fever of a pernicious type appeared in February, and prevailed in May, June, July and August.

There are numerous records of the prevalence of Yellow Fever at Freetown and elsewhere on the coast during these latter months.

In Senegambia there are records of the occurrence of Yellow Fever " in the early part of the year " in 1900 and 1911, and cases continued to occur in January, February and March, 1912.

In the Soudan the epidemic of 1828 is said to have begun at Christmas. On the Ivory Coast there was an epidemic in 1857 which began in February, and in 1903 another which commenced in January.

In 1896 an epidemic of a malignant type of fever was prevalent during the first four months of the year on the Gold Coast.

In 1905 in Togoland, cases of Yellow Fever occurred in January and February, and in the same year, and during the same months, at Agoué, Ouidah and Grand Popo in Dahomey.

Assistant Surgeon Eames (*vide* Second Report, page 89) records an outbreak on the River Bonny in March, 1862, which was fatal to 130 white inhabitants out of 163 in three months.

The above evidence, which might easily be increased, is sufficient to prove that in the past Yellow Fever has not been limited to the period of "the rains," although it is certainly more prevalent at that period of the year.

The following table shows the months in which the epidemics of 1910 and the succeeding years began and ended: —

	Began.	*Ended.*
	1910.	
Freetown ...	April 7th ...	September 15th.
Gold Coast ...	March 10th ...	May 25th.
Axim ...	July 6th ...	—
Sawmills ...	July 18th ...	—
Lagos ...	July 26th ...	August 5th.
	1911.	
Accra ...	February 19th ...	June 22nd.
Avreboo ...	June 22th ...	—
Gambia ...	May 18th ...	November 21st.
	1912.	
Accra ...	April 10th ...	June 27th.
Labadi ...	July 19th ...	—
Seccondee ...	May 17th ...	—
Axim ...	December 5th ...	—
	1913.	
Grand Popo ...	February 19th ...	March 12th.
Accra ...	March 15th ...	April 14th.
Warri ...	June 13th ...	June 30th.
Accra ...	June 16th ...	July 3rd.
Lagos ...	July 21st ...	September 16th.
Lagos ...	October 4th ...	November 5th.

For all the above periods quarantine was declared.

The following are single cases for which quarantine was not declared: —

	1913.
Saltpond	January 18th
Grand Popo—Agoué (Dahomey) ...	May 2nd
Abokobi (Gold Coast)	May 14th
Quittah (Gold Coast)	July 2nd
Lome (Togoland)	September 13th
Forcados (Southern Nigeria)	October 20th
Lagos	November 26th
,, ...	December 24th
,, ...	December 28th

It would appear therefore that although by far the greater number of epidemics of Yellow Fever on the West Coast of Africa have occurred during the rainy season, yet there is no month in the year during which the disease may not be met with, even in an epidemic form.

If we assume the correctness of these various observations, and there appears to be no reason for not doing so, as they are confirmed by experience on other parts of the West African coast and elsewhere, they can be explained in the light of our present day knowledge of the two diseases, Malaria and Yellow Fever, with which we are certainly and mainly dealing, by the fact that speaking generally the conditions described favour the multiplication of mosquitoes, both *Anophelines* and *Stegomyia*, and therefore tend to favour the incidence of the diseases of which they are the carriers. It is not, however, at first sight so easy to explain the statement that slight and intermittent rains favour the occurrence of epidemics of Yellow Fever.

Some researches of Mr. Bacot, which are described in the section on Mosquitoes (*vide* p. 220), throw a new light upon the influence of moisture and rainfall in producing a sudden increase in the number of mosquitoes, and afford a probable explanation of the connection between a slight rainfall and disease on the West Coast of Africa.

The researches of Mr. Malcolm Evan MacGregor at the Wellcome Research Bureau on the life history of *Stegomyia* bred from the eggs on the dried leaves sent home by Mr. Bacot, are also of great interest (*vide* p. 235).

(VII.) INTERVALS BETWEEN EPIDEMICS.

"The History of Yellow Fever," by Augustin, to which frequent reference is made in the Second Report, contains a summary of the Yellow Fever years, and the periods of immunity in Africa from 1494 to 1907.

It cannot be supposed for a moment that the list of epidemics therein given really represents the true incidence of the disease on that part of the world during that period, but it is probable that few severe epidemics amongst Europeans in the later years have been omitted. What was happening amongst the natives at the same time is unfortunately not known.

Starting at the year 1778, which for reasons given in the Historical Retrospect (*vide* Second Report) we have fixed as the earliest trustworthy record of its presence on the Coast, we find that in the 130 following years 70 Yellow Fever years are included.

The number of these years contained in each decade is as follows: —

	Epidemic years.
1778-1787	3
1788-1797	1
1798-1807	3
1808-1817	6
1818-1827	9
1828-1837	4
1838-1847	5
1848-1857	7
1858-1867	8
1868-1877	4
1878-1887	6
1888-1897	4
1898-1907	10
130	70

During the following periods, viz.: —

From 1821 to 1830
„ 1852 „ 1860
„ 1862 „ 1869
„ 1897 „ 1907

the disease was continuously in evidence.

In the table showing the incidence of Yellow Fever in the West African Dependencies from 1900 to 1914 given in the Second Report (*vide* page 139) the only year in which it seems to have been absent is 1909, the year immediately preceding the epidemics which attracted special attention, and led to the appointment of the Commission.

During the period from 1778 to 1907 the longest interval of apparent freedom was from 1793 to 1803, eleven years; the next was from 1831 to 1836, six years; the total of the free years is 60.

A study of the periods of prevalence and of apparent freedom gives no indication of the existence of any cycle or law of periodical recurrence, and it is very unlikely that such exists.

* Evidence has since been obtained of the presence of the disease at Phillipville, in French Gaboon, in July, 1909.

It is, however, highly significant that from 1897 to 1914, a period during which attention has been much directed to tropical diseases, Yellow Fever has been continuously observed in the Dependencies on the West African coast, with the exception of only one year.*

In the Second Report (page 37), under Sierra Leone, a list is given of the periods between the years 1807 and 1884 during which no mention is made, in a report of the latter date, of the presence of Yellow Fever in that Colony. The intervals vary in duration from four to ten years, and it is remarked that "it would be of great interest to determine whether the disease was really absent during these periods, but it is very unlikely that the most diligent search amongst the records would bring to light evidence of a convincing character." It is the same with every other Dependency upon the West Coast.

The Commission has elicited no evidence which either proves or suggests that during these intervals the disease is continuously present either amongst the Europeans or amongst the native inhabitants of every place where its presence, at some time or other, has been recognised. It may be there, but the fact has not been *proved*, and it is, in their opinion, more probable that continuity is maintained by the existence of endemic areas and endemic foci than by its continuous and universal prevalence in a mild form amongst the native population, in the same way that Malaria may be said to be continuously and almost universally present.

Such foci may also conceivably lead, through movements of man or mosquito, to the establishment of new or secondary foci, in which a similar "smouldering" of infection may be maintained.

The fact, which has been proved, over and over again, during the period covered by the work of the Commission, that the natives, as a whole, are susceptible to Yellow Fever, although they usually have it in a mild form, is conclusive against the theory of its universal prevalence amongst them. Having regard to the rarity of second attacks occurring in the same individual, it is clear that Yellow Fever belongs to that class of diseases which is characterised by the fact that, as a rule, immunity is conferred by a single attack. Exceptions occur, however, in the case of each of these diseases; and there is no reason to believe that the exceptions are more numerous in the case of Yellow Fever than with the others; indeed,

* But *vide* footnote on opposite page.

it is probably true that they are less numerous. No one, indeed, denies that in the separate towns of each Colony, in which Yellow Fever has at some time appeared, there are periods during which it is not present among the Europeans. It is not, however, so easy to disprove its continued presence amongst the natives.

The question of real interest is, "What happens to the virus in these intervals of absence or inactivity?"

Upon this it is easy to speculate and advance theories, but so long as we lack the means of identifying with certainty the minor manifestations of the disease amongst the natives, all such labour is useless.

It may, however, be well to point out that we know just as little of the life history of the virus of such a common affection as Measles, although the opportunities of observing and studying that disease have been immeasurably greater than with Yellow Fever. Measles appears in, say, a village, the epidemic runs its course and the disease disappears from the village, but not from the country. After an interval of varying duration it reappears, without in many cases the source of reinfection being discovered, yet it is not suggested that it has really been present in the village all the time.*

But in a country in which a disease is constantly met with, the virus, if not again and again introduced, must in some way be kept in a condition of potential activity.

Apart from some animal, or man or the mosquito, and the native must be the man, and the *Stegomyia* the mosquito, we have no knowledge as to how this can be effected in such a disease as Yellow Fever, and naturally it is around man and the mosquito, both known to be concerned, that discussion centres as the possible "reservoir."

How the solution of this difficult problem may possibly be reached is discussed in the section of the report dealing with "Suggestions for further research" (*vide* page 253).

SECTION VIII.

TYPES OF THE DISEASE IN THE WEST AFRICAN DEPENDENCIES.

In the Second Report (p. 129) we have already discussed the clinical types of Yellow Fever as observed in various parts of the world.

* We hear, however, that the suggestion is about to be made.

The concluding paragraphs of that section are as follows: —

"From Ocean Springs as a centre Yellow Fever was carried to nine states and forty-two cities. The total number of cases officially recorded from September 4th, 1897, to December 25th, 1897, was 4,426, and the deaths numbered 494. In these figures the cases variously given as 500, 600 and 700, which occurred before the disease was officially recognised, are not included.

"It would be difficult to find a more complete illustration than is afforded by the record of this epidemic of the occurrence in a negroid population of Yellow Fever as a mild disease, and of the dire events which may follow failure to recognise its earliest appearance, even though it should present itself in that seemingly innocent garb. This mild form occurs in West Africa, where hitherto only the appearance in Europeans of the type accompanied by hæmorrhage has been considered sufficient to justify a diagnosis of 'Yellow Fever.'"

(*A*) MILD TYPE IN NATIVES.

Having regard to the great difficulty attending the diagnosis of the disease in cases of the mild type occurring in natives, it is fortunate that we are able to give the details of four cases of the kind which have been brought to the notice of the Commission, and which are not open to question.

Case 1.—A man with a normal temperature, and whose blood was free from malarial parasites, was injected with 1 cc. of blood from a patient with Yellow Fever in the second day of the disease. Two days later the volunteer had rigors and pyrexia; two days later he complained of headache and backache, and albumen appeared in the urine. Jaundice appeared on the fifth day. In from six to seven days all these symptoms passed off.

Case 2.—Blood from Case 1 taken on the second day of his illness, was injected intramuscularly into a second volunteer, and similar symptoms appeared and disappeared.

Case 3.—Blood from Case 2, taken on the second day of his illness, was injected into a third volunteer, and similar symptoms appeared and disappeared.

Case 4.—A similar proceeding, taking the blood of Case 3, resulted in a very mild attack. The albuminuria lasted only two days.

Case 5.—Blood from Case 4, injected into the fifth patient, produced no reaction whatever

It had been suggested that the virulence of the infection in Yellow Fever increased with its passage through *non-immunes* and diminished in its passage through natives. These cases, so far as they go, lend support to that theory. It is, of course, possible that the absence of any reaction in Case 5 may have been due to the fact that the patient was completely immune.

These natives are reported to have stated that they knew this fever, which was "big fever" in children, but "small" in adults, "white man would die of it, but they would not."

The following case, classified as "Probable Yellow Fever," is of this type: —

I.R., Vol. I., pp. 224–227.

"CASE NO. 3. L. 25.

"*Sex*: Male.

"*Age*: 29 years.

"*Nationality*: Negro, Effik tribe.

"*Occupation*: Labourer.

"*Date of admission*: 15th May, 1913.

"*Date of discharge*: 30th May.

"*Diagnosis*: Mild yellow fever.

"*History.*—Patient, a labourer working at the Customs, came to the out-patient department at 12 noon on the 15th May, complaining of severe frontal headache and pyrexia. His temperature was 102° and he seemed greatly distressed. He stated that he had been ill for the past six days, and unable to go to his work.

"*On admission.*—Patient was in great distress, respirations hurried. Sweating freely. Conjunctivæ injected. Temperature 102°, pulse rate 98. Complains of severe headache and aching pains in the loins and all over the body.

"*Alimentary system.*—Tongue dry and coated, tip and edges clean. Bowels constipated. Appetite lost. Liver normal, no tenderness. Spleen is enlarged, no tenderness. Nausea and epigastric discomfort present.

"*Circulatory system.*—Heart sounds normal. Pulse slow and compressible, 98 per minute.

"*Respiratory system.*—Lungs normal, respirations hurried.

"*Urinary system.*—Patient passed six ounces of urine on admission. Examination: Acid reaction. Sp. gr. 1025. Albumen present.

"*Nervous system.*—Severe frontal headache. Aching pains in the loins and body. Reflexes normal.

"*Blood examination.*—No malaria parasites present. Leucopenia present. No pigmented leucocytes. Differential count: Polymorphonuclear, 76 per cent.; lymphocytes, 15·2 per cent.; mononuclear, 4·6 per cent.; eosinophil, 4·2 per cent.

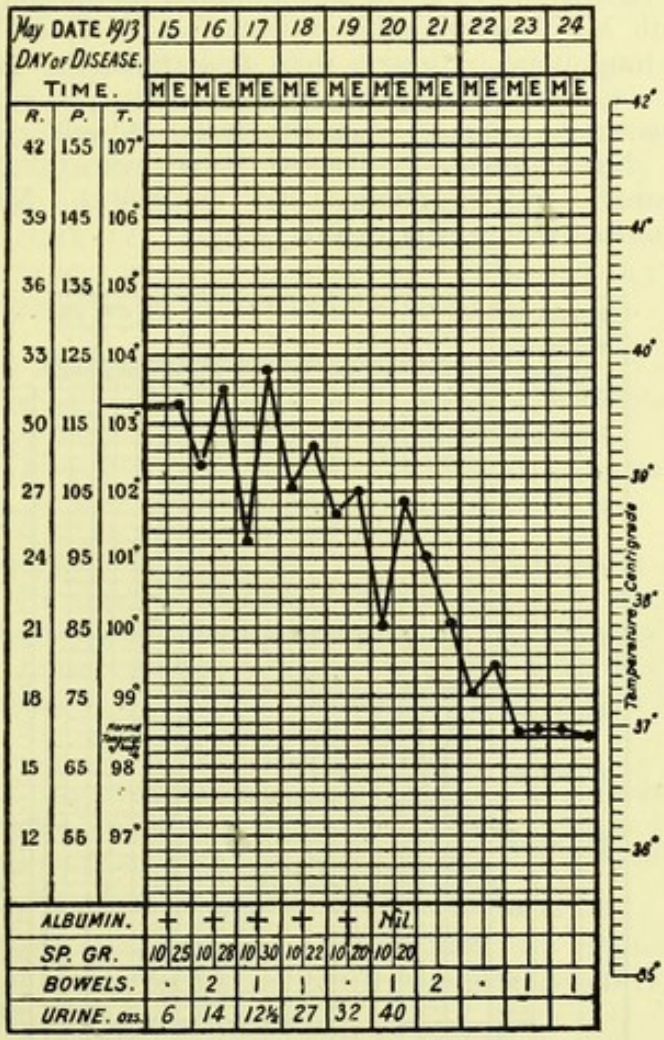
"Temperature rose to 103·2° at 8 p.m., pulse rate 96.

"*16th May.*—Patient had a bad night, very restless and complained of severe headache and pains all over the body. No vomiting,

but nausea present. Temperature at 8 a.m. was 102·4°, pulse rate 88. Urine passed, high in colour. Examination: Acid reaction. Sp. gr. 1020, albumen present.

"*17th May.*—Patient had a better night. Bowels opened. No vomiting. Headache and pains less. Urine passed, increased in quantity, albumen present, but lessened in amount. Temperature at 8 a.m. was 101·4°, pulse rate 78. Temperature rose towards evening and was 103·4° at 8 p.m., with a pulse rate of 84.

"*18th May.*—Patient had a quiet night, slept better. Headache and pains have gone. Bowels were opened freely. Urine passed in large quantity. Albumen still present, but lessened in amount. Conjunctivæ are now yellow. Appetite returning. Temperature still raised.



"Patient continued to improve daily, jaundice deepened Bowels became regular. Appetite increased. Urine increased in quantity and on the 20th May albumen disappeared from the urine and bile appeared.

"Patient made an uneventful recovery and was discharged cured on the 30th May."

The following case was classified as "Probable Yellow Fever": —

I.R., Vol. I., pp. 224-227.

"CASE NO. 4. L. 24.

"*Sex*: Male.

"*Age*: 22 years.

"*Nationality*: Negro, Yoruba tribe.

"*Occupation*: Sanitary inspector.

"*Date of admission*: 16th May, 1913.

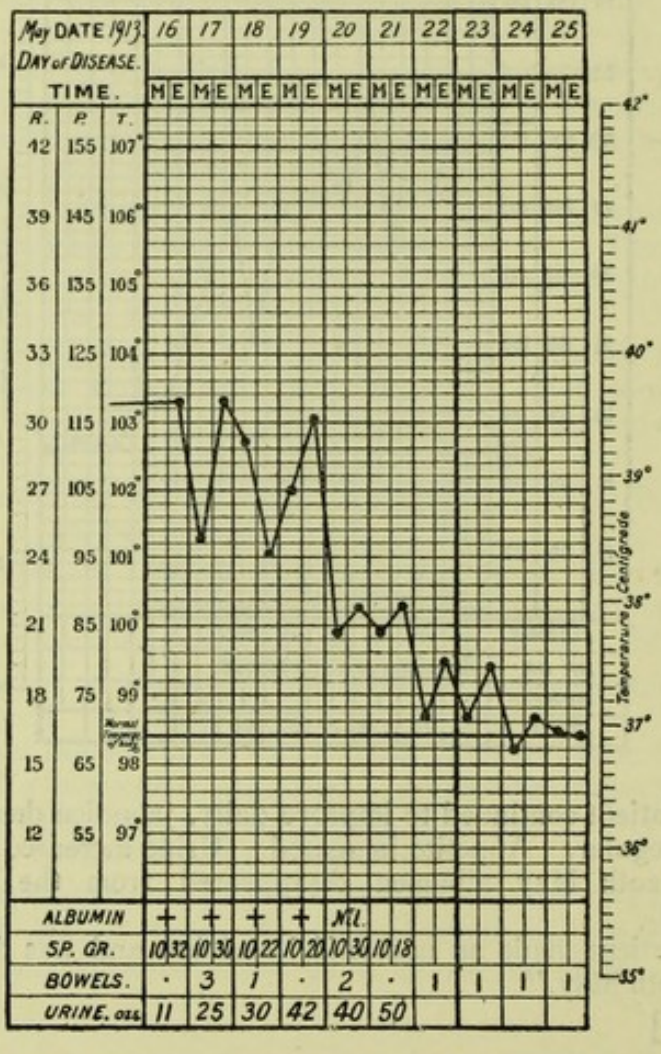
"*Date of discharge*: 30th May, 1913.

"*Diagnosis*: Mild yellow fever.

"*History*.—Patient states that he began to feel ill about six days ago, the illness beginning with headache, rigors, and aching pains all over the body. He also had pyrexia. He continued at his work, but got worse, and reported sick and was sent to hospital.

"*On admission*.—Patient was admitted into hospital at 3.45 p.m. on the 16th May, complaining of fever, severe frontal headache and general aching pains. Bowels were also confined. He seemed very distressed. Conjunctivæ injected and red.

"*Alimentary system*.—Appetite lost. Bowels constipated. No vomiting. Nausea present. Tongue coated, with tip and edges clean. Liver normal. Spleen normal, no tenderness. No epigastralgia present, but this was present two days ago.



"*Circulatory system.*—Heart sounds normal. Pulse: low tension, 82 per minute.

"*Respiratory system.*—Lungs normal, respirations hurried.

"*Nervous system.*—Frontal headache and aching pains in the loins and extremities. Reflexes normal.

"*Urinary system.*—Patient had passed no urine since early morning and passed none after admission until 6 a.m. next day, the 17th. Examination: Reaction acid. Sp. gr. 1032. Albumen present.

"*Blood examination.*—No malaria parasites present. Leucopenia present. Differential count: Polymorphonuclear, 80 per cent.; mononuclear, 10 per cent.; lymphocytes, 10 per cent.

"Temperature on admission was 103·2°, pulse rate 82.

"*17th May.*—Patient had a very restless night, did not sleep. Temperature was raised, being 104° at 8 p.m., with a pulse of 82. Passed no urine during the night. Headache and pains were very severe. At 6 a.m. passed six ounces of very highly coloured urine which contained albumen. Temperature at 8 a.m. was 101·4°, pulse 84. Had an attack of vomiting, dark green fluid with brown debris. Temperature rose in the evening and at 8 p.m. was 103·4° with a pulse of 88. Bowels were opened twice.

"*18th May.*—Patient had a better night, is more comfortable and the headache and pains are lessened. Passed urine, but still diminished in quantity, high coloured and contains albumen. Temperature at 8 p.m. was 102·6°, pulse rate 88; at 8 p.m. temperature was 101°, pulse 84. Scleræ are now tinged with yellow

"*19th May.*—Patient much better, had a better night. Bowels opened. No further vomiting. Urine increased in amount. Still contains albumen, but the percentage is lessened. Temperature at 8 a.m. was 102°, pulse rate 75. Temperature rose towards evening, and at 8 p.m. was 103·2°, pulse 88. Conjunctivæ are not so injected, scleræ are yellow.

"*20th May.*—Patient is very much better. Headache has quite gone. Bowels regular. Temperature falling. Urine has increased in amount and on examination is acid, sp. gr. 1020, no albumen present. Scleræ are very yellow. Appetite has improved.

"Patient continued to do well and slowly improved. Jaundice disappeared on the 26th May, and he was discharged from the hospital on the 30th May."

(*B*) SEVERE TYPE IN NATIVES.

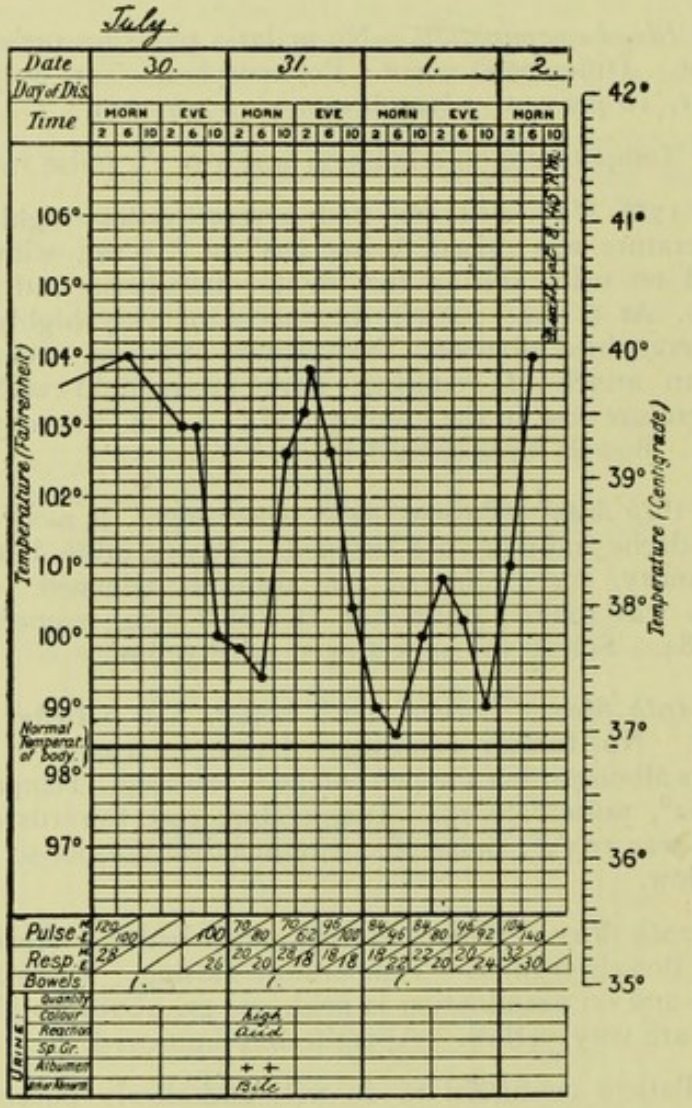
Cases of the hæmorrhagic type in natives do not differ materially from those occurring in Europeans.

The following are examples of fatal cases in natives which were observed in the Freetown epidemic of 1910:—

*Case 15. Y.F. Report. p. 36.

"A NEGRO, AGED 23 YEARS. BY OCCUPATION A CLERK ON THE RAILWAY.

"*Previous history.*—The patient had never been out of West Africa. His previous illnesses were not recorded. He had not been in the habit of taking quinine.



"*History of present illness.*—He stated that he had been ill since July 27th, suffering from fever and much pain in the back and chest; that he was treated as an out-patient and went home. On July 28th the previous symptoms were aggravated and he was unable to present

* The full reference is as follows:—"Report on Certain Outbreaks of Yellow Fever in 1910 and 1911." Waterlow & Sons Limited, London. (By A. E. Horn, M.D. and T. F. G. Mayer, M.R.C.S., L.R.C.P.) This Volume will be referred to thus: "Y.F. Report, p.—."

himself at the hospital for treatment as an out-patient. He was visited at home by his doctor. Throughout the day he vomited nearly all his food.

"On July 29th he was again visited by the doctor and admitted to hospital on July 30th when his temperature was 104°; he complained of pain in the abdomen, especially in the hepatic area. His general condition was weak. He stated that vomiting was troublesome, and that the vomited matter was of a yellowish green colour and liquid. The bowels were freely opened. The pulse rate was 120; the respirations 28; the tongue was coated; the eyes were jaundiced. At 10 p.m. the temperature was 103°.

"On July 31st at 6 a.m. the patient felt a great deal better. He had slept fairly well and the temperature was 99·4°. The pain in the chest and abdomen was a little better than on the previous day. The urine was highly coloured, there was much deposit in it. Its specific gravity was 1025, it was acid in reaction, highly albuminous, and bile was present in it.

"The patient was delirious and somewhat restless during the night.

"On August 1st at 6 a.m. the temperature was normal. The patient was very weak. The eyes were very much jaundiced. The urine was highly coloured and contained much deposit. He vomited the medicine given him once during the day, and passed one motion of a yellow colour.

"He was somewhat delirious during the night and passed his urine into his bed.

"He looked very weak and restless on the morning of August 2nd. At 6 a.m. the temperature was 104°, the pulse 140 and the respiration 30. A hypodermic injection of digitalin and strychnine was given; at 8.45 a.m. the patient died in convulsion, the temperature being 104°.

"No microscopical blood examination was made during the patient's illness.

"*Post-mortem examination.*—A limited examination only was allowed.

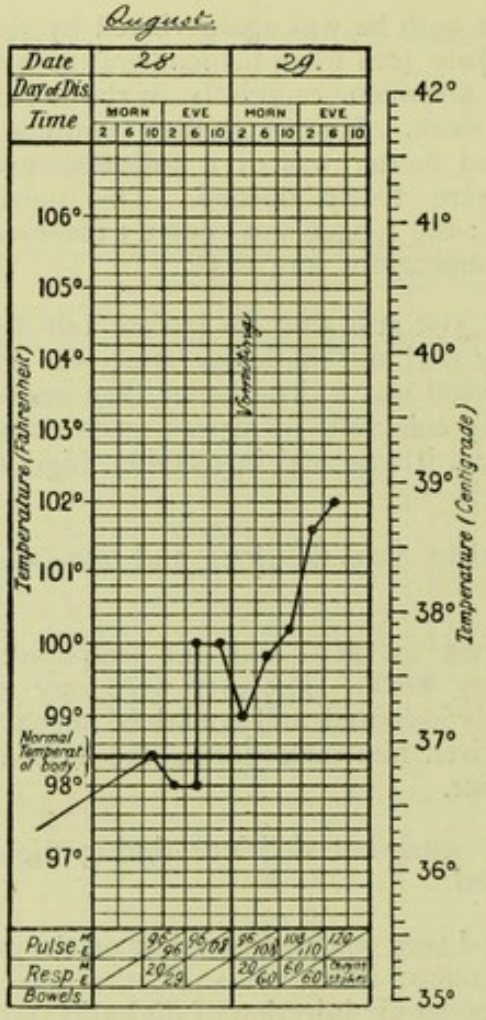
"The stomach contained 'coffee-grounds.' A portion near the cardiac end was marked with arborescent and congested capillaries.

"The liver was of a typical boxwood colour."

"A Negro Labourer of the Mendi tribe, aged about 26 years, living in Freetown (Kru-bay). Case 20. Y.F Report, p. 42.

"*Previous history.*—He was a native of Sierra Leone. His previous illnesses had not been recorded. He had not been in the

habit of taking quinine. He had not been out of Freetown for some time before the present illness.



"*History of present illness.*—On August 28th, at 6.30 p.m., the patient was admitted to hospital. He was said to have been taken ill three days before with fever, headache and pains all over his body. His skin was cold and his pulse weak. He was restless, tossing about so much that his temperature could not be taken; the pupils were dilated and did not react to light. He appeared stupefied, but could be roused. There was retention of urine and the bladder was distended. A soft catheter was passed and drew off ten ounces of urine.

"On August 29th he had black vomit in the morning. His condition resembled that of the day before. He was very weak. The temperature was 97·8°, the pulse 96, respirations 20 to the minute. In the afternoon he again vomited. His skin was cold and clammy, that of the face was perspiring freely. His condition did not improve, his temperature rising to 101·8°. At 6.45 p.m. the patient died.

"*Post-mortem examination.*—The lungs: There was considerable œdema of the left lung.

"The stomach contained a large quantity of black fluid like that which was vomited, and there were punctate hæmorrhages in the mucous membrane of the stomach wall.

"The small intestines also contained much black fluid like that in the stomach.

"The liver was mottled.

"The kidneys were congested, there were hæmorrhages under the capsule.

"The brain was congested, but there were no hæmorrhages into it."

(*c*) MILD TYPE IN EUROPEANS.

The following is an example of a case of the mild type in a European. It was classified by the Commission as "Probable Yellow Fever."

"CASE NO. 2.—LAGOS. L. 122.

"*Sex*: Male.

"*Age*: 27 years.

"*Nationality*: European, German.

"*Occupation*: Trader.

"*Date of admission*: 14th February, 1914.

"*Date of discharge*: 27th February, 1914.

"*Diagnosis*: Yellow fever.

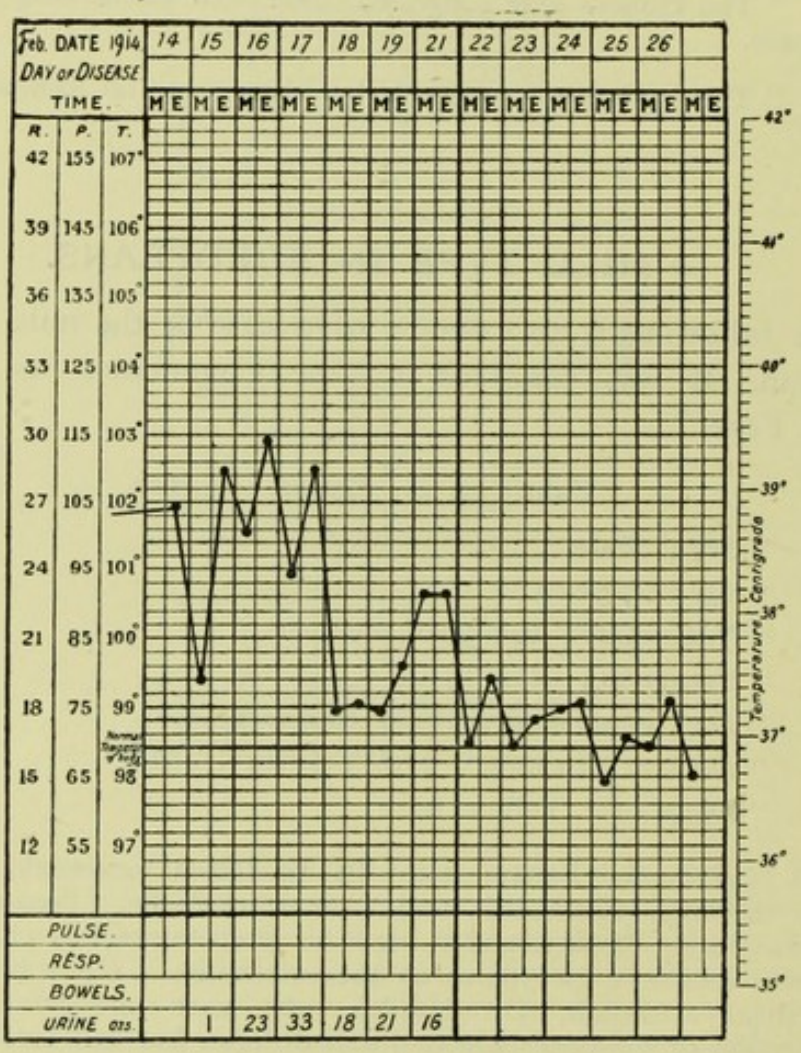
"*History.*—Patient states that he felt ill yesterday, the 13th, in the morning, with chills and frontal headache. Became gradually worse during the day, and at night his temperature was 104°, with very severe headache and pains in the extremities. He was seen by his medical attendant, Dr. Maples, who gave him an intramuscular injection of quinine. He had a bad night, but felt better early next morning. During the day the temperature again rose, headache became severe, nausea and epigastric discomfort was present. No vomiting until he made himself vomit to relieve the nausea. In the evening his temperature was 104°, conjunctivæ were injected and red, headache very severe, and his urine on examination was albuminous. So he was sent to the hospital at 7 p.m.

"*On admission.*—Temperature was 101·8°, pulse rate 98. Conjunctivæ very injected. Complained of severe frontal headache and

aching pains in the loins. Patient has only been out eight months of this, his first, tour. Has taken quinine regularly.

"*Alimentary system.*—Gums red and swollen. Tongue, white dorsum, with red tip and edges. Bowels constipated. Liver and spleen both normal, no tenderness. Nausea and epigastric discomfort present. Great thirst present.

"*Circulatory system.*—Heart sounds normal. Pulse slow, 90 at 8 p.m.



"*Respiratory system.*—Lungs normal. Respirations hurried.

"*Nervous system.*—Severe frontal headache present. Aching pains in the loins. Reflexes normal.

"*Urinary system.*—Urine passed on admission. Very high coloured. Acid reaction. Sp. gr. 1030. Albumen present, high percentage. Quantity has been diminished.

"*Other systems.*—Skin, sweating. Face very flushed. Conjunctivæ injected. Eyes shining. Photophobia present.

"*Blood examination.*—No malaria parasites present. *Paraplasma flavigenum* present. Differential count: Polymorphonuclears, 61 per cent.; lymphocytes, 27·4 per cent.; mononuclear, 8·4 per cent.; transitionals, 2·8 per cent.; mast cells, 0·4 per cent.

"15*th February.*—Patient had a fair night, but was restless in the early part. Bowels moved after calomel. Urine passed, but diminished in quantity, only 7 ozs. passed in the previous twenty-four hours. Highly albuminous. Temperature at 8 a.m. was 99·4°, pulse rate 88. Tube casts present in the urine. During the day the temperature rose, and at 4 p.m. was 103·6°, pulse 100. Patient very excitable, complained of great thirst. Face very flushed and conjunctivæ were very injected. At 8 p.m. temperature was 102·4°, pulse 96.

"16*th February.*—Patient was very restless last night and only slept after a draught. Conjunctivæ very injected. Nausea troublesome. Urine still diminished and contains albumen. Patient is very nervous and complains of great thirst. Temperature at 8 a.m. was 101·6°, pulse rate 88. At 8 p.m. temperature rose to 102·8°, pulse rate 90.

"17*th February.*—Patient had a better night and slept. Is feeling much improved this morning. Temperature at 8 a.m. 100·6°, pulse 100. Headache still present, also loin pains. Urine is still diminished and contains albumen, sp. gr. 1030, acid reaction. At 8 p.m. temperature rose to 102·4°, with pulse of 90. Thirst is lessened. Conjunctivæ still injected.

"18*th February.*—Patient had a good night and is feeling very much better. Bowels opened. Urine passed in increased quantity, and on examination still contains albumen. Conjunctival injection passing off. Scleræ are now tinged with yellow. Temperature is 99°, with pulse rate of 100.

"19*th February.*—Patient is much improved and had a good night. Temperature still 99°. Bowels opened. Urine examined and found to contain bile, but no albumen. Scleræ are decidedly yellow. Nausea and epigastric discomfort have passed off. Appetite is returning. Urine has not yet reached the normal. Headache quite gone.

"Patient continued to improve gradually, jaundice slowly disappeared on the 24th, and patient was discharged cured on the 27th February.

"Note by Commission.

"Some blood films from this case were examined by Dr. Wenyon, who found red cells with patches of basophilic change. In one film curious star-like artefacts occurred which he thought might be mistaken for parasites."

(*d*) SEVERE TYPE IN EUROPEANS.

The following case occurred in the Lagos epidemic of 1913 : —

"CASE NO. 7. L. 37.

"*Sex* : Male.

"*Age* : 34.

"*Nationality* : European, British.

"*Occupation* : Bank accountant.

"*Date of admission* : 17th July, 1913.

"*Date of death* : 20th July, 1913.

"*Diagnosis* : Yellow fever.

"*History.*—Patient states that on the 16th he began to feel ill about mid-day with chilly sensations, followed by frontal headache. He finished his work and in the evening had to go to bed as he was feeling worse. The headache had increased in severity and he had racking pains in the loins and limbs. He was seen by a doctor that night, and also next morning, and as his condition seemed serious he was sent into hospital.

"Patient has had several attacks of malarial fever. Present tour in Lagos 7½ months' duration. Has kept good health up to the present.

"*On admission.*—Patient complains of great and severe frontal and ocular headache with racking pains in the loins and extremities. Face is flushed, conjunctivæ injected and the eyes shining and watery. Bowels have been confined, nausea is present, and he has pain and discomfort in the epigastrium, increasing on pressure.

"*Alimentary system.*—Bowels are constipated, appetite lost. Tongue is pointed, with red tip and edges and furred dorsum. Liver is normal, no tenderness. Spleen is also normal. Epigastrium is tender and painful on pressure.

"*Circulatory system.*—Heart sounds are normal. Pulse is slow, low tension, 96 per minute.

"*Respiratory system.*—Lungs normal. Respirations hurried.

"*Nervous system.*—Severe frontal headache and pains in the eyes. Racking pains in the loins and extremities. Reflexes normal.

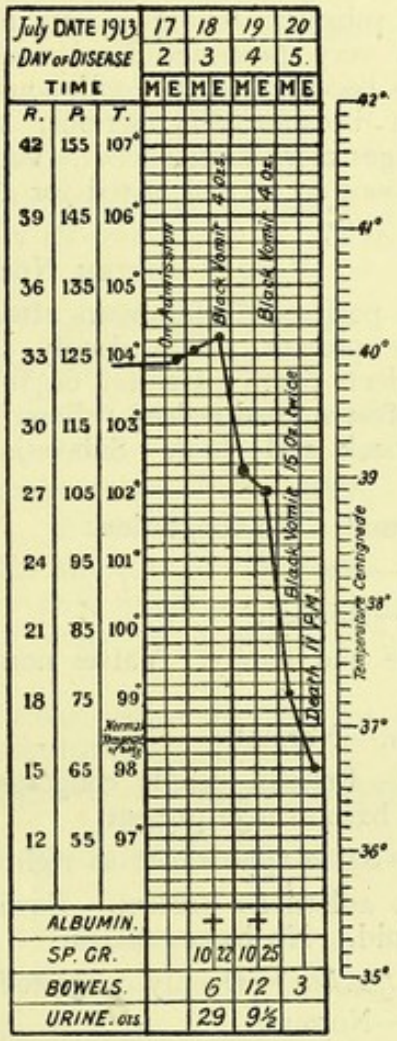
"*Urinary system.*—Urine is very cloudy and diminished. Examination : Acid. Sp. gr. 1022. Albumen present.

"*Blood examination.*—No malaria parasites present. Pigmented leucocytes present. *Paraplasma flavigenum* present. Differential count : Polymorphonuclear, 78 per cent. ; mononuclear, 7 per cent. ; lymphocytes, 13 per cent. ; eosinophil, 2 per cent. Leucopenia present.

"Temperature on admission at 10 p.m. was 103·8°, pulse rate 96.

"*18th July.*—Patient had a quiet night, headache not so severe this morning. Eyes injected and shining. At 8 a.m. temperature was 104°, with a pulse rate of 80. About 10 a.m. patient felt uncomfortable in the stomach and caused himself to vomit. Vomited matter

consisted of a dark brown fluid with chocolate-coloured debris. Bowels moved at 10.30 a.m., motion being a greenish fluid with chocolate-coloured debris. Vomiting stopped after the application of a sinapism, but nausea and gastric discomfort were present. Temperature at 104° all the evening and at 8 p.m. was 104·4°, pulse rate 70. Bowels were again moved at 8 p.m. and the motions contained dark chocolate-coloured debris. Passed eight ounces of very muddy urine, which contained a large amount of albumen.



"19*th July*.—Patient had a restless night and did not get much sleep. During the early hours of the morning patient had several motions and the stools were dark and chocolate-coloured. Eyes were still injected. Epigastric pain and discomfort with nausea present. An erythematous rash appeared on the skin of neck and chest. Urine was diminished and contained a large percentage of albumen. Temperature at 8 a.m. was 102·4°, pulse rate 64. In the afternoon, at 5.20 p.m., patient had an attack of vomiting, four ounces of black vomit. Bowels moved again and the stools were black and tarry. No urine passed except the one ounce at 1 p.m. Black vomit again occurred at 7.15 p.m. and petechial hæmorrhages appeared in the skin

of neck, chest and back. The temperature at 8 p.m. was 101·8°, pulse rate 68. Only 1½ ounces of urine passed in the twelve hours.

" *20th July.*—Patient had a fair night and was quieter. Bowels moved several times towards morning; the stools were black and tarry. No more vomiting during the night, but at 8.40 a.m. he had a severe attack and vomited 12 ounces of black vomit. No urine was passed through the night. Skin was jaundiced. Temperature 101·4°, pulse rate 68. Conjunctivæ showed small hæmorrhages and the scleræ was deeply jaundiced. Patient became much worse towards the evening. Very restless, with subsultus tendinum very marked. Ecchymoses of the genital organs very pronounced. Urine suppressed. Delirium present. Vomiting became almost continuous, typical black vomit. Patient's condition became very serious, skin deeply jaundiced, petechial hæmorrhages more pronounced. Very restless and delirious. At 10 p.m. convulsions set in and lasted for about an hour, and death occurred at 11 p.m.

" POST-MORTEM NOTES.

" Autopsy was performed nine hours after death.

" Rigor mortis present. Skin deeply jaundiced. Post-mortem staining of dependent parts. Genital organs cyanosed. Palms of hands and soles of feet stained a deep yellow. Petechial hæmorrhages in skin of neck, back and chest. Subconjunctival hæmorrhages in both eyes.

" *Brain.*—Normal. No congestion.

" *Spinal cord.*—Normal.

" *Membranes.*—Normal.

" *Heart.*—Pale and flabby. Valves normal. No hæmorrhages. Weight, 8½ ounces.

" *Large vessels.*—Normal.

" *Lung, right.*—Bronchi deeply congested. Base of lung congested and areas of hæmorrhage present.

" *Lung, left.*—Same appearance as right.

" *Pleuræ.*—No adhesions present. Each cavity contained four ounces of yellow fluid. No hæmorrhages.

" *Larynx and trachea.*—Deeply congested.

" *Peritoneum.*—Normal.

" *Oesophagus.*—Intensely congested.

" *Stomach.*—Contained ten ounces of black fluid. Mucous membrane congested. Rugæ swollen and thrown into corrugations. Patches of hæmorrhage in mucous membrane, most marked at the cardiac end and along the lesser curvature. Large hæmorrhage in posterior wall.

" *Small intestine.*—Duodenum intensely congested. Submucous hæmorrhages along its entire length. Jejunum also congested and hæmorrhages present. Ileum congested for about half its length. The intestinal canal contained a dark, tarry fluid.

" *Large intestine.*—Mucous membrane congested and gelatinous in appearance near the ileo-cæcal valve. Empty.

"*Helminths.*—None present.

"*Liver.*—Pale, boxwood colour. No hæmorrhages in capsule. On section, greasy. Very friable. Weight, 58½ ounces.

"*Gall bladder.*—Empty. Mucous membrane congested.

"*Pancreas.*—Normal. Weight, 5 ounces.

"*Spleen.*—Slightly enlarged and congested. Weight, 7½ ounces.

"*Kidney, right.*—Enlarged. Capsule strips easily. Dilated stellate veins under capsule. Weight, 8½ ounces.

"*Kidney, left.*—Enlarged. Capsule strips easily. Weight, 8 ounces.

"*Suprarenal capsules.*—Normal.

"*Lymphatic system.*—Normal.

"*Bladder.*—Contracted and contained ½ ounce of very dark brown urine. Highly albuminous on examination. Mucous membrane normal.

"LABORATORY REPORT.

"*Microscopic examination:*

"Blood smears showed no malaria parasites.

"*Histological examination:*

"*Liver.*—Advanced fatty degeneration. Cells vacuolated and protoplasm granular. Distorted arrangement of lobules.

"*Kidney.*—Cells swollen and granular. Tubules denuded of epithelium in places and filled with granular and hyaline debris. Droplets of fat in cells of convoluted tubules. Several small hæmorrhages.

"*Stomach.*—Mucous membrane swollen and vessels congested. Punctiform hæmorrhages present.

"*Spleen.*—Congested. Capsule thickened."

The following is an example of a fatal case in a Syrian:—

"CASE NO. 11. L. 41.

"*Sex*: Male.

"*Age*: 35 years.

"*Nationality*: Syrian.

"*Occupation*: Trader.

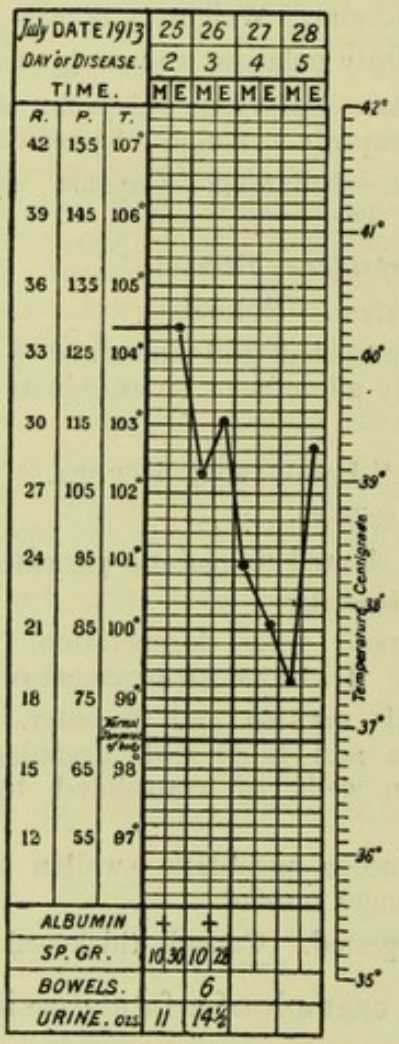
"*Date of admission*: 25th July, 1913.

"*Date of death*: 28th July, 1913.

"*Diagnosis*: Yellow Fever.

"*History.*—Patient was admitted into hospital at 9 p.m. on the 25th July from the Isolation Hospital, where he had been under observation from the 20th. He was one of the occupants of the house in which Case No. 8 had occurred, and had been removed with the other contacts on the 20th. On the morning of the 24th he complained

of not feeling well, and that he had a severe headache and aching pains in the back and limbs. In the evening his temperature rose and he had vomiting, bilious in character. He had a restless night and was much worse next day, and was sent to the Lagos Hospital.



"*On admission.*—Patient was very distressed, respirations were hurried. Face was flushed, eyes shining and bright. Conjunctivæ were very injected and red. Temperature 104·6°, pulse rate 120 per minute.

"*Alimentary system.*—Appetite lost. Bowels constipated. Tongue dry and pointed, with white dorsum and red tip and edges. Liver was normal, no tenderness. Spleen was enlarged and palpable, no tenderness. Nausea was present, with epigastric pain and discomfort, which increased on pressure.

"*Circulatory system.*—Heart sounds normal. Pulse 120 per minute.

"*Respiratory system.*—Lungs normal. Respirations hurried.

"*Urinary system.*—Patient passed 2 ozs. of urine after admission. Examination: Acid reaction. Sp. gr. 1030. Albumen present, high percentage.

"*Blood examination.*—No malaria parasites present. *Paraplasma flavigenum* present. Pigmented leucocytes present. Differential count: Polymorphonuclear, 76 per cent.; mononuclear, 7 per cent.; lymphocytes, 13 per cent.; eosinophil, 4 per cent.

"Temperature rose at 10 p.m. to 104·4°, pulse rate 112.

"*26th July.*—Patient had a bad night, very restless. Complained of severe frontal headache and pains in the loins. At 8 a.m. temperature was 102·4°, with a pulse rate of 90. Had an attack of vomiting, bilious in character. Passed 14 ozs. of urine, which on examination was found to be highly albuminous. Temperature rose in the afternoon and at 8 p.m. it was 103·2°, with a pulse of 84. Patient is looking very ill. Conjunctivæ very injected and red. Epigastric pain and discomfort, with nausea present. Vomited several times during the afternoon.

"*27th July.*—Patient had a bad night, very restless. No urine passed at all. Temperature at 8 a.m. was 100·8°, pulse rate 72. Vomited at 8.30 a.m. a clear fluid with chocolate-coloured debris. Scleræ are yellow. Nausea still present with epigastric discomfort.

"*28th July.*—Patient passed a quiet night. No urine passed for the past twenty-four hours. Temperature at 8 a.m. was 99·4°, pulse rate 72. Temperature began to rise in the afternoon and at 8 p.m. was 102·6°. Patient began to get comatose, and death occurred quietly at 8.15 p.m. Skin deeply jaundiced.

"Post-mortem Notes.

"Autopsy was performed twelve hours after death.

"Rigor mortis present.

"Skin and scleræ stained an intense yellow. Genital organs cyanosed.

"*Brain.*—Appeared normal.

"*Spinal cord.*—Normal.

"*Membranes.*—Congested.

"*Pericardium.*—Showed old adhesions. Contained 1 oz. of fluid.

"*Heart.*—Pale and flabby. Minute hæmorrhages seen on the surface of the ventricles. Valves normal. Sub-endocardial hæmorrhages well marked in the left ventricle. Weight, 8½ ozs.

"*Large vessels.*—Normal.

"*Lung, right.*—Very congested, particularly at base.

"*Lung, left.*—Same as right.

"*Pleuræ.*—Adhesions present in right side, left side normal. Some effusion present.

"*Larynx and trachea.*—Normal.

"*Peritoneum.*—Normal.

"*Stomach.*—Contents 10 ozs. of black fluid. Mucous membrane very congested. Rugæ swollen and prominent. Submucous hæmorrhages well marked at the cardiac and pyloric ends. Large extensive hæmorrhage along the greater curvature.

"*Small intestine.*—Duodenum intensely congested. Numerous submucous hæmorrhages present. Contained black fluid similar to that in the stomach. Jejunum also intensely congested and minute submucous hæmorrhages present. Ileum very congested along its entire length to within two feet of the ileo-cæcal valve.

"*Large intestine.*—Mucous membrane congested and thickened. Contents a brown fluid.

"*Helminths.*—Numerous ascarides Two tape worms (*T. saginata*) also found.

"*Liver.*—Pale yellow in appearance with patches of hyperæmia. Well marked subcapsular hæmorrhages. On section, greasy and very friable. Weight, 46 ozs.

"*Gall bladder.*—Normal.

"*Pancreas.*—Normal. Weight, 5 ozs.

"*Spleen.*—Enlarged and tough. Congested. Weight, 14½ ozs.

"*Kidney, right.*—Very congested. Enlarged. Capsule strips easily. On section, cortex congested, medullary portion showing hæmorrhages. Weight, 6½ ozs.

"*Kidney, left.*—Same as the right. Weight, 7 ozs.

"*Suprarenal capsules.*—Normal appearance.

"*Lymphatic system.*—Normal.

"*Bladder.*—Contracted. Contained 1 oz. of dark, turbid urine. Acid reaction and highly albuminous.

"LABORATORY REPORT.

"*Histological.*

"*Liver.*—Profound fatty degeneration present. Great increase of fibrous tissue. Normal structure of organ practically obliterated. The few cells clearly visible contained fatty globules and vacuoles.

"*Kidney.*—Hyperæmia and a number of hæmorrhages present. Cells of the convoluted tubules were swollen and granular. Tubules denuded in places, and filled with granular and hyaline debris.

"*Spleen.*—Engorged.

"*Stomach and intestines.*—Ecchymoses present. Vessels engorged. Epithelium swollen and granular."

The consideration of the clinical features of the various types is reserved for the section on "Diagnosis" (*vide* pp. 153-159).

SECTION IX.

SYMPTOMATOLOGY.

To discuss in detail the symptomatology of such a disease as Yellow Fever would result in the production of a bulky text book, and is obviously beyond the scope of this report and of the reference to the Commission.

Moreover, the cases constituting the epidemics of 1910 and 1911 at Freetown, Seccondee, Saw Mills, Axim, Lagos, Accra and Bathurst have already been analysed very fully by Drs. Horn and Mayer, who were in succession attached to the Colonial Office, about that period, and the results are contained in the "Report on Certain Outbreaks of Yellow Fever in 1910 and 1911," issued by the Colonial Office in 1913 (*vide* pp. 88-91).

Dr. E. J. Wyler has analysed, under similar headings, the cases occurring at Lagos in 1913 and 1914 (*vide* I.R., Vol. I., pp. 142-144), and Dr. Leonard has also submitted those cases to a very careful analysis, which will be found in the same volume of the Reports by Investigators (*vide* pp. 291-294).

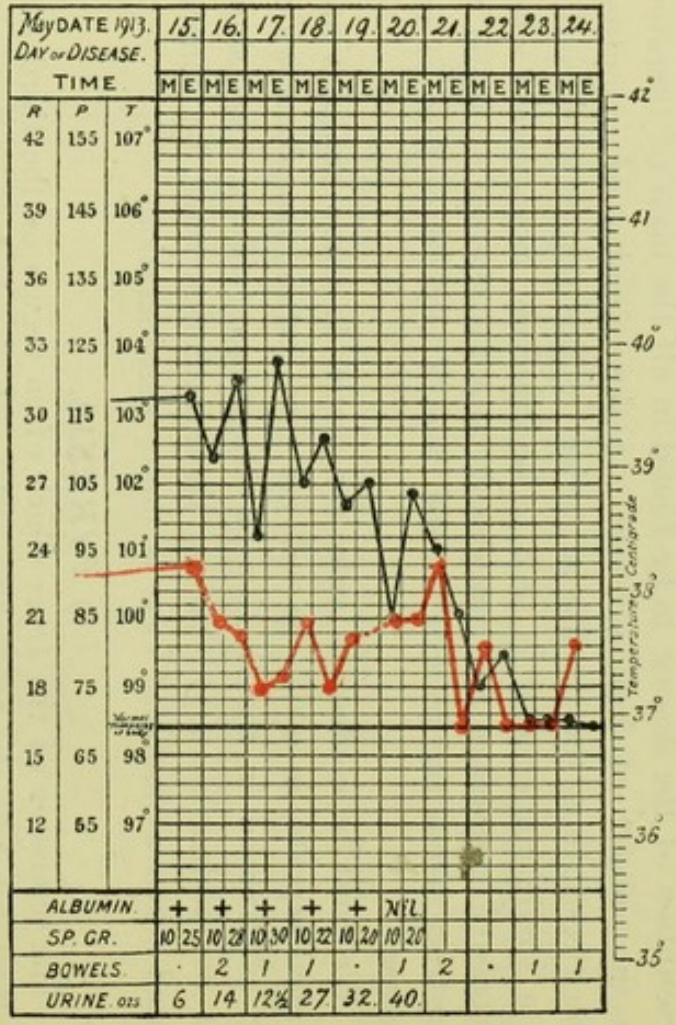
The synopsis of those cases emphasises the statements in the Second Report as to the infinite variety in which Yellow Fever may present itself even in a single epidemic, a lesson learned from a careful reading of the "Report on the Pathology, Therapeutics, and general Aitology of the epidemic of Yellow Fever which prevailed at Lisbon during the latter half of the year 1857, by Dr. Robert D. Lyons, late Pathologist in the Crimea." That report, as already stated, probably contains the most masterly description of the disease to be found in all the mass of literature on the subject of Yellow Fever. If the complex of symptoms which constitutes the disease is subject to this degree of variation in a single epidemic, it is seen to be infinitely more varied when successive outbreaks are considered, and an attempt is made to construct from the records of the cases a clinical picture of the disease.

We must be content to refer the reader to those analyses and clinical reports, in which he will see that certain symptoms which are emphasized in the Section on Diagnosis (*vide* p. 152) stand out as landmarks, and that on these attention must be concentrated when a doubtful case is under consideration.

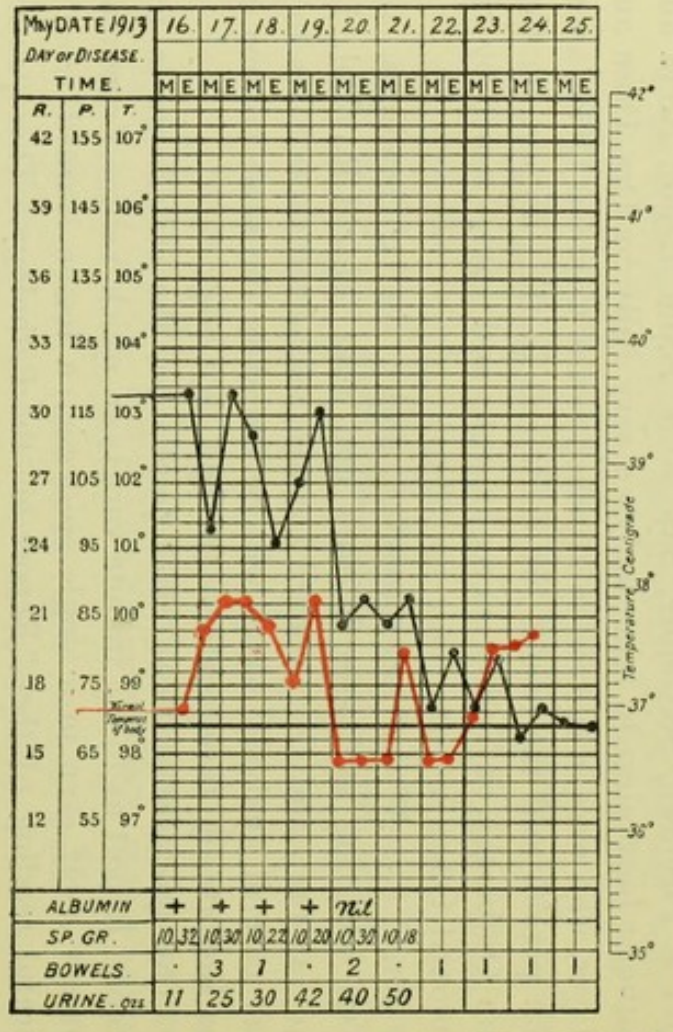
(*A*) PYREXIA.

The remission of the fever which often occurs on the third day or later, gives to the temperature chart the typical "saddle-back" character, but this feature is by no means constant, and it may be of service to illustrate, by charts of cases which have been observed, the types of pyrexia most often met with.

(1) REMITTENT TYPE (RECOVERY).

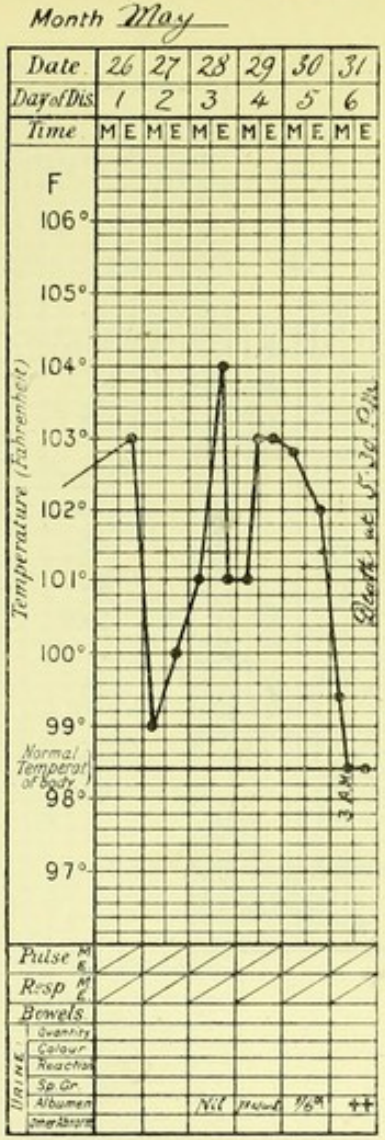


Case No. 3, L. 25. p. 225. I.R., Vol. I.

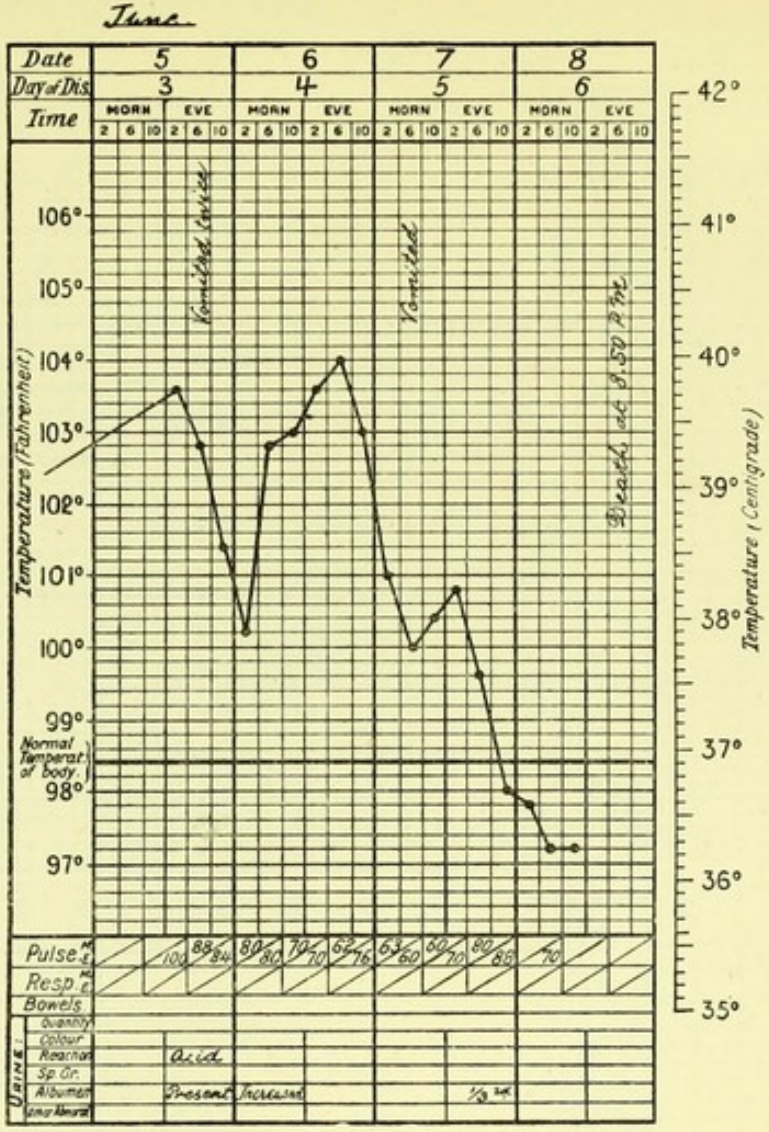


Case No. 4, I., 24. p. 226. I.R., Vol. I.

(II) REMITTENT OR SADDLE-BACK TYPE (FATAL).

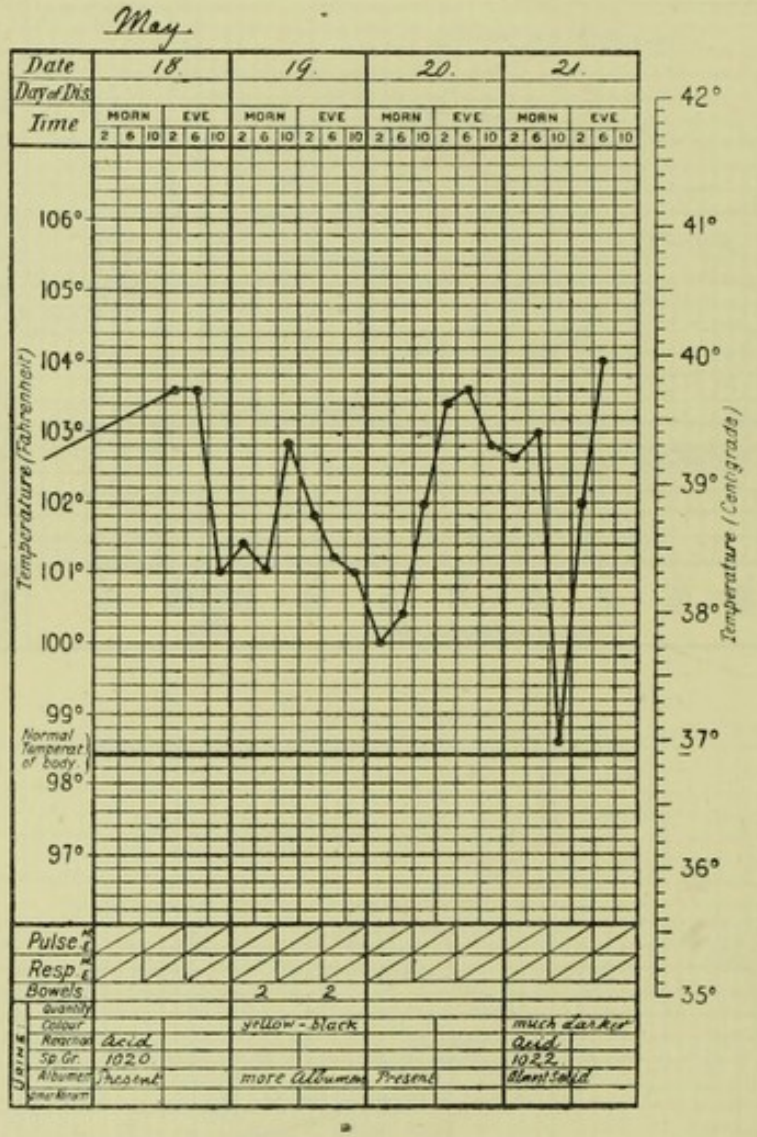


Case 9. Y.F.R., p. 28.

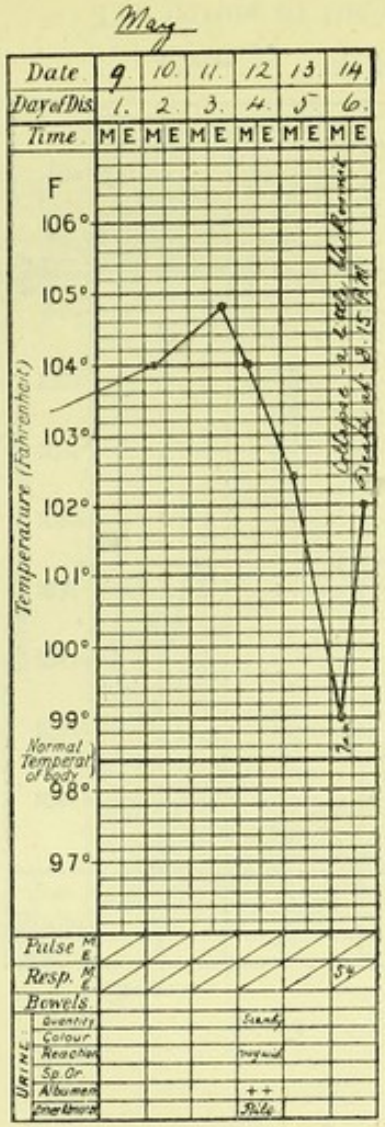


Case 10. Y.F.R., p. 29.

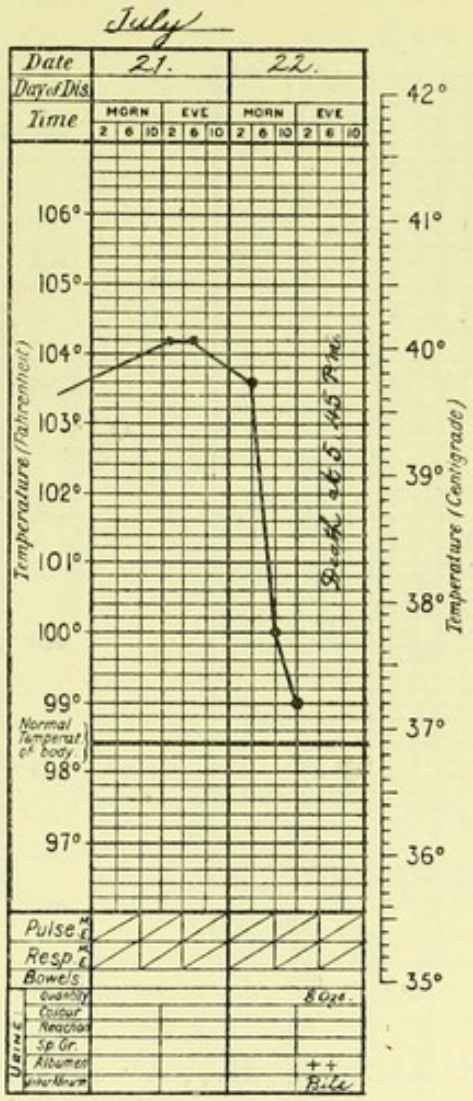
(II) REMITTENT OR SADDLE-BACK TYPE (FATAL)—*continued.*



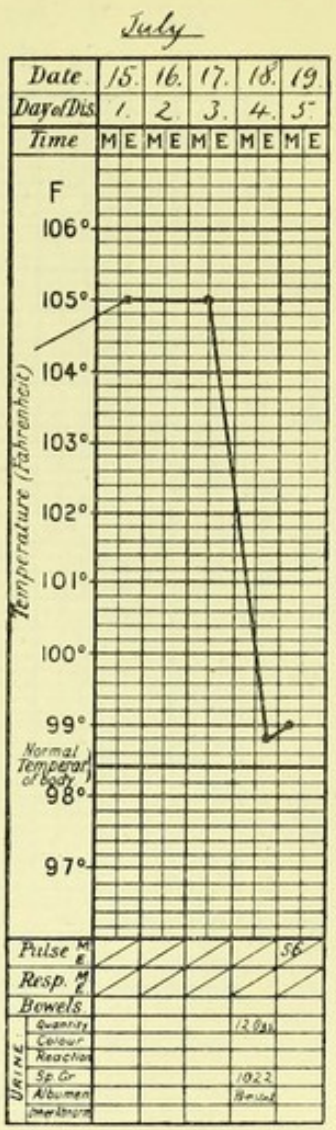
Case 30. Y.F.R., p. 52.



Case 6. Y.F.R., p. 25.

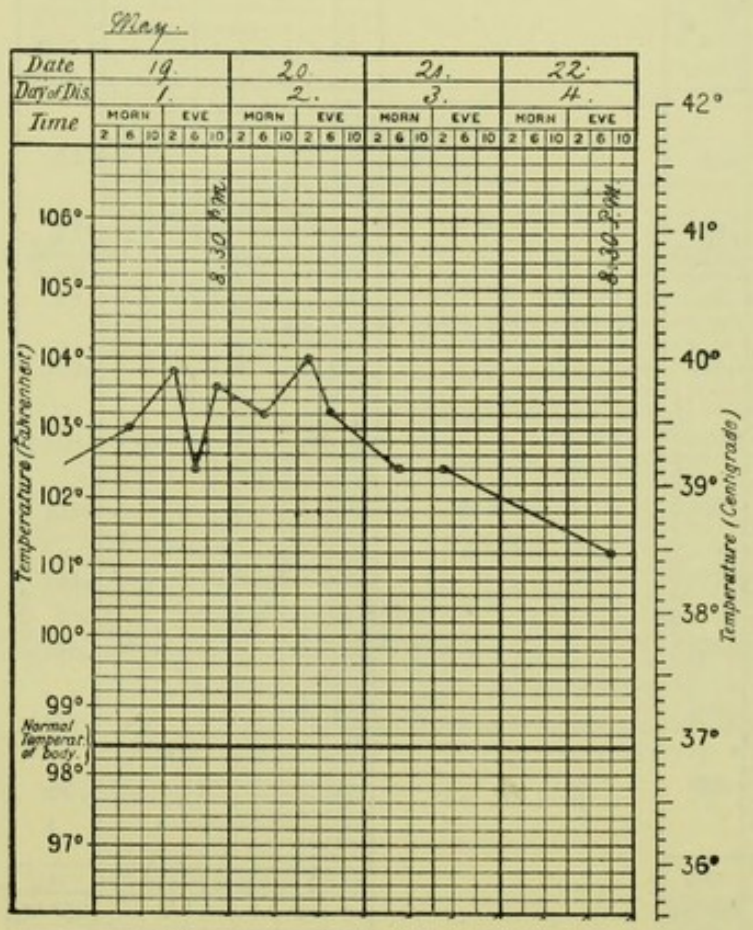


Case 13. Y.F.R., p. 35.

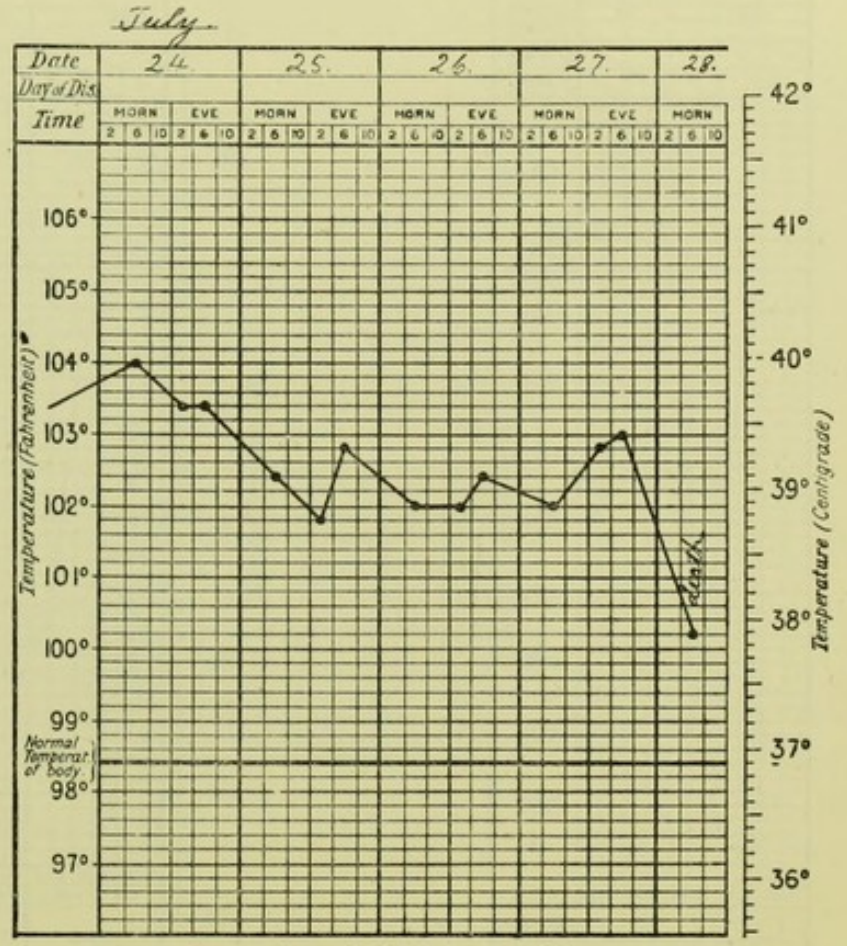


Case 35. Y.F.R., p. 57.

(IV) CONTINUED TYPE (WITH SLIGHT REMISSIONS).



Case 51. Y.F.R., p. 74.



Case 61. Y.F.R., p. 83.

The nature of the cases attended with hyperpyrexia is separately considered (*vide* p. 188).

(*B*) THE CHARACTER AND COURSE OF THE JAUNDICE.

The jaundice of Yellow Fever is probably of hæmatogenous origin and not due to biliary obstruction, otherwise the fæces should be clay coloured, a condition which is rarely observed. The skin is at first of a pale yellow tinge, later of a deep orange colour, and this may deepen into a dark mahogany brown. The time of its appearance is dealt with in the section on Diagnosis (*vide* p. 152). After the scleræ it is seen in the skin of the face, neck and upper part of the trunk, and if absent during life, as it may be, it is almost invariably developed after death. During convalescence it gradually disappears.

The association of jaundice with malaria of the bilious remittent type is considered on page 161.

(*C*) THE CHARACTER OF THE VOMITED MATTERS.

It may be of interest to record the successive changes observed in the character of the vomited matters in some fatal cases.

Case 1.—A European:—

(*a*) Pale, greenish fluid with dark chocolate-coloured debris.
(*b*) Greenish fluid with chocolate-coloured debris.
(*c*) Thick dark brown fluid.
(*d*) Black vomit.

Case 2.—A European:—

(*a*) Dark brown fluid with chocolate-coloured debris.
(*b*) Black vomit.

Case 3.—A Syrian:—

(*a*) Colourless fluid with chocolate-coloured debris.
(*b*) Black vomit.

Case 4:—

(*a*) Bilious.
(*b*) A clear fluid with chocolate-coloured debris.
(*c*) Black fluid.

Case 5.—A Syrian:—

(*a*) Dark green fluid.
(*b*) Almost black fluid.

Case 6.—A European:—

(*a*) Bile.
(*b*) Dark green fluid.
(*c*) Black fluid.
(*d*) "Black vomit," followed by
(*e*) Dark blood.

Case 7.—A European:—

(*a*) Dark "coffee ground" material.
(*b*) A very dark stringy black coffee ground material.

Case 8.—A native:—

(*a*) All food taken.
(*b*) Yellowish green liquid.
(*c*) Coffee grounds.

The occurrence of the appearance usually described as "fly specks" in the vomit, which may precede the onset of true black vomit, is recorded in the following case:—

Case 9.—A European:—

(*a*) The vomit contained black specks.
(*b*) "Vomited a large quantity of black matter and died."

It is to be noted that all these cases were fatal, but that in the earlier stages the vomited matter did not present the appearance which some are disposed to regard as alone typical of Yellow Fever, *i.e.*, "black vomit."

We may recall what is stated in the Second Report (p. 66) to have occurred in the French Soudan in the years 1887 and 1888:—

"'Typho-malarial Fever' continued, but was of a less severe type. In discussing the nature of these epidemics it is mentioned that 'the errors in diagnosis' were due to the absence of 'black vomit' in more than half the cases, owing to the fact that the patients died before there had been time for the appearance of this symptom. Epistaxis and tarry stools were, however, noted in some of these cases. The conclusion is arrived at that, under various names, the disease throughout was Yellow Fever, and that there had been an annual epidemic from 1878 to 1888."

SECTION X.

DIAGNOSIS.

The diagnosis of Yellow Fever is a problem for the clinician and often a very difficult one. When he is in doubt the laboratory does not come to his aid, and, perhaps for his own good, he has to depend upon his powers of observation. For his comfort we may recall (*vide* Second Report, p. 110) Dr. Kohnke's observation that "Diagnosticians who can at all times differentiate between

the very mild cases of Yellow Fever and diseases resembling it, exist mainly in the imagination of the laity."

Whatever difficulties may arise when we attempt to determine the nature of a suspected case of this disease from the perusal of a written record, we doubt whether at the bed-side they are sensibly greater than those which attended the diagnosis of, say, Enteric Fever before the introduction of the Widal test, or of certain other diseases in the pre-laboratory period. The physician who does not commence his examination of any and every patient by a prolonged look at his face is apt to miss much that the eye trained by many years of clinical experience can see at a glance, and is likely to be numbered with those who are paralysed when the resources of a clinical laboratory are not available.

The Commission has fortunately had the advantage of seeing physicians from abroad whose views on this and other problems of the enquiry have been formed as the result of such an experience, and at these interviews the important question of the diagnosis of the disease has not been overlooked.

The recognition of this, as of many other diseases, depends upon the capacity to observe and to attach the true value to the presence or absence of each one of a number of separate features, and not upon the presence or absence of some one of their number. In other words, no single sign or symptom is characteristic, or pathognomonic of Yellow Fever, each may in turn be absent; the disease is to be recognised from the clinical picture viewed as a whole.

(*A*) DIAGNOSIS OF CASES OF THE MILD TYPE.

The most important signs and symptoms are as follows:—

1. *The Aspect of the Patient.*—There is a degree of distress out of proportion to the temperature and to the urgency of the other symptoms. Insomnia, troubled sleep and *restlessness* are very often observed.

In the recorded cases, the following statements constantly recur.

"The patient was in great distress."

"The patient had a very anxious and distressed appearance."

"Patient was very distressed and looked ill."

"He felt very ill and had to go to bed."

2. *Flushing of the Face and Injection of the Conjunctivæ.*—There is an intense active capillary congestion of the skin and mucous membranes. The eyes are bloodshot and watery; the face is red and swollen; the upper lip is often puffy.

3. *Severe Frontal Headache.*—This symptom is rarely absent and usually attends the onset. The headache of Yellow Fever is almost invariably frontal, and it is very probable that the great distress and restlessness just described are in great part due to the intensely severe headache.

4. *Aching pains* in the loins and limbs and elsewhere.

Pains of this nature are, of course, common at the onset in many febrile diseases, particularly Influenza, but in Yellow Fever they are specially severe, and out of proportion to the pyrexia.

The following descriptions are typical:—

"Aches and pains all over the body."

"Aching pains in the loins and all over the body."

"Pains and aches all over the body, especially in the loins."

"Racking pains in the loins and extremities."

"Aching pains in the back and extremities."

5. *Epigastric Tenderness.*—This is generally recognised as a very common and an important symptom; it was noted as present in 22 out of 38 cases in the Lagos epidemic.

Dr. Paez (*vide* p. 162) lays special stress upon *Epigastric pulsation* as of great importance in diagnosis.

6. On or about the third day in cases of this type the aspect of the patient changes, the stage of *restlessness* is replaced by that of *stasis** (a term used by Dr. H. R. Carter, of the U.S. Public Health Service, a great authority on this disease, and the discoverer of the period of extrinsic incubation).

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* "Yellow Fever, its Epidemiology, Prevention and Control." H. R. Carter. Supplement No. 19, U.S. Public Health Reports, 11th September, 1914.

The pains and distress disappear; the patient can now sleep or rests without sleeping. The appearance of the face changes, the active congestion of the skin and mucus membranes is replaced by passive congestion. "The face is no longer swollen, it is not bright red; shows a dusky pallor rather; the conjunctivæ are red, but with tortuous veins; they are dry rather than moist, making the dull-red eye of this stage. A distinct yellow colour is nearly always observable in the eyes."

"He lies flat in bed on his back; slides down on his pillow. The whole appearance of the man as he lies in bed is one of rest. His mind is clear; he speaks only when it is necessary to speak; speaks slowly, distinctly with a low voice; and he is tired, very, very tired."*

7. *Pyrexia.*—"Yellow Fever is not a disease of high temperatures. Rarely does it go over 103·5° F., even in bad cases. The temperature of light cases is highest on the first day. The temperature of moderate cases is highest on the first or second day and then commences to fall; 100° to 102·5° would include nine-tenths of all cases of Yellow Fever we get in this country (*i.e.*, America.) . . . . . The temperature goes on gradually down to the fourth or fifth day, or a little beyond the sixth day."*

8. *Albuminuria.*—The presence of albumen in the urine is, excluding Pyrexia, certainly the most constant symptom in Yellow Fever; it was only absent in a single case amongst those so classified by the Commission; in that case the evidence as to the nature of the disease was conclusive, both on clinical and on epidemiological grounds. (Case 23, Yellow Fever Report). It is not, however, the mere presence of albumen in the urine that is of so much importance, as that may happen in Malaria and other febrile disorders, but in Yellow Fever it appears with slight pyrexia, and is often out of proportion to the degree of fever. "When you find a man with a temperature of 101·5° to 102° with albumen that you have to shake out of the tube, that is not the ordinary albumen of high temperature of an ordinary infection."*

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* Carter *Op. cit.*, p 24.

It is usually found about the evening of the third day. "When it appears on the first day it goes to a fatal termination, on the second day it is of very bad augury."*

At first it is small in amount, but increases for the next two or three days, and may do so *whilst the temperature is falling and the quantity of urine is diminishing.*

It may persist until the sixth or eighth day and gradually disappear as the urine returns to the normal quantity. This correllated sequence of events does not occur, so far as we are aware, in any other disease for which Yellow Fever is likely to be mistaken. It was observed in all the less severe cases during the Lagos epidemic.

The finding of tube casts in the centrifugalised deposit, especially if bile stained, is valuable confirmatory evidence.

9. *High Temperature with a Slow Pulse.*—(Faget's sign). Unlike what usually happens in the majority of acute febrile disorders the pulse in Yellow Fever very often does not follow the rise and fall of the temperature. This is known as Faget's sign, and is undoubtedly often observed in Yellow Fever, but in the early period of the illness, when the difficulty of diagnosis is greatest, and the question most important, the pulse is often rapid, full and bounding. Moreover this condition is often met with in other diseases, but not often in Malaria. Faget's sign is sometimes present throughout, but usually appears later, during the remission of the fever, and the slow pulse rate may be prolonged into the stage of convalescence. Faget's sign was noted in 33 out of 38 cases in the Lagos epidemic of 1913.

It is not improbable that the slow pulse of Yellow Fever, and of other conditions in which jaundice is present, is to be attributed to a like cause.

10. *Condition of the Gums.*—The condition of the gums should be carefully noted in every case in which Yellow Fever is suspected, as it may give an important clue to the nature of the disease. They are very often red and swollen and later may bleed.

11. *The Tongue.*—The appearance of the tongue varies, as it does in every febrile disease, but the most typical condition is a

* H. R. Carter, *Op. cit.*, p. 26.

pointed tongue, with a white dorsum and red tip and edges. It is not uncommonly described as furred, with the tip and edges clean; later it becomes small, dry and brown.

12. *Nausea and vomiting.*—Nausea is rarely absent, vomiting more often so, particularly in the mild cases occurring amongst natives.

13. *Jaundice.*—It is often difficult in native adults, owing to the natural pigmentation of the sclerotics, to be sure of the presence of jaundice, although not so in native children. The time of appearance in 24 carefully observed cases, all of which recovered, in the Lagos epidemic of 1913, was as follows: —

Day of the disease.	Cases.
4th	3
5th	5
6th	5
7th	2
8th	2
9th	2
10th	1
11th	3
12th	1
	24

In all these cases the sclerae are mentioned as the first site in which the colouration was noticed.

14. *Skin rash.*—The occasional occurrence of a rash, which is generally described as erythematous, has often been observed in Yellow Fever.

The following are descriptions of such a condition in a European who recovered. On the 7th day of the illness it is noted: —

> "There was an erythematous blush on the skin of the back and chest. On the eighth the rash was more pronounced and rosy. It looked like the rash of measles and extended to the abdomen, arms and legs. It had not appeared on the face. The rash was accompanied by some pruritus."

In a fatal case in a European, on the 4th day of the illness it is noted that: —

> "A rash like measles appeared on the face, the upper part of the trunk and the backs of the hands. Two days later it was fading, and after a similar interval it had disappeared, to be replaced by petechiæ about the neck and trunk and on the hands."

In a European æt. 45, in whom the disease was fatal, it is noted that "the skin is yellowish-red, almost the colour of brawn."

In a rapidly fatal case in a European, on the 4th day "an erythematous rash appeared on the skin of the neck and chest."

In a similar case, also in a European, it is noted on the 3rd day that "the skin is covered with a red rash."

15. *Epigastric Pulsation.*—Special stress was laid by Dr. Paez (*vide* p. 162) on this symptom, which, so far as we are aware, has not hitherto been observed.

16. *Other symptoms.*—Brief mention may be made of the following symptoms, as their presence or absence should always be noted in doubtful cases: —

Photophobia, thirst, a peculiar odour of the body described as "fishy," epistaxis, constipation, high coloured urine, pigmentation of the nails.

(*B*) DIAGNOSIS OF CASES OF THE SEVERE TYPE.

It would carry us far beyond the scope of this report to consider in detail the phenomena which may be met with in cases of Yellow Fever of the severe or hæmorrhagic type; moreover, it is unnecessary, as they are fully described in the text books, particularly those devoted to tropical diseases.

It may, however, be of service to comment briefly upon certain features which have been observed in cases which have come under the notice of the Commission.

Onset.—The onset of the illness in these, as in the milder cases, is usually sudden, and attended by rigor or sensations of chilliness, but a gradual onset is not uncommon, and does not preclude a severe or fatal attack. With what frequency "ambulant" cases occur amongst the natives is quite unknown.

In the Abeokuta case (*vide* p. 54) the patient had been feeling ill for three or four days before the onset of the serious symptoms, and was able to travel by rail to Lagos, yet the attack was fatal. A native who walked to the hospital stated that he had been ill for six days previously, yet the attack was severe. In the native cases it is not uncommon to find that they have been at work during the period

of the disease to which it is believed the power of infecting a mosquito is limited. The following are examples of this: —

> "The patient states that he felt ill four days ago, with a sensation of chilliness and headache. He continued at his work for a couple of days, but felt worse each day."—Lagos, Case 24.
>
> "Patient states that he felt ill on the sixteenth, but continued at his work all that day. Next day, though still feeling 'seedy,' he went to work again, but that night he had a severe frontal headache. * * * * * *."—Lagos, Case 28.

On reference to the sporadic cases (p. 57) it will be seen that the patient from Ogbomosho was taken off a passenger train, not because he complained of illness, but owing to the fact that he was found to have a temperature of 103°F.

In a Syrian, who died of Yellow Fever, the history of the onset of his illness was as follows: —

> "On May 18th the patient complained of feeling tired and of yawning and stretching himself frequently. On May 19th all the above feelings were exaggerated. On May 20th he took a dose of Epsom salts, but the tiredness was not relieved thereby. He sought medical advice at 6 p.m, when the temperature was 101° F."—Case 8, Yellow Fever Report.

In the Second Report (p. 125) the details are given of a remarkable case of Yellow Fever in a European, in which for five days the symptoms justified the diagnosis of Catarrhal Jaundice; yet on the sixth day the temperature, which had hitherto been normal, suddenly rose to 101°F then to 106°F. The patient became comatose, albumen appeared in the urine, dark fluid came from the mouth, and death followed on the following day. The post-mortem appearances were typical of Yellow Fever.

The consideration of other signs and symptoms in the cases of the severe type is deferred to the following section on "Differential Diagnosis."

SECTION XI.

DIFFERENTIAL DIAGNOSIS.

(*A*) The Differential Diagnosis of Malaria and Yellow Fever.

As this enquiry has proceeded it has become obvious that the most debatable question is still, as it has always been, the differential diagnosis of Malaria and Yellow Fever.

The Second Report of the Commission contains many illustrations of the fact that in the past cases of Yellow Fever have been diagnosed as Malaria, but it is not likely that the opposite error has often been made. Everywhere throughout the world the influence of Governments and of local popular opinion has been against a recognition of the fact that Yellow Fever was within their borders. Terror of the disease and fear of the effect of the announcement upon trade have generally been the determining factors.

Those concerned took less trouble to learn to distinguish the one disease from the other, because they had determined beforehand, if possible, never to admit the existence of Yellow Fever.

Augustin gives a list of 152 names which have been at one period or another in use to describe the disease; indeed, the writers of all nationalities appear to have vied with each other in the production of names, many of them doubtless invented with the sole purpose of avoiding the use of the term "Yellow Fever" and implying that it is really a form of Malaria.

Second Report, p. 140.

As already stated, "the Commission are of opinion that the day has gone by for endeavouring by the use of euphemistic terms to conceal the presence of Yellow Fever, and that the only hope of eradicating the disease lies in boldly facing the facts."

Second Report, p. 60.

Again, "It is to be particularly noted that with a change in the observer temporarily in charge, 'Yellow Fever' immediately appears in a place where 'bilious remittent fever,' 'bilious hæmaturic fever,' and 'malignant (hyperpyrexia) fever' had recently been present." One of the most comprehensive names, which is of frequent occurrence in the West African reports, is "bilious remittent hæmorrhagic fever."

When the symptoms of two diseases having a resemblance to one another are enumerated on paper without comment or explanation, it may appear to the inexperienced either impossible to mistake the one for the other, or impossible to differentiate them; nevertheless, almost a single glance may be sufficient to enable a practised clinician to decide with which of the two he is dealing. In the recognition of disease there is much that cannot be written down so clearly that he who reads may see, if it were not so a "Family

Encyclopædia of Medicine" would suffice for diagnosis. The vomiting of any black material may be "black vomit" to one who has never seen it in Yellow Fever, but it is not necessarily so to a physician experienced in the diagnosis of that disease.

Dr. Felix Paez, Chief of the Medical Department of the Hospital Ruiz, Ciudad Bolivar, Venezuela, who has had very considerable experience of Yellow Fever in that country, kindly attended a meeting of the Commission and gave interesting evidence on the question of the differential diagnosis of the bilious remittent type of Malaria from Yellow Fever and on other points.

The following is an *epitomé* of Dr. Paez' views:—

(1) He recognised three types of Yellow Fever:—

(i.) A very mild form=20 per cent.
(ii.) The common form=60 per cent.
(iii.) A severe form=20 per cent.

There was not much difficulty in differentiating Malaria from Yellow Fever. Bilious remittent fever was recognised as Malaria; it was characterised by vomiting and jaundice. Only very mild cases of Yellow Fever could be mistaken for bilious remittent. Including these mild cases, hæmorrhages from the nose or gums or elsewhere would be found in 95 per cent. (*sic*) of the cases of Yellow Fever, if carefully looked for. A peculiar sniffing or sighing type of breathing was frequently present in Yellow Fever.

(2) The pulse was high in Malaria, but low in Yellow Fever. He attached great importance to Faget's sign, which was absent in Malaria. He had seen a pulse of 38 in convalescence and 45 was common.

(3) He also attached importance to the appearance, increase, decline and disappearance of albumen in the urine; albuminuria was not present in Malaria of the bilious remittent type: to the lessened quantity of the urine and its high specific gravity.

(4) Also to the appearance of jaundice on the third day, rarely on the second; usually slight at first, but sometimes very intense. Some of the slight cases did not show any jaundice.

(5) Also to the facial appearance, but this was not absolutely diagnostic. Two or three definite signs must be assembled before a case could be recognised with certainty.

(6) He laid special stress upon epigastric pain and *pulsation*, the latter could be seen. It occurred in very mild cases of Yellow Fever. It was not, in his opinion, hepatic or due to over distension of the right side of the heart; probably it was derived from the cœliac artery. It was never present in Malaria.

(7) The vomit in the first instance was alimentary, then bilious and then would contain specks of blood, "fly specks" or red blood filaments. There might be a vomit of red blood, especially in children. Sometimes there would be a black vomit, like coffee, at other times only "fly specks."

(8) The liver and spleen were commonly enlarged in bilious remittent fever, whereas enlargement of the liver was rare in Yellow Fever, and the spleen was seldom or never enlarged in ordinary cases, but it might be so in very severe cases.

(9) The temperature in Malaria might drop quickly to the normal in one day. If a Yellow Fever patient also suffered from a malarial paroxysm the typical remission on the third day would not be observed. He did not think that *latent* Malaria would modify the course of Yellow Fever.

(10) Fever of the bilious remittent type was, in his opinion, more common as the earliest, than as a subsequent, manifestation of Malaria.

(11) He had seen death from Malaria. Consciousness was lost and the heart failed, whereas in Yellow Fever they died of anuria, sometimes with convulsions.

(12) He had seen hyperpyrexial fever, it was really pernicious Malaria.

The Commission are indebted to Dr. Felix Paez for the translation from "Yellow Fever, by Dr. Luis Cuervo Marquiz" of the

following tabular statement with comments on the differential diagnosis of Yellow Fever and Bilious Remittent Malarial Fever:—

"DIFFERENTIAL DIAGNOSIS OF YELLOW FEVER FROM BILIOUS REMITTENT MALARIAL FEVER.

"*Bilious Remittent Fever.*	*Yellow Fever.*
"(1). It is localised to intense marshy foci.	(1) It is observed in places where malaria does not exist and is absent in others intensely paludic.
"(2). It is found particularly in the open country.	(2). Particularly found in towns or where there are collections of people.
"(3). It spares new comers, and it is usually preceded by advanced malarial conditions.	(3). New comers are most frequently attacked. It is not preceded by malarial conditions.
"(4). The first attack predisposes to others.	(4). A first attack preserves from further ones.
"(5). It is not transmissible.	(5). It is transmissible.
"(6). It is sporadic, or may affect the epidemic form after great floods, and at the beginning or end of the rainy season.	(6). It is epidemic or endemo-epidemic. The influence of floods has not been well established.
"(7). There are generally prodromal symptoms.	(7). The invasion is generally sudden.
"(8). During the period of invasion the face does not present any noticeable feature.	(8). The *facial syndrome*, characterised by the turgescence of the skin of the face, the congestion of the ocular and buccal mucosæ, and more particularly of the palatine and gingival mucosæ, is typical of yellow fever, and is comparable only with those of eruptive fevers. It is not constant in the mild form.
"(9). The skin does not present any characteristic feature. It is pale, moist, without patches or rashes during the invasion. Ecchymoses and large blood effusions of the cellular tissue are exceptional.	(9). The skin is congested at the initial period and turns yellow during the second and third. These hæmorrhages are not present as a general rule, but are met with frequently.
"(10). Hæmorrhages are present in a restricted number of cases. Epistaxis as a rule is very slight. Hæmatemesis, enterorhægia and other hæmorrhages of mucosæ are so rare that some authors, as Dutraulau and Vallin, deny their existence. "Hæmorrhages cannot be considered as symptoms of remittent fever, but as complications.	(10). Hæmorrhages are constant symptoms. In the mild form they may be confined to slight epistaxis or be totally absent.
"(11). The temperature rises and maintains during the stadium period for some time with morning remissions and evening rises. The oscillations may be of 1·5°, 2°, 2·5°, between morning and evening temperatures.	(11). The temperature rises rapidly during the first 12 or 36 hours to the maximum. Then a remission may follow, which in many cases may go on to a complete defervescence or it may rise again to the initial figure, to go down again in a rapid or oscillating manner.
"(12). The recurrences during remission, which are only the continuation of the fever, are the rule.	(12). Recurrence is rare. The period of calm is constant.
"(13) Jaundice is an early symptom.	(13). Jaundice is relatively late.
"(14). There is no diminution in the quantity of urine nor anuria, except when there is some renal complication. Albuminuria may be present in grave cases. The urine is bilious.	(14). Albuminuria and the diminution of the quantity of urine which may go on to anuria are constant in grave cases. The urine seldom contains bile.

" Bilious Remittent Fever.	*Yellow Fever.*
" (15). Cephalalgia and rachialgia are moderate. The first is seldom localized.	(15). Cephalalgia and rachialgia are constant and intense. Cephalalgia is localized in the frontal region.
" (16). Meningo-encephalic manifestations are of no importance and are frequently absent.	(16). Meningo-encephalic conditions are constant.
" (17). Indefinite duration.	(17). The evolution lasts a week or a week and a half.
" (18). Convalescence is slow and there is weakness. Malarial manifestations may follow.	(18). Convalescence is easy.
" (19). Nothing particular occurs during convalescence.	(19). Depression, hypothermia and slowness of the pulse are nearly constant.
" (20). Quinine is the remedy for the disease.	(20). Quinine fails.
" (21). Post-mortem shows infections of the spleen and liver, and black dots on the surface of the brain, especially in the bulb.	(21). The liver is either enlarged, or normal or small and generally yellow. The spleen is normal or small, except when there is a malarial condition co-existing.
" (22). The fever is frequently followed by intermittent fits.	(22). Intermittent fits are met with only when there is existing malaria.
" (23). The mortality is great, but not to the proportions of yellow fever. Generally, death is the consequence of a series of attacks	(23). There is a higher mortality than in the remittent fever.

" The diagnosis is a very easy one to be made theoretically, as we see, but in practice there are cases in which the most experienced practitioner is doubtful about the disease he has to confront.

" In a remittent fever cephalalgia, severe rachialgia, nausea and vomiting, albuminuria, epistaxis, jaundice, that is to say, the syndrome of a case of yellow fever of medium intensity, may be met.

" Similarly, in a case of yellow fever one may find cephalalgia, moderate rachialgia, bilious vomits, slight remittence, early jaundice, bilious urine and the whole aspect of the remittent fever. In these cases it is very difficult to make a diagnosis when yellow fever and remittent fever co-exist in the same place.

" In our opinion, to settle the matter from the first moment is impossible, and that only by a close and attentive examination of the preceding conditions, of the progress of the disease, by a grouping of the symptoms rather than by isolated symptoms, we may obtain the elements to make a diagnosis which will be always of a reserved character. And still there are cases in which even *a posteriori* one cannot say which disease one has dealt with.

" Putting aside the etiological elements, which sometimes are conclusive, we think that in the first stage the *facial syndrome;* in the second stage the thermic remission, the albuminuria, the jaundice, the slowness of the pulse; in the third stage the multiple hæmorrhages, the diminution or suppression of urine and the aspect of the vomit; in the convalescence the hypothermia, the depression, the slowness of the pulse, and in the whole course of the disease a particular aspect of the patient, which you see but which you cannot describe, are the salient features which practically separate the two diseases."

It will be noticed that on some points the views of Dr. Cuervo Marquiz and Dr. Paez are not in accord.

Dr. Paez is of opinion that the bilious remittent type of Malaria can only simulate the very mild type of Yellow Fever, whereas it is clear from the tabular statement of Dr. Marquiz that it may resemble the more severe type.

Again, fever of the bilious remittent type, in Dr. Paez' opinion, is more common as the earliest than as a subsequent manifestation of Malaria, whereas Dr. Marquiz considers that it is usually preceded by advanced malarial conditions.

It is clear from the omission of any mention of the possible presence of parasites and pigmented leucocytes in the blood in Malaria, and their absence in uncomplicated Yellow Fever, that at the date at which Dr. Marquiz wrote this aid to diagnosis had not been discovered.

Dr. G. C. Low in a paper on the "Differential Diagnosis of Yellow Fever and Malignant Malaria" (B.M.J., September 20th, 1902, p. 860) reviews the various symptoms of the two diseases and concludes thus:—

> "It is fortunate, with all these symptoms in so many ways resembling each other, that we possess an almost decisive method of at once determining between the two diseases—namely, the examination of the blood for the malarial parasites.
>
> "It is true that in some cases the parasites of malignant malaria may be extremely scanty in the peripheral blood, and repeated search may be necessary to find them; but, as a rule, this does not hold good, one or two glances through the microscope often being sufficient to clear up the matter, parasites and corroborative evidence in the shape of pigmented leucocytes being seen. Of course, quinine must not have been administered before the examination of the blood is made; if this drug has been recently given a negative result is of no value."

It has been calculated upon the basis of certain standards, which it is unnecessary to set out in detail here, that the lowest number of parasites in the body capable of producing a first attack of Malarial Fever is:—

> "At least one parasite to 100,000 hæmatids; that is, 50 parasites in 1 c.mm. of blood; or 150,000,000 in a man of 10 stone (64 kilograms) in weight."

"The Prevention of Malaria," R. Ross, 1910, pp. 90-94.

Also that:—

"If the parasites are so few as this we can expect to find them at the rate of about one every quarter of an hour. But chance intervenes here: if we are lucky we may find the first parasite almost at once; if we are unlucky we may have to search several hundreds of thousands of hæmatids before finding an infected one. There is always the danger of overlooking a plasmodium when it should have been seen."

"In the thick-film process (1903) 1 c.mm. of blood occupies only about one-fifth of a square c.m. of area or less, so that there should be twenty to thirty times more hæmatids and parasites per field."

"Such calculations demonstrate the absurdity of supposing that there are no plasmodia present in a person because we fail in finding one after a few minutes' search. As a matter of fact, even if as many as 150,000,000 plasmodia are present in an average man, the chances are that ten to fifteen minutes' search will be required for each plasmodium found; while if we are careless or unfortunate we may have to look much longer."

If therefore the fever is due to Malaria, and the observer is competent, and his search sufficiently prolonged, the parasites should be found.

The consideration of this question of diagnosis is continued in the following sections on "Albuminuria in Malaria" and on "The Diagnostic Significance of the Presence of Malaria Parasites in cases of Pyrexia and on their absence."

Quite recently a paper has appeared in the American "Journal of Tropical Diseases and Preventive Medicine" on "A method of Concentrating Malaria Plasmodia for Diagnostic and Other Purposes," by C. C. Bass, M.D., and F. M. Johns, M.D., of the Tulane College of Medicine, New Orleans (p. 298-303), which may possibly prove of very great assistance in the differential diagnosis of Malaria and Yellow Fever.

The paper commences as follows:—

"While working in Panama upon the cultivation of Malaria plasmodia during the summer of 1912, we discovered that whenever defibrinated or citrated blood containing crescents was centrifuged at a high rate of speed for a sufficient length of time these plasmodia rose to the top of the cell column, and that by this means a mass of almost pure crescents could be obtained from blood containing large numbers of them. The possibilities of this method of concentration of plasmodia for diagnostic and other purposes were at once appreciated after we had learned by further experiment that both the gametes and the schizonts of the other species of plasmodia could be concentrated in the same way."

The principles involved are thus explained: –

"The fundamental principles involved are the fact that a malaria plasmodium with its host erythrocyte is larger than the non-parasitized erythrocytes, and that when centrifuged at proper speed for sufficient length of time the larger cells rise to the top of the cell column, while the smaller cells collect beneath. Most of the leucocytes are still larger than most of the parasitized cells and accordingly rise to a higher level in the cell column, in fact, to the surface. After sufficient centrifuging, we have in the tube from the bottom upward, non-parasitized erythrocytes, parasitized erythrocytes, leucocytes and serum. If citrated, in place of defibrinated, blood is centrifuged, a greater or less amount of platelets settles upon the leucocyte layer, but unless it is centrifuged for a long time at high speed, most of them remain suspended in the supernatant plasma. The older and larger the parasites, the more certainly and promptly do they collect at the top when the blood is centrifuged. Crescents, other mature gametes, and tertian and quartan schizonts more than half grown, rise much more quickly than smaller parasites. In fact, many of the very smallest rings of the æstivo-autumnal species do not rise at all and little concentration of these can be obtained. The large ring forms and ameboid parasites of all species rise promptly. By proper technique ninety per cent. or more of all the plasmodia (except the smallest rings in which the percentage is considerably lower) can be collected from 10 cc. of blood and all placed upon one or two slides in the form of ordinary blood spreads. Of course, in very heavy infections, the total quantity of plasmodia may be too great for it all to be made into one or two ordinary blood spreads."

"The Ross thick film method, with which almost all workers on malaria are familiar, increases the chances of finding plasmodia in a search of a given length of time approximately ten times, since it is possible to examine in this way a film as much as ten times thicker than the thickest ordinary blood film that can be satisfactorily examined. The method has the advantage of being adaptable to field work, while our method would be applicable for diagnostic purposes to office and hospital work and only to a somewhat limited extent to general field work.

Assuming that one cc. of blood would make about one hundred ordinary blood spreads, and that at least 90 per cent. of all the plasmodia (except small æstivo-autumnal rings) present in 10 cc. of blood, can be collected and placed on one spread, the advantage over the ordinary blood spread method appears to be approximately 900 times. In other words, one minute spent in looking for plasmodia in a specimen prepared by this method should yield the same results as 900 minutes, or 15 hours, spent examining an ordinary blood spread. There is no reason why the idea of the Ross thick film method should not be combined with our method if desired, which would increase the efficiency to 9,000 times the ordinary blood spread method."

The description of the complete technique is too long for reproduction here and the reader is referred to the original paper.

The plates which accompany the paper give a very good idea of the degree of concentration which can be obtained by this method.

The long period which the authors have devoted to the perfection of the technique before publishing their results is a useful example to all workers in science, and increases the probability that the method will come into general use and will prove of great value in the differential diagnosis of Malaria and Yellow Fever.

(*B*) Albuminuria in Malaria and Yellow Fever.

The Commission have devoted considerable attention to the subject of the occurrence of albuminuria in Malaria, and have received much assistance from the work of the Investigators and from the evidence of witnesses who have kindly given them the benefit of their experience.

The question is one of great importance, in view of the contention that albuminuria is of such frequent occurrence in Malaria, that in the differentiation of that disease from Yellow Fever its presence in any case of suspected Yellow Fever is of little diagnostic value.

The statements in the text books and in the literature of the subject indicate considerable divergence of view, some authors being of opinion that this association is of frequent occurrence, whilst by others it is regarded as extremely rare.

Sir Patrick Manson writes as follows:—

"Tropical Diseases," 5th Edition, 1914, p. 55.

> "*The Urine in Ague.*—During the cold stage the urine is often limpid and abundant, and is passed frequently; but during the hot and sweating stages it is scanty, loaded, sometimes albuminous."

Subsequently the same author, in describing the clinical forms of Malarial Fevers, observes:—

Ibid, p. 71.

> "It is neither necessary nor desirable to attempt to describe in detail the infinite variety malarial attacks exhibit. It would be impossible in a limited space to do so; and if done the result would amount only to an uninteresting and unprofitable ringing of the changes on rigor, pyrexia, diaphoresis, bilious vomiting, bilious diarrhœa, constipation, catarrhal gastritis, headache, boneache, prostration and so forth."

It is of interest to note that in this list of symptoms neither albuminuria nor any more severe renal complication is mentioned.

We shall therefore probably not be misrepresenting Sir Patrick Manson's views in concluding that in his experience albuminuria is not a common complication of Malaria.

Sir Leonard Rogers states:—

"*The Urine in Malaria.*

"The urine may be increased during the cold stage and decreased and of high specific gravity after the sweating one, but it very rarely shows albumen or other marked changes in uncomplicated cases." "Fevers in the Tropics," 2nd Edition, p. 207.

The same author, under "The Urine in Yellow Fever," states:—

"Of still greater importance is the presence of ALBUMEN (*sic*), as the prognosis largely depends on the quantity present; moreover, it has considerable diagnostic value. The date of its appearance is very variable, although it rarely appears on the first day (3 per cent.), becomes more common on the second day (18 per cent.), and is most usually first evident on the third and fourth (55 per cent.), appearing with diminishing frequency after the fifth day. It varies from a trace up to an amount sufficient to completely solidify the fluid on boiling. The quantity of urea excreted in the twenty-four hours is also reduced in yellow fever, and very markedly so in many of the more severe attacks, much in proportion to their severity. Granular and hyaline casts may be present at any period, and blood corpuscles and detrities in addition in the second stage." *Ibid*, p. 274.

The same author, in discussing the diagnosis of Yellow Fever, writes as follows:—

"Such mild cases are most likely to be mistaken for a malignant tertian malaria, especially if complicated by the hæmoglobinuria of blackwater fever, the temperature curves being not at all dissimilar. The microscope is the surest means of differentiating between them, for the finding of malarial parasites, or in blackwater fever an increase and pigmentation of the large mononuclears, will enable those diseases to be recognised. The pulse is also a very important guide, for it is nearly always rapid during the pyrexia of malarial fever, but soon becomes slowed down in yellow fever. *Ibid*, p. 275.

"Relapsing fever is said also to be easily mistaken for yellow fever * * * * * * in both the above diseases albumen is rarely found in the urine, except during hæmoglobinuria complication, whilst it is present in yellow fever after the second day."

It is clear from the above statements that the author does not regard albuminuria as other than a rare complication of Malaria.

Castellani and Chalmers (2nd Edition, p. 863) under "Malaria," state:—

"During the attack the urine is at first increased in quantity. * * * * * *. Notwithstanding this increase in quantity the specific gravity is raised * * * * * * the colour is dark and the acidity of the

urine is increased * * * * * *. Serum-albumen may be present after severe attacks, and proteose has been reported, as well as nucleo-proteid. When the intermission comes, the urine diminishes in quantity * * * * * *. During convalescence the most marked features are the polyuria with low specific gravity, which in subtertian fevers may be so marked as to alarm the patient * * * * * *."

The same authors (p. 883) under "(*b*) Pernicious Fevers with Local Symptoms":—

"*Comatose Pernicious Fever.*—The urine, which may have casts and a little albumen, is usually passed involuntarily, as are the motions."

These authors are also clearly of opinion that albuminuria is only a rare complication of Malaria, and that it is, as a rule, only met with in severe attacks of that disease, in which other unmistakable symptoms are present.

Vol. 1, p. 417, *et seq.*

Dr. Charles F. Craig, in the article on the Malarial Fevers in Osler and McCrae's "System of Medicine," writes as follows:—

"Tertian and Quartan Malaria.

"*The Cold Stage.*

"* * * * * *. The urine is increased in quantity and lowered in specific gravity."

"During the cold stage an excessive amount of urine is often voided, polyuria being a most frequent symptom."

"Albuminuria is present in a considerable proportion of cases. Of over 1,000 cases of tertian infection, personally observed, nearly 400 showed albumen in the urine and 86 showed the presence of a few granular and epithelial casts." (p. 418.)

"Symptoms of Tertian Æstivo-Autumnal Fever.

"*Hot Stage.*

"The urine is increased in quantity and is generally albuminous."

This is evidence that, in America, during a malarial attack, presenting a typical cold and hot stage, and therefore easily recognisable by those and other features, albumen may be found in the urine in a considerable percentage of cases.

Ibid, pp. 428, 429.

The same author, under "Complications and Sequelæ," states:—

"The most common disease of the *genito-urinary* system complicating malaria is nephritis. Some form of nephritis occurred in at least 4 per cent. of æstivo-autumnal infections and in about ½ per cent. of tertian infections personally observed.

"It is more frequently a sequela of malaria than a complication."

Also, later (p. 431), under "Sequelæ of Malaria":—

> "Among diseases of the genito-urinary system albuminuria is of frequent occurrence during acute attacks of malaria, and oftentimes persists for some time after the cessation of such attacks. Thayer and Hewetson found albuminuria in over 50 per cent. of their cases. Thayer found that it was most frequent in æstivo-autumnal infections, occurring in 58·3 per cent. of these infections, in contrast to 38·6 per cent. of tertian and quartan infections. Rem-Pici has contributed most extensively to our knowledge of the albuminurias occurring during and after malarial infections. From personal experience albuminuria occurs in about 50 per cent. of cases of æstivo-autumnal and in about 30 to 35 per cent. of cases of tertian and quartan malaria.
>
> "Both acute and chronic nephritis may occur as sequelæ of the malarial fevers. * * * * * *. Personal observations suggest that nephritis occurs in at least 3 per cent. of all cases of æstivo-autumnal infections, the most common form being chronic parenchymatous. It is rare in tertian and quartan infections, but is always found in fatal cases."

A "complication" of a disease is an event of occasional occurrence during the course of the disease, certainly not one of its distinctive features. Similarly, a "sequela" of a disease is a lesion sometimes met with after the acute symptoms distinctive of the disease have disappeared.

Applying these tests to the occurrence of albuminuria in Yellow Fever and Malaria respectively we observe that in the former disease it is invariably present, appears at or about a certain day, continues for a variable period, and, in cases which recover, disappears as the illness passes off, without leaving permanent effects upon the renal organs; whereas in the hospital cases of Malaria at Baltimore, upon which these observations were made, presumably severe cases, nephritis was found more frequently as a sequela than as a complication, but in only 3 per cent. of such infections. The small amount of albumen found in the large proportion—50 per cent. to 38 per cent.—of the cases observed at Baltimore is mentioned in the extracts from Dr. Thayer's article on "Malaria" in Allbutt and Rolleston's "System of Medicine," quoted below.

The paper by Thayer and Hewetson referred to above in Dr. Craig's article is based on the records of 616 cases of Malarial Fever treated in the wards and out-patient department of the Johns Hopkins Hospital between the years 1889 and 1894.

Thayer & Hewetson. "The Malarial Fevers of Baltimore." JohnsHopkins Hosp. Rep., 1896, Vol. V., p. 5.

It is of interest to note, as reference is made to the statement in a later section of this report (*vide* p. 183) that "excepting two or

three instances where the patients entered the hospital during convalescence, the specific micro-organism was found in every case of Malarial Fever treated in the wards."

The condition of the urine is thus described (p. 73):—

"*Urine.*—The analysis of the urine in the 335 cases occurring in the hospital shows the following results:—

"The urine was normal in 151 instances.

"Albumen was noted in 133 instances.

"Casts of the renal tubes were found in 31 instances.

"The 'diazo' reaction was present in 18 instances.

"Acute hæmorrhagic nephritis was present in 3 instances.

"Severe subacute diffuse nephritis was present in 1 instance.

"No note was made in 51 instances.

"In not a single instance of malarial fever observed in the hospital or in the out-patient department was hæmaturia present, with the exception of the three cases of acute nephritis, where the blood was present in the shape of altered red corpuscles, giving a smoky character to the urine."

Dr. Thayer in the article on "Malaria" in Allbutt and Rolleston's "System of Medicine" makes a fuller statement as to the amount of albumen found in the Johns Hopkins Hospital cases:—

Vol. II., Part II., p. 263.

"*The Urine in Malaria.*—* * * * * *. In the regularly intermittent fevers, tertian and quartan, a trace of albumen was present in 38·6 per cent. of 352 cases in the wards of the Johns Hopkins Hospital. In æstivo-autumnal fever it was more frequent, occurring in 58·3 per cent. of 165 cases. In the great majority of instances there was only a slight trace. In many of the cases in which albumen is found occasional hyaline casts may be detected in the sediment. In pernicious fever traces of bile may be found."

And later in the same article the following occurs (p. 365):—

"*Nephritis.*—Acute nephritis is not an uncommon sequel, occurring in 1·7 per cent. of 1,832 cases analysed at the Johns Hopkins Hospital. Rare in tertian and quartan infections, it is by no means infrequent in æstivo-autumnal fever. There is nothing remarkable in the character of the disease, which pursues the course of an ordinary acute toxic nephritis. Of 26 cases of malarial nephritis 14 recovered; 4 died; in 9 the result was doubtful; in 2 chronic nephritis followed. We have since seen several additional cases of chronic nephritis of undoubted malarial origin."

W. S. Thayer, 1898, p. 181.

The same author in "Lectures on the Malarial Fevers" states:—

"*Albumen.*—Albumen is usually present after severe paroxysms. In the regularly intermittent fevers it may amount only to a slight trace, whilst in severe infections it may be more abundant.

"The *sediment* here shows usually a few hyaline or granular casts. In the milder cases these are *only to be found after the most prolonged and careful search.* Where the albumen is more abundant they may be frequent. Italics not in the original.

"Acute nephritis occasionally occurs in connection with or following malarial infection. Here the sediment shows numerous hyaline, granular and epithelial casts, and in some instances blood.

"Malarial fever may be followed by severe chronic nephritis; here the quantity of albumen may be abundant (one half per cent. or more), while the sediment may show numerous casts and renal epithelial cells."

Osler (7th Edition, p. 15) states under "Morbid Anatomy":—

"3. The accidental and late associations of malarial fever:—

"(*c*) *Nephritis.*—Moderate albuminuria is a frequent occurrence, having occurred in 46·4 per cent. of the cases in my wards. Acute nephritis is relatively frequent in æstivo-autumnal infections, having occurred in over 4·5 per cent. of my cases. Chronic nephritis occasionally follows long continued or frequently repeated infections."

Dr. David G. Willets, in an article on "Malaria in the Philippine General Hospital, Manila, P.I., during the fiscal year, 1913," gives under "Miscellaneous Hospital Findings":— "The Philippine Journal of Science," Vol. IX., Sec. B., No. 5, September, 1914, p. 445.

"TABLE III.—URINALYSIS.*

	Number.	Per cent.
Persons not examined	28	—
Persons examined	157	—
Persons negative	3	1·9
Persons with—		
Albumen	73	46·5
Albumen and casts	38	24·2
Albumen casts, pus cells and red cells	13	8·3
Albumen and pus cells	9	5·7
Albumen and red cells	8	5·1
Albumen casts and red cells ...	8	5 1
Albumen casts and pus cells ...	3	1·9
Albumen pus cells and red cells ...	2	1·3
	157	100·0

* *Author's Note.*—"As a rule but one morning specimen of urine was examined. The heat and acetic acid test was used for albumen."

We shall now proceed to consider the evidence bearing on this question contained in the reports from Investigators and the evidence of witnesses, many of whom were able to speak as to the condition of the urine in Malaria, as that disease is observed amongst Europeans and natives on the West Coast of Africa.

Lt.-Colonel Statham, who investigated on behalf of the Commission at Sierra Leone a series of 800 cases of medical pyrexia in 1913, and whose report thereon, and also on a further series of 300 cases of the same nature of earlier date, is contained in the Second Volume of Investigators' Reports (pp. 353-386) states (p. 359):—

> "Of 150 urine examinations which time has permitted me to look up, half in Europeans and half in natives, albumen was present in 9 of 75 cases amongst the former and 32 of 75 amongst the latter.
>
> "The presence of traces of albumen in natives is largely due, I believe, to urethral affections. Possibly ankylostomiasis, so prevalent among them, may also account for the presence of albumen in their urine. Casts were rarely or never found in these native albuminurias."

We have analysed Table IV. (p. 364) of Colonel Statham's Report, which deals with 71 cases of fever of a doubtful nature amongst adults, with the following results:—

(1) Malarial parasites were not found in any of the 71 cases, but it is noted in many of the cases that quinine had been given.

(2) Of 39 cases in which there is a record of the condition of the urine as regards albumen it was absent in 38, of which 17 are regarded as Malaria, either on clinical grounds or from the effect of quinine.

(3) Many of the cases in which the condition of the urine is not noted were also regarded as cases of Malaria.

(4) A slight cloud of albumen was present *in only one case* (No 71), which is classed as "?Typhus, Dengue type, 3 distinct rashes."

It does not therefore appear that albuminuria is of frequent occurrence in cases of pyrexia of a doubtful nature amongst adults at Sierra Leone whether Europeans, West Indians or natives.

Dr. G. G. Butler, in a Report on work carried out at Sierra Leone in 1913, also contained in the Second Volume of Investigators'

Reports (pp. 389 to 416), p. 397, deals with this qestion as follows: —

> "The presence of albumen has been the point to which particular attention has been directed. Amongst the in-patients a difficulty has been met with owing to the untrustworthiness of the native dressers, *e.g.*, one specimen of urine was watered down and made to serve as specimens from four different patients."
>
> "The question of small quantities of albumen in the urine has appeared to me to be an important point to investigate, on the supposition that a mild case of yellow fever may well show only a trace of albumen, for I have assumed that the less toxic the condition of the patient the less likelihood is there of any damage to the kidneys, or, in other words, that the albuminuria may be a measure of the severity of the illness."

Dr. Butler examined as a control 437 urines from hospital out-patients, irrespective of their illness, of these in 248 albumen was absent; in 189, *i.e.*, 43 per cent. albumen was present, in quantity from a trace upwards. Of these it was present in "some quantity" in 60 cases: —

> "These figures only give a rough idea of the prevalence of slight cases of albuminuria in patients examined in a routine fashion and quite irrespective of their illnesses.
>
> "The cause of their condition appears to be largely the prevalence of chronic urethral disease; among the Freetown natives of the hospital class a prostatitis or gleet is almost the rule above a certain age, and the presence of prostatic threads with the absence of casts is suggestive that the albumen is not of kidney origin.
>
> "Owing to this state of affairs the difficulty of associating the presence of albuminuria with the illness of the patients is unfortunately increased.
>
> "Under the heading of malaria a statistical account will be given of the extent of albuminuria found associated with the condition—*without the elimination of urethral disease, however.*" (p. 398.)

Dr. Butler's results from the examination of the urine in the malarial cases were as follows (p. 403): —

> "*Albuminuria.*—Urine examinations in these malarial cases has not been so frequent as I could wish: this has been due to two reasons—firstly, because the diagnosis of malaria having been made on the blood condition, before I had been put on my guard by the control observation, any further examination of the patient was supposed to be unnecessary; and secondly, because most of the malarial cases were out-patient cases which made this further procedure rather awkward. However, there have been 42 examinations of urine among the in-patient cases; 21 showed no albuminuria, and the remaining 21 showed its presence as a 'thin cloud' with the acidifying and boiling test. In one case there was quite a heavy cloud of albumen."

It will, however, be remembered that Dr. Butler found albumen in the urine in 43 per cent. of his control cases; if therefore we apply that experience to these 42 malaria cases it is obvious that the share taken by the malarial infection in the production of the albuminuria in the in-patient cases was either insignificant or, having regard to the fact that the figures only give "a rough idea" of the frequency of slight albuminuria, and also to the statement as to the untrustworthiness of the native dressers, that it had no effect whatever.

It is clear from the foregoing statement that it is necessary to be *extremely* careful in drawing conclusions as to the significance of albuminuria in natives, either that: —

(1) Malaria is commonly associated with albuminuria; or

(2) That a given case is possibly one of mild Yellow Fever as albumen is present in the urine; or

(3) That the mere presence of albumen in the urine in such patients has necessarily any significance, either as regards Malaria or Yellow Fever.

As already stated, more than once, it is not the presence of albumen in the urine which is the point of so much importance in the diagnosis of the mild type of Yellow Fever, but its appearance on or about a certain day, its increase, and its gradual disappearance during convalescence, accompanied by characteristic changes in the quantity of the urine.

Dr. G. E. H. Le Fanu has reported the results of an investigation of cases of fever at Quittah from March to June, 1914.

The cases numbered 106, of which 81 were in children, and 25 in adults from 17 years upwards.

The following diseases were met with: —

Malaria	94	(worm infections in 11)
Yellow Fever	3	
Helminthiasis	4	
? Enteritis	1	
Typhoid Fever	2	(1 doubtful)
Pulmonary Congestion ...	1	
Undiagnosed	1	
	106	

Malarial parasites were found in 88 of the cases diagnosed as Malaria, as follows:—

Subtertian	55
Tertian	19
Quartan	2
Subtertian and Tertian	4
Tertian and Quartan	2
Quartan and plasmodium tenue	1
Species not determined	5
	88

The following statement as regards the cases of Yellow Fever occurs in the Report:—

> "Three cases of yellow fever were observed. In one (No. 26), which was fatal, there could be no doubt as to the diagnosis. In the second (Case 63) there seems to have been a latent malarial infection, as careful examination of the thick films repeatedly revealed the presence of pigment, though no parasites were found until the 8th day. The third case (No. 98) was slight and of short duration."

Table 1 of the Report contains a list of cases with albuminuria and jaundice.

Thirty-seven cases are included in this table, from which it appears that albuminuria was present in 34 cases:—

Slight	23
Marked	6
Very marked	5
Not examined	1
Absent	2
	37

Of the 37 cases included in this table, evidence of malarial infection was present in 28 cases.

Jaundice was observed in nine cases and worms were found in 15 cases.

Analysis of the table shows that the number of cases in children in which albuminuria was present is very large, viz., 20 out of 22, in one the urine was not examined and in one only was albumen absent. All these were cases of Malaria except one.

In eight cases in children aged 2 years and under, albumen was found in the urine; one of these was only 8 months old.

The nature of the test for albumen employed in these cases is not stated in the Report.

The following are all the statements of witnesses which have a bearing upon the question under discussion.

Sir Charles Pardey Lukis, K.C.S.I., Director-General of the Indian Medical Service, who kindly attended a meeting of the Commission, stated that a parenchymatous nephritis was common in Malaria in India.

Lt.-Colonel Statham stated to the Commission that albuminuria had been shown in only two or three out of some thirty cases of Malaria in Europeans, but in about one-third of the native cases.

Colonel Gorgas stated that albuminuria was very common in severe Malaria, and that the albuminuria in Malaria was more marked in negroes than in whites and subsided with the fever. In Yellow Fever there was a progressive decrease of the urine and increase of the albumen.

Dr. W. E. Deeks, chief of the medical clinic of the Ancon Hospital, Panama, who kindly gave evidence before the Commission, stated that in his experience albuminuria was present in almost *all severe cases of æstivo-autumnal Malaria.* It nearly always cleared up rapidly, and was simply a slight febrile albuminuria. Casts were also found. He was of opinion that in 80 per cent. of the cases of Malaria that he had seen albumen could be found by the cold nitric acid test, if the urine was examined when it was quite fresh. He had frequently seen 25 per cent. by bulk of albumen in the urine of such cases. There was no difficulty in distinguishing between cases of this kind and Yellow Fever, if the microscope was used. If a case of Malaria was untreated parasites could always be found. He had only seen about 20 cases of Yellow Fever.

Dr. Bailey stated at an interview that "since the occurrence of certain cases at Burutu and Forcados in 1913, 30 of which in natives he thought might be Yellow Fever, they had carried out from 200 to 300 tests of urine as they had applied the test to every one who said he had a headache. The albuminuria in these cases usually cleared up rapidly, and was obviously connected with the course of the fever. He had once found albuminuria in a European case of

Malaria, in which he had also found the parasite, but it was a mere trace, quite unlike this group of cases."

The late Dr. Mackinnon stated that "he used formerly to examine the urine in Malaria cases. He had not found much albuminuria."

Dr. Hutton stated that "he had not examined the urine to any considerable extent, as people were suspicious, and it was difficult to get specimens. In the case of the school children at Abokobi the specimens obtained showed no albumen."

At that school several children were found to have pyrexia due to malarial infection. One child had a temperature of 104° F., but was not inconvenienced by it.

Dr. E. W. Graham stated that "the results of examining the urine in Malaria cases had been negative as regards the presence of albumen."

Dr. Leonard informed the Commission that "he had not observed albuminuria in uncomplicated cases of Malaria. Whilst in charge of the native hospital at Calabar the urine was regularly examined. He had seen no albumen in cases of fever at Calabar, nor any cases resembling those diagnosed as Yellow Fever at Lagos."

Dr. Leonard also stated that "As to the occurrence of gleet, with as a result the presence of albumen in the urine, he had experienced no difficulty; as he found that in such cases if the patient passed urine, and then shortly afterwards a fresh specimen was collected and tested, there was, as a rule, no reaction. When there was, it was a slight one and there was nothing like the amount of albumen present in the Yellow Fever cases."

Dr. Hänschell stated that "every case admitted into the European or native hospital (at Sekondi) was tested for albuminuria. He supposed that he had tested nearly 300 in all. He had only found four cases in which albuminuria and Malaria were combined. There was albuminuria in 30 or 40 cases, but those patients were mostly there for surgical complaints, and many had had gonorrhœa recently or still had it. Others were cases of Pneumonia, and in three schistosome ova were found in the urine."

We are now in a position to formulate the conclusions which may be deduced from the evidence brought forward both generally and as regards West Africa.

Conclusions.

(1) There is evidence that in severe attacks of æstivo-autumnal Malaria accompanied by pyrexia, albumen may be present in the urine.

(2) That in such cases the amount of albumen is generally a mere trace.

(3) That the albuminuria does not run a clinical course in any way similar to that observed in Yellow Fever.

(4) That it is probably a pyrexial albuminuria, and is similar to that occasionally met with in Pneumonia, Typhoid Fever, and other acute febrile diseases.

(5) That casts may be present, but are only found in very severe cases of malarial pyrexia, whereas they are commonly met with in Yellow Fever, and may, in that disease, be bile stained.

(6) That the evidence from West Africa affords no support to the contention that albuminuria is of common occurrence in Malaria as observed in that country amongst Europeans.

(7) That the frequent occurrence of urethritis, either acute or chronic, amongst the natives of West Africa, indicates the necessity for eliminating that source of error in all cases of pyrexia suspected to be due to Yellow Fever.

(8) That the diagnostic value of albuminuria as a symptom of Yellow Fever remains unimpaired.

(*C*) The Diagnostic Significance of the Presence of Malaria Parasites and Pigmented Leucocytes in the Blood in Cases of Pyrexia, and of their Absence.

The importance of an examination of the blood for malarial parasites and pigmented leucocytes in all cases of fever in tropical countries is generally recognised, but as to the inferences to be drawn from their presence or absence, as regards the diagnosis of the disease from which the patient is suffering, there is not the same general agreement.

It will probably be useful to state first the broad facts as to the distribution of the parasites in the peripheral blood and in the organs in the various types of malarial pyrexia, in order to make the points at issue clear to those whose work has not lain specially in this branch of medicine.

The following extracts are from an article entitled "A Study of Some Fatal Cases of Malaria," by L. F. Barker, contained in the Johns Hopkins Hospital Reports:—

"Since the discovery of Laveran's parasite, which rendered possible, under ordinary circumstances, the early recognition of a malarial infection by means of the microscopical examination of the fresh blood, it has become a comparatively rare occurrence for a patient to die of this disease. 1896, Vol V., pp. 221, 299.

"The study of the pathology of malaria is consequently limited to the few instances in which the patients die from traumatism, or from some intercurrent disease, and to those rare cases of pernicious malarial infection which terminate fatally."

In a separate section "On the unequal distribution of the parasites in the body in malarial infection" contained in the same paper, the following occurs:— *Ibid*, p. 263

"* * * * * * * the broad statement may be made that in infections with quartan parasites one sees the most equal distribution of the parasites throughout the blood and various organs, and that in infections with parasites of the æstivo-autumnal variety the most unequal distribution is encountered. In infection with parasites of the tertian type the character of the distribution may be said to stand between that of the quartan and that of the æstivo-autumnal infections, approaching perhaps a little more closely to the former.

"In the quartan fevers the parasites are nearly always to be seen in numbers in the blood in any of the peripheral parts * * * * * *."

"The parasites in tertian fever, although usually quite abundant in the circulating blood, show decidedly a more marked tendency to accumulate in the internal organs, such as the spleen, the liver and the marrow of bones. This is notably true at the time of the paroxysms, when the segmenting organisms, although usually still present in severe infections in considerable numbers in the peripheral blood, are for the most part retained in the internal organs and especially in the spleen. But it is in the infections with the æstivo-autumnal parasites, infections which include the majority of comatose and other pernicious cases, that the most curious and marked variations in the distribution of the parasites are to be met with * * * * * *.

"In the æstivo-autumnal infections the number of organisms circulating in the peripheral parts affords, as a rule, very indifferent data upon which to base an idea of the severity of the infection. * * * * * * numerous slides prepared from the peripheral blood may

show very few organisms, and these often of the type most difficult to recognise, while in a drop of blood taken from the spleen quite a large number of the parasites may often be made out with ease.

"The occurrence of segmenting organisms in the peripheral blood is a phenomenon of extreme rarity in æstivo-autumnal infections."

It may, however, be noted that punctures of the spleen during life have not shewn that when the malarial parasites are scanty in the blood they *must* be numerous in internal organs.

We are now in a position to state the points at issue, viz.: —

(1) Under what circumstances does the finding of malaria parasites in the blood justify a diagnosis of Malaria?

(2) Under what circumstances does the absence of parasites from the peripheral blood negative a diagnosis of Malaria?

It is perhaps unnecessary to state that the diagnosis in any case of disease is the opinion arrived at, after a consideration of all the facts of the case, as to the nature of the malady from which the patient is suffering.

In dealing with a native population saturated with Malaria, such as that of the West African Colonies, and with malaria-infected Europeans living there, it is certain that the parasites of that disease will be found in many patients who are not suffering at the time from Malaria, although they are harbouring the organisms.

It is also important to remember the length of time after infection that the parasites may remain in the body and their capacity for lying latent during long periods.

We may illustrate the point by reference to the description contained in the Second Report of the Commission of what occurred immediately preceding the acceptance by all concerned of the diagnosis of Yellow Fever in the Ocean Springs Epidemic, Mississippi, in 1897. This epidemic started with a large number of mild and unrecognised cases, variously estimated at from 500 to 700, and during its official continuance included 4,426 cases with a mortality of 494.

"The record of the final interview between the Federal and the State officials, when the diagnosis of Yellow Fever was still being resisted and the tension extreme, is almost dramatic. Just as relations were about to be broken off and the Marine Hospital Service officers had decided to leave, 'the resident physician hastily announced the

imminent death from convulsions of Miss Shutze, the patient seen by Dr. Saunders and diagnosed as Yellow Fever. This information was a thunderclap to those who had announced it Dengue.'

"It is interesting to note that the case on which the diagnosis of Yellow Fever was finally accepted by all was one in which that disease proved fatal in an individual previously infected with Malaria, and in whose blood the malarial parasites were found shortly before death. They were present in four out of five cases of the fever then again specially examined, but it is not stated that the other cases were fatal."

This occurrence sufficiently illustrates the fact that all patients in whose blood malarial organisms are found are not necessarily suffering from that disease alone. They may, as in the case just mentioned, be ill with Yellow Fever. It is a good example of the danger of relying upon laboratory tests to the exclusion of clinical experience.

We have now to consider whether there are circumstances under which a diagnosis of Malaria is justified, notwithstanding the absence of parasites from the peripheral blood.

It is obvious that if they can always, or nearly always, be found in cases of Malaria in which the symptoms are severe, their absence in any case of serious illness tells very decidedly against a diagnosis of Malaria.

Similarly, if they can always, or nearly always, be found in cases of Malaria of the type which simulates Yellow Fever, their absence tends to exclude Malaria as a possible diagnosis.

It is therefore a matter of great importance to decide when they are commonly present and when they may be absent.

These points are to some extent dealt with in the quotation from Dr. Barker's article, but further evidence is necessary.

It will be remembered that in discussing the occurrence of albuminuria in Malaria (*vide* p. 172) reference was made to the fact that in 616 cases of Malaria treated in the Johns Hopkins Hospital, between the years 1889 and 1894, Thayer and Hewetson found the parasite in every acute case of that disease admitted to the wards.

Lt.-Colonel Statham in the article to which reference has previously been made (*vide* Investigators' Reports Vol. II., p. 377) discusses this question as follows:—

"2. The great difficulty occasionally met with is in finding parasites in cases which are clinically typical malarias. This difficulty is comprehensible when the immune West African is in question, but in a West Indian or European soldier this difficulty is also often

encountered, and the parasite is only found after hours, or even days, of searching, though no quinine may have been taken, and periodicity allowed for. I have had similar difficulty with subtertian malaria in South Africa, but cannot remember such cases in India.

"This difficulty of demonstrating the parasite in some cases may account for some of the cases in the group labelled 'Probable Malaria' in Table XI., though it has to be admitted that in the majority of these cases only one blood examination was carried out. It may also account for some of the cases in the 'Pyrexia with enteritis' group and in the 'Pyrexia of uncertain origin' group, where some of the clinical symptoms pointed to malaria, but no parasites could be found."

Osler and McCrae—"A System of Medicine;" 1907, article, "Malaria." Vol. I, p. 422.

McCrae, in the article from which we have already quoted under "Symptoms of Quotidian Æstivo-Autumnal Infections," states:—

"The temperature curve in the quotidian form is not characteristic, as it resembles very closely that of double tertian infection, and we must therefore depend upon the microscope in making our diagnosis. There is no greater proof of the value of a microscopic examination of the blood than is found in the ease with which the various forms of malarial fever may be diagnosed and differentiated by it."

Again:—

"In a fatal case (of the comatose form) observed by the writer, the temperature never went above 101° F., until a few hours before death, when it rose to 103° F., the entire attack lasting six days. In this case the disease was not recognised by the attending physician until a few hours before death, when a blood examination was asked for and large numbers of quotidian æstivo-autumnal parasites were found."

Ibid, p. 425.

In the same article under "The Irregular and Intermittent Forms" we read:—

"An examination of the blood, if carefully made and repeated if necessary, will invariably demonstrate the type of malarial parasite concerned, which is generally one of the æstivo-autumnal organisms."

Ibid, p. 427.

Again, under "Latent and Masked Infections":—

"A latent malarial infection may be defined as one in which parasites can be demonstrated in the blood, but in which there are no symptoms which would lead a clinician to suspect malaria, whilst a masked infection is one in which the symptoms are obscured by some accompanying disease, or in which they are atypical in character."

"At the United States Army General Hospital in San Francisco, California, out of 1,267 cases of malaria in which the parasites were demonstrated in the blood, 395 or 25 per cent. have shown either latent or masked infections.

"The æstivo-autumnal infections comprised 275 of the cases, thus showing that the æstivo-autumnal parasite is concerned most often in latent and masked malaria. Examinations of the blood in such cases have shown the parasites in all stages of development, but always in small numbers. Of the 395 cases, 277 were latent infections, or

infections in which the malarial parasites could be demonstrated in the blood, but which presented no clinical symptoms, while 118 were masked infections, most of them being in patients suffering from other diseases which masked the malarial symptoms. Of the masked infections, chronic dysentery, chronic diarrhœa, pulmonary tuberculosis and amœbic dysentery were the diseases which most often masked the malarial infections."

It may be remarked, in passing, that these were the diseases from which the patients were suffering; the malarial symptoms may have been masked, or there may have been no malarial symptoms to mask.

And again:—

"*Examination of the blood.*—In most instances one examination of the blood will be sufficient, but if a negative result is obtained repeated examinations should be made at short intervals. If this is done, almost invariably, even in the most obscure æstivo-autumnal infections, the parasites will be discovered. *Ibid*, p. 433.

"Cases of malaria of this variety undoubtedly occur in which no parasites can be discovered in the peripheral blood, *but not when the infection is severe enough to produce symptoms.* (The italics are not in the original.)

"The symptoms in æstivo-autumnal infections are often so obscure or even so slight *that malaria is not suspected, and in many cases an examination of the blood will show the presence of the malarial plasmodia before any clinical symptoms sufficiently severe to excite a suspicion that the infection existed.* It follows then that an examination of the blood in all cases of disease occurring in malarious localities should be adopted as a routine measure." (Italics are not in the original.)

The above statements lend no support to the view that a large number of cases of severe illness of sudden onset with marked pyrexia, and albuminuria, cases which may indeed end fatally in a few days, but in which no malarial organisms have been found after repeated examinations of the blood, may yet be due to Malaria.

Sir Leonard Rogers, in his work on "Fevers in the Tropics," writes as follows:— Second Edition, p. 220.

"TABLE XXIII.—NUMBER OF MALARIAL PARASITES FOUND IN 200 CASES.

	Malignant Tertians.		Benign Tertians.		Totals.		
Very numerous	20	(1)	35	(4)	56	(5)	78 per cent.
Numerous ...	54	(7)	46	(3)	100	(10)	
Rather few ...	9	(4)	12	(0)	21	(4)	
Very few ...	13	(9)	7	(2)	20	(11)	10 per cent.
Crescents only	3	(1)	—	–	3	(1)	

"Very numerous = Parasites found immediately.

"Numerous = Parasites found after a very short search, one minute or less.

"Rather few = Parasites found up to five minutes.

"Very few = Occasional parasites after five to ten minutes' search.

"In 78 per cent. the parasites were sufficiently numerous to allow of their detection within a minute or two.

"In only 10 per cent. were they so few as to necessitate over five minutes' search.

"The figures in the brackets indicate the number of cases in which quinine was known to have been taken before the blood was examined, while this was also doubtless the case with some others in which the point had not been noted. They show that although the parasites may be found in large numbers after some quinine has been taken, yet as a rule they are few in number after its administration; no less than 11 out of the 20 cases with 'very few' parasites had been noted to have previously taken the drug. If these are excluded, then the parasites were 'very few' in only 5 per cent. of the remainder. On the other hand, cases which are undoubtedly malarial clinically are met with in which no parasites are found at a single examination of the blood. It is difficult to accurately estimate their proportion, but a careful study of my two years' records has led me to the conclusion that they constitute between 10 and 20 per cent. of the total number of malarial fevers seen, the majority of the patients having taken quinine before admission, but most of them can readily be recognised by clinical methods, and especially by the temperature curves of four-hour charts. The absence of the parasites, then, should not be taken as evidence of the case not being malarial if it presents the typical characters of that disease, especially if quinine has been taken before the microscopical examination."

Ibid, p. 226.

The same author states under "Complications of Malaria":—

"*Cerebral Malaria*:—

"* * * * * *. It only occurs in very intense infections, as in the case already mentioned, from which the later stages of the malignant tertian parasites of the coloured plate were drawn * * * * * *. Now during this complication of malaria (which by the way is almost always of the malignant tertian form) the parasites are so numerous in the peripheral blood that they are seen in every field of the microscope, so that they can be found easily within five minutes, including the staining of the slide."

Dr. Deeks, Chief of the Medical Clinic in the Ancon Hospital, kindly gave evidence at one of the meetings of the Commission, and was specially questioned on the diagnosis of Malaria, a disease of which he has had large experience, and Yellow Fever. In his

opinion Malaria parasites were always found in severe cases of the æstivo-autumnal type, provided they had not been treated with quinine, and it was cases of that type which most often resembled Yellow Fever. He thought there was no difficulty in distinguishing between cases of that kind and Yellow Fever, if the microscope was used.

Major Perry, of the Sanitary Department, Panama Canal Zone, who attended at the same meeting, was also of opinion that there was no practical difficulty in distinguishing between cases of Malaria of the type under discussion and of Yellow Fever.

The inferences* to be drawn from the foregoing and other evidence, so far only as the question of the presence of malarial parasites is concerned, would appear to be:—

(1) That in nearly all severe untreated cases of æstivo-autumnal Malaria with pyrexia, parasites are present.

(2) That if quinine in considerable doses has been given it may be difficult to find parasites, though in practically all cases they can be found by means of Ross's thick film method (*vide* p. 167).

(3) That after heroic doses of quinine, in cases which afterwards terminate fatally, parasites may not be discovered until the post-mortem examination, and then they may only be found in certain regions, such as the brain and spleen, and even in those situations they may not be numerous.

(4) That if in an untreated case of pyrexia, accompanied by bilious vomiting and jaundice, no malarial parasites are found by the thick film method, the case is almost certainly not one of Malaria.

(5) That in any untreated case of severe pyrexia of sudden onset in which no Malaria parasites are found in the peripheral blood after several careful examinations the presumption is strongly against a diagnosis of Malaria, on that ground alone, and apart from any other consideration.

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* Some of these inferences are stated in Doctor Deeks's own words.

(*D*) Hyperpyrexial Fever and Hyperpyrexia in Malaria and in Yellow Fever.

The investigators appointed by the Commission were instructed to pay close attention to (amongst many others) all cases of fever which might be or might resemble "(*j*) Hyperpyrexial Fever."

The following description of this disease, the nature of which is very doubtful, is taken from Sir Patrick Manson's work on "Tropical Diseases":—

Fifth Edition, p. 381.

> "*Symptoms.*—Thompstone and Bennett describe the clinical features thus: 'This fever is generally ushered in by a slight rise of temperature, followed by profuse perspiration and a fall in the temperature to about 99° F. After a period of apyrexia of perhaps twenty-four hours' duration, the temperature begins again to rise, slowly at first, but when 105° is passed, with alarming rapidity, one degree in ten minutes having been frequently observed, and it may reach 107° on the second day. For fourteen or even for thirty days subsequently there is absolutely no tendency for it to fall. The skin acts either very slightly or not at all, and all antipyretic drugs fail.'
>
> "In due course the tongue becomes dry and shrivelled, but the spleen and liver are not enlarged; the urine is normal and abundant, the bowels being regular or loose. The conjunctivæ are injected, the pupils contracted. There is much anxiety and restlessness; but the mind is clear in most cases except when the temperature is very high.
>
> "If the patient is to recover, a change for the better may be looked for about the end of the third week. Convalescence is very gradual, and it may be six weeks before temperature is normal. Half the cases die.
>
> "A curious feature is the remarkable rapidity with which the blood coagulates the moment it is exposed to the air.
>
> "Malaria parasites, though carefully sought for, have not been found; neither have attempts at cultivations from the blood yielded any micro-organism. The white corpuscles are rather in excess."

We are not aware that the observation of Thompstone and Bennett has been confirmed; certainly no case has been observed to which this description would apply, or in which hyperpyrexia lasted for any period approaching fourteen days, but hyperpyrexia has been a feature of a certain number of cases, most of which were diagnosed locally as either "Yellow Fever" or as "suspected Yellow Fever."

There is little doubt that on the West Coast of Africa cases have occurred in the past in which hyperpyrexia has been a very

marked feature, and that such cases have been invariably reported under the heading "Malaria." Hyperpyrexia occurs in Pernicious Malaria, and some, or possibly all of them, may have been of that nature, but the measure of proof which would have been afforded by the discovery of malarial parasites in the blood and organs has very often been lacking.

Sir Patrick Manson gives the following description of the "Cerebral Form of Pernicious Malaria," in which hyperpyrexia is a marked symptom:— *Ibid*, p. 73.

> "*HYPERPYREXIAL.*—There can be little doubt that many of the cases of sudden death from hyperpyrexia and coma, usually credited to what has been called 'ardent fever' or 'heat apoplexy,' are really malarial. If careful inquiry be made into the antecedents of many of these cases, a history of mild intermittent fever will often be elicited; or it will be found that the patient had been living in some highly malarious locality.
>
> "In the course of what seemed to be an ordinary malarial attack the body temperature, instead of stopping at 104° or 105° F., may continue to rise and, passing 107°, rapidly mount to 110° or even to 112°. The patient, after a brief stage of wild, maniacal or, perhaps, muttering delirium, becomes rapidly unconscious, then comatose, and dies within a few hours, or perhaps within an hour, of the onset of the pernicious symptoms."

The following is the Medical Report on a case, which occurred in West Africa, of the kind described by Sir Patrick Manson:

> "CASE REPORT.
>
> "Sergt.-Major ————
>
> "*Disease:* Malaria.
>
> "*Admitted:* 8-10-13.
>
> "*Result:* Death, 13-10-13.
>
> "*Cause:* Hyperpyrexia.
>
> "On the morning of Wednesday, October 8th, 1913, I was called to attend Sergt.-Major ———— in his quarters, and found him suffering from Malaria; the case was neither severe nor in any way out of the ordinary. His temperature varied from 99° to 101·4°, gradually subsiding under ordinary treatment till on Sunday it was normal. He was kept in bed, however, and when seen by me on Monday morning it was found that he had a temperature of 99·2°. He had no pain, headache, or other symptoms. His condition remained the same throughout the day, and in no way gave rise to any alarm.
>
> "Between 6.30 and 7 p.m. his temperature suddenly rose to 106° F. Cold sponging, stimulants and intramuscular injections of

quinine were resorted to, for he became slightly delirious and his pulse was weak and rapid. About 8 o'clock he became quieter, his skin became moist, and he settled down to sleep; half an hour later he died without even waking up.

"In the opinion of some of his friends, Sergt.-Major ——— had had a good deal of Malaria lately without reporting sick. I think that this is probably true, as he certainly seemed more debilitated and weaker than one would expect him to be in such a comparatively mild attack as this last one."

In the Second Report of the Commission (p. 61), in the account of the incidence of Yellow Fever in the Gambia, the following occurs:—

"1906.

"One case of remittent fever ending in malarial cachexia, and one of malignant remittent fever with hyperpyrexia. In the latter case quinine was not for some reason assimilated, though given by the mouth in large doses, the liver being at the same time acting freely, the hyperpyrexia could only be subdued by ice-packs, and intramuscular injections of quinine produced an immediate beneficial effect on the course of the fever, causing an uninterrupted convalescence to set in."

"In the case of a similar nature previously reported in detail (1899) it was clear that the ice-packs and not the quinine caused the fall of temperature. The exact nature of these cases is doubtful."

I. R., Vol. I., p. 275, *seq.*

The "Report on certain outbreaks of Yellow Fever in Lagos, 1913, and January and February, 1914," by Dr. T. M. Russell Leonard, contains an account of certain cases diagnosed as Yellow Fever, all of which occurred on board ships, and in all of which hyperpyrexia was a prominent symptom.

As some readers of this report may not possess the volume of the Investigators' Reports in which those cases are detailed, a selection of typical examples is reproduced here:—

"Case No. 29. L. 102.

"*Sex*: Male
"*Age*: 21 years.
"*Nationality*: European, German.
"*Occupation*: Steward.
"*Date of death*: 26th October.
"*Diagnosis after post-mortem examination*: Yellow fever.

"This case died on board the ss. '*Elizabeth Brock*,' at 7.10 a.m. on the 26th October. The body was brought ashore for an autopsy.

"*Previous history*.—This was obtained from the Captain of the vessel. The man complained of being ill on the morning of the 23rd October with headache and fever, temperature at noon that day being 103·2°, and at 8 p.m. 103·4°. Next day, the 24th, the temperature

was 100·2° at 8 a.m., and 104° at 8 p.m. On the 25th the temperature fell to 99·2° and then began steadily to rise, being 103·8° at 8 p.m. that night, and next morning, the 26th, at 7 a.m., it was 106°, and the patient died at 7.10.

"Autopsy performed at the Lagos Hospital at 9 a.m.

"*Skin.*—Sallow appearance. Deep cyanosis of the ears and genital organs. No rash present.

"*Rigor mortis.*—Present.

"*Brain.*—Normal.

"*Spinal cord.*—Normal.

"*Membranes.*—Normal.

"*Heart.*—Weight, 11½ ozs. Pale and flabby. Valves normal.

"*Large vessels.*—Normal.

"*Lung, right.*—Weight, 18½ ozs. Very congested, particularly at base.

"*Lung, left.*—Weight, 17½ ozs. Congested.

"*Pleuræ.*—Normal. No adhesions. Contents, 2 ozs. yellow fluid.

"*Larynx, trachea, bronchi.*—Mucous membrane congested.

"*Peritoneum.*—Normal.

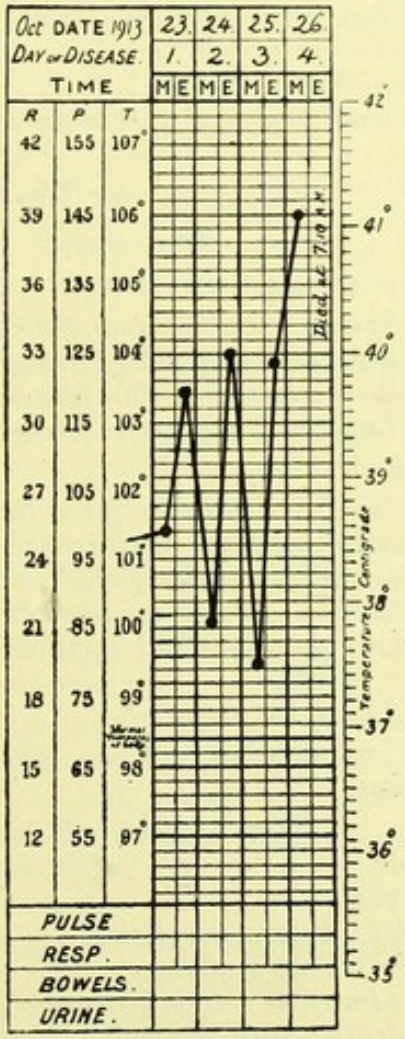


CHART 28.

"*Stomach.*—Mucous membrane congested. Rugæ swollen. Extensive submucous hæmorrhages at the cardiac end, pylorus and posterior wall. Vessels engorged. Stomach empty, brown mucus adhering to walls.

"*Small intestine.*—Duodenum congested. Hæmorrhages present in its entire length. Jejunum also congested and hæmorrhages present. Contents, brown fluid.

"*Large intestine.*—Normal.

"*Helminths.*—None present.

"*Liver.*—Weight, 68 ozs. Congested. Hæmorrhages present under capsule. Friable. Greasy on section.

"*Gall bladder.*—Normal. Contents, 2 ozs. normal bile.

"*Pancreas.*—Normal. Weight, 6 ozs.

"*Spleen.*—Weight, 13½ ozs. Enlarged, soft and pulpy.

"*Kidney, right.*—Weight, 6½ ozs. Congested. Capsule strips easily. Stellate veins enlarged.

"*Kidney, left.*—Weight, 6½ ozs. Same appearance as right.

"*Suprarenal capsules.*—Normal.

"*Lymphatic system.*—Normal.

"*Bladder.*—Mucous membrane congested. Hæmorrhages present. Contained one teaspoonful of muddy urine. Acid in reaction Highly albuminous. Tube casts also present.

"*Diagnosis.*—Yellow fever.

"Smears from organs and specimens sent to Research Institute.

"LABORATORY REPORT.

Microscopic.

"1. Smear preparations from:—

(*a*) *Spleen.—Paraplasma flavigenum* present.
(*b*) *Liver.—Paraplasma flavigenum* present.
(*c*) *Bone marrow.—Paraplasma flavigenum* present.
(*d*) *Lung.—Paraplasma flavigenum* present.

"2. Histological:—

(*a*) *Liver.*—Extensive fatty metamorphosis. Lobules distorted. Small hæmorrhages present. Few cells contained large fatty globules.
(*b*) *Kidney.*—Fatty metamorphosis present. Tubules filled with granular and hyaline débris. Denuded of cells in places.
(*c*) *Spleen.*—Congested.

"3. Urine examination: Acid reaction. Highly albuminous. Tube casts present.

"CASE NO. 32. L. 105.

"*Sex*: Male.
"*Age*: 27 years.
"*Nationality*: European, British.
"*Occupation*: Ship's officer.
"*Date of admission*: 26th November, 1913.
"*Date of death*: 26th November, 1913.
"*Diagnosis*: Yellow fever.

"*History.*—Patient was sent into hospital at 4.15 p.m. on the 26th November from the s.s. '*Bassa.*' The patient was delirious, temperature 106·8°. The vessel had arrived from Forcados on the 24th; the man had been 'seedy' for a couple of days.

"*On admission.*—Patient wildly delirious. Face and neck cyanosed. Pulse very quick and thready. Pupils widely dilated. Passed 4 ozs. of urine after admission. Temperature in axilla, 106·8°.

"*Alimentary system.*—Liver and spleen were normal. Tongue was pointed and red.

"*Respiratory system.*—Respirations were rapid. Breathing stertorous.

"*Nervous system.*—Pupils widely dilated. Delirium present.

"*Urinary system.* Urine was clear, reddish yellow in colour. Acid reaction. Sp. gr. 1025. No albumen present. Phosphates present.

"*Skin.*—Skin was covered with a red rash. Face, neck and chest showed patches of cyanosis. Conjunctivæ very injected. Eyes shining.

"*Blood examination.*—Few malaria parasites present. *Paraplasma flavigenum* present. Differential count: Polymorphonuclear, 66·5 per cent.; mononuclear, 11·6 per cent.; lymphocytes, 18 per cent.; eosinophil, 0·5 per cent.; transitionals, 3·4 per cent. Patient was given an intramuscular injection of quinine, grs. 10. Wet pack.

"At 5.20 p.m. temperature in axilla was 106·2°. Breathing stertorous. Face and chest cyanosed. At 5.30 patient placed in ice pack, rectal temperature 108·6°. At 6 p.m. vomiting occurred, bilious in character, and took place several times. At 6.45 p.m. rectal temperature was 105·6°, pulse had improved and was 115 per minute. Breathing easier and not stertorous. Delirium stopped and patient quiet.

"At 7.45 p.m., patient in the same condition, rectal temperature 105·7°, pulse 129 per minute. Vomiting again occurred, bilious. At 8.45 p.m. patient became very restless. Rectal temperature 105·8°. Convulsions set in, and patient died at 9 p.m.

"*Post-mortem notes.*—Autopsy was performed at 8 a.m. next morning. Skin was yellow. Ears, neck and face cyanosed. Genital organs were deeply cyanosed. Conjunctivæ showed hæmorrhages.

"*Rigor mortis.*—Present.

"*Brain.*—Vessels engorged. Brain substance congested.

"*Spinal cord.*—Congested.

"*Membranes.*—Congested. Vessels engorged. Dura mater adherent to calvarium. Pia and arachnoid mater adherent to brain.

"*Heart.*—Weight 10½ ozs., pale and flabby, valves normal. Hæmorrhages present on the epicardium as well as on the endocardium of the right auricle and ventricle.

"*Large vessels.*—Normal.

"*Lung, right.*—Weight 14½ ozs., normal, some congestion at base.

"*Lung, left.*—Weight 12½ ozs., normal.

"*Pleuræ.*—Normal, no adhesions.

"*Larynx, trachea, bronchi.*—Mucous membrane, slight congestion.

"*Peritoneum.*—Normal.

"*Stomach.*—Peritoneal surface congested. Vessels engorged. Mucous membrane congested. Rugæ prominent. Large areas of hæmorrhage in the posterior wall, cardiac and pyloric ends, and along the greater curvature. Contents: 1 oz. of brown fluid.

"*Small intestine.*—Duodenum congested. Hæmorrhages present in its entire length. Jejunum and ileum presented the same condition. Contents: brown fluid.

"*Large intestine.*—Normal.

"*Helminths.*—None present.

"*Liver.*—Weight, 43 ozs., congested, with yellow patches. Friable, greasy on section. Hæmorrhages seen under capsule.

"*Gall bladder.*—Distended with normal bile.

"*Pancreas.*—Normal. Weight, $3\frac{3}{4}$ ozs.

"*Spleen.*—Weight, $6\frac{1}{2}$ ozs. Congested. Soft and pulpy.

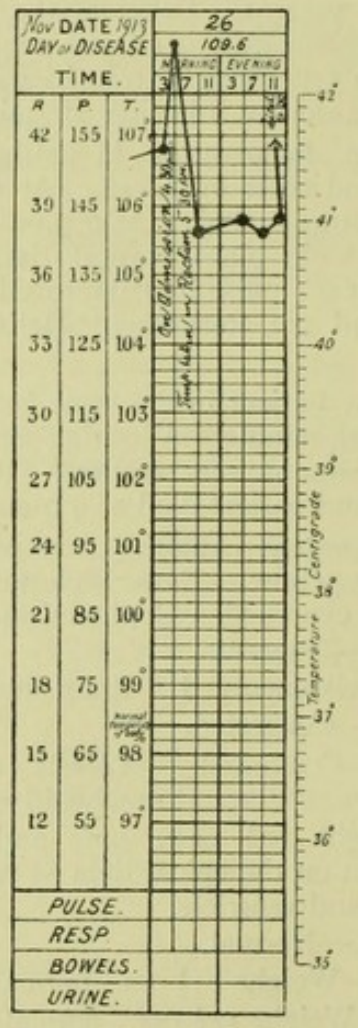


CHART 31.

"*Kidney, right.*—Weight, 5½ ozs. Very congested. Capsule strips easily. Stellate veins prominent.

"*Kidney, left.*—Weight, 5½ ozs. Same appearance as the right.

"*Suprarenal capsules.*—Normal.

"*Lymphatic system.*—Normal.

"*Bladder.*—Contracted. Mucous membrane congested and showed small hæmorrhages. Contents: 3 ozs. turbid urine. Acid reaction and highly albuminous.

"LABORATORY REPORT.

"*Microscopical.*

"1. Blood smears and smears from organs.

"(*a*) *Blood.—Paraplasma flavigenum* present.

"(*b*) *Heart.—Paraplasma flavigenum* present.

"(*c*) *Spleen.*—Negative.

"(*d*) *Lung.—Paraplasma flavigenum* present.

"2. Histological.

"(*a*) *Liver.*—Fatty degeneration. Small hæmorrhages present.

"(*b*) *Kidney.*—Fatty degeneration present. Tubules denuded of epithelium in places. Tubules blocked with granular and hyaline débris.

"3. *Urine examination*: Acid reaction. Highly albuminous. Tube casts present."

"CASE NO. 34. L. 107.

"*Sex*: Male.

"*Age*: 41 years.

"*Nationality*: European, British.

"*Occupation*: Steward.

"*Date of death*: 24th December, 1913.

"*Diagnosis after post-mortem*: Yellow fever.

"*History.*—The following history of the case was obtained from the Captain of the vessel, as the patient had died on the way to the hospital. The deceased had been 'seedy' for the previous two days, but had not complained. On the morning of the 24th he complained that he felt feverish, and, his temperature being taken, it was found to be 104°. He went to bed and a doctor was sent for. He was quite sensible and had taken some beef tea. Dr. Gray saw him at 3 p.m., and found him quite unconscious, with stertorous breathing, and with an axillary temperature of 109°. He advised his immediate removal to hospital, and death took place on the way.

"POST-MORTEM NOTES.

"The autopsy was performed at 5 p.m. that evening. Face, ears and neck were cyanosed. Patches of petechial eruption present on the abdomen and thighs. Genital organs cyanosed. Body was well nourished and fat.

"*Rigor mortis.*—Had not begun.

"*Brain.*—Vessels engorged. Brain substance congested.

"*Spinal cord.*—Congested.

"*Membranes.*—Vessels engorged. Membranes adherent.

"*Heart.*—Weight, 13 ozs. Pale and flabby. Valves normal.

"*Large vessels.*—Aorta showed a patch of atheroma.

"*Lung, right.*—Weight, 16 ozs. Congested at base.

"*Lung, left.*—Weight, 17 ozs. Very congested at base.

"*Pleuræ.*—Normal. No adhesions.

"*Larynx, trachea, bronchi.*—Mucous membrane congested.

"*Peritoneum.*—Normal. Very fatty.

"*Stomach.*—Peritoneal surface congested. Vessels prominent and engorged. Mucous membrane congested. Rugæ swollen. Hæmorrhages present at cardiac and pyloric ends, also on posterior wall and along the greater curvature. Stomach was empty.

"*Small intestine.*—Duodenum congested. Hæmorrhages present in its entire length. Jejunum also congested and submucous hæmorrhages present. Ileum congested.

"*Large intestine.*—Normal.

"*Helminths.*—None present.

"*Liver.*—Weight, 82 ozs. Left lobe yellow. Right lobe very congested. Hæmorrhages present under capsule. Very friable. Greasy on section.

"*Gall bladder.*—Normal.

"*Pancreas.*—Weight, 5 ozs. Normal.

"*Spleen.*—Weight, 4 ozs. Soft and pulpy.

"*Kidney, right.*—Weight, 7 ozs. Congested. Capsule strips readily. Cortex congested.

"*Kidney, left.*—Weight, 7½ ozs. Very congested. Capsule strips easily.

"*Suprarenal capsule.*—Normal.

"*Lymphatic system.*—Normal.

"*Bladder.*—Normal. Contained 3 ozs. of urine. Urine was acid in reaction and albuminous.

"LABORATORY REPORT.

"*Microscopical.*

"1. Blood and smears from organs:—

"(*a*) *Blood*: *Paraplasma flavigenum* present.

"(*b*) *Spleen*: Negative.

"(*c*) *Liver*: *Paraplasma flavigenum* present.

"(*d*) *Kidney*: Negative.

"2. Histological:—

"(*a*) *Liver*: Fatty degeneration present and extensive. Hæmorrhages present.

"(*b*) *Spleen*: Normal.

"(*c*) *Kidney*: Fatty metamorphosis. Tubules filled with granular and hyaline débris. Cells of convoluted tubules swollen and granular.

"3. Urine examination: Acid reaction. Albumen present. Tube casts also present."

"CASE NO. 35. L. 119.

"*Notes by Dr. Manson.*

"*Sex*: Male.

"*Age*: ——.

"*Nationality*: European, British.

"*Occupation*: Ship's officer.

"*Date of death*: 28th December, 1913.

"*Diagnosis after post-mortem*: Yellow fever.

"Dr. Manson reports that he was called to see this patient on the afternoon of the 28th, the vessel lying in the Lagos Roads. On his arrival he found the patient unconscious and in convulsions, and death occurred in his presence about 5 p.m.

"The following history was obtained from the captain of the vessel. The deceased had complained of fever on the 25th December, and his temperature was 102°. On the 26th, at 10 a.m., it was 103°. On the 27th the morning temperature was 103°, and at 6 p.m. it had risen to 105·4°. On the 28th at 2 a.m. it was 105·4°, at 9 a.m. 103·4°, and at 4 p.m. it had risen to 106°. At 4.30 p.m. patient had vomited some black-looking fluid. Temperature taken just before death was 106°, and the pulse rate 70.

"POST-MORTEM NOTES.

"Autopsy was performed by Dr. Manson at 7 a.m. next morning.

"*Rigor mortis* was well marked. Petechial patches on the neck and chest. Genital organs cyanosed.

"*Kidneys.*—Enlarged. Capsules strip easily.

"*Spleen.*—Enlarged and soft.

"*Liver.*—Size normal, paler than normal.

"*Stomach and duodenum.*—Removed *en masse*. Stomach contained some greenish-black fluid which looked like altered blood. Hæmorrhages present in the M. membrane of the greater part of the stomach and duodenum.

"*Bladder.*—Contracted but contained a small amount of urine, which was drawn off and on testing was found to contain albumen.

"Portions of spleen, liver and kidney, together with smears and the whole of the stomach and duodenum, were sent to the Medical Research Institute, Yaba, for further examination and report.

"*Diagnosis.*—Yellow fever.

"*Laboratory Report.*—None received.

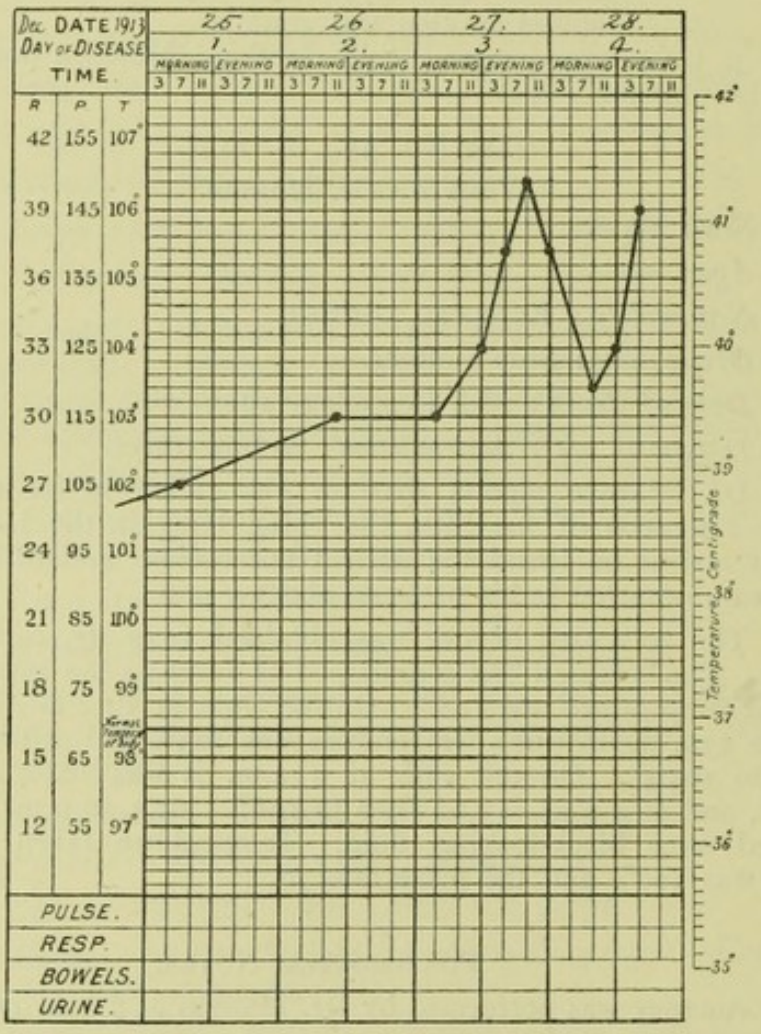


CHART 32.

"NOTE.—With the exception of the pulse record on the day of death (made by the Medical Officer, Lagos), this chart was compiled from observations made by the captain of the vessel.

"According to the captain's statement the pulse-rate had never been more than 80 per minute."

In each of these cases, although the evidence is defective in certain important particulars, it is, we think, difficult to arrive at any other diagnosis than that of Yellow Fever, which was the opinion formed by the medical officers, who either saw the case or made the post-mortem or pathological examination. If this view is correct, the cases are sufficient to establish the fact that hyperpyrexia may be a feature of Yellow Fever, and that a careful examination of the blood is necessary in all such cases before it is concluded that they are cases of Malaria. The defects in the evidence are due to the fact that all the cases occurred on board ship.

The following case is of great interest, and there is no doubt room for difference of opinion as to its nature:—

"CASE NO. 37.

"*Sex*: Male.

"*Age*: No record.

"*Nationality*: European, British.

"*Occupation*: Ship's officer.

"*Date of death*: 23rd October, 1913.

"The following report of this case was sent in by the surgeon of the vessel:—

"'On Monday, the 20th of October, at 10.40 a.m., the deceased reported sick. On examination, I found that his temperature was 105°, no headache or any other symptom complained of. He was placed in hospital on the ship, phenacetin and caffeine being administered. Diet: Milk and soda. Temperature became normal about 11 p.m., when 20 grains of quinine were given by the rectum, patient being unable to take quinine by mouth.

"'From above date and hour (11 p.m.) temperature remained normal until the evening of the 22nd, when it rose to 101°, but was reduced at 11 p.m. to normal.

"'On the morning of the 23rd I was sent for by the night attendant at the hospital. I found the patient slightly delirious, head very hot, temperature 103°. I placed calves of legs in flannel steeped in mustard and water and administered brandy, heart's action being very weak. Temperature rising at 6 a.m. to

104° and delirium increasing, I blistered behind the ears. At 7.15 a.m. temperature was 106·5°. I had a consultation with

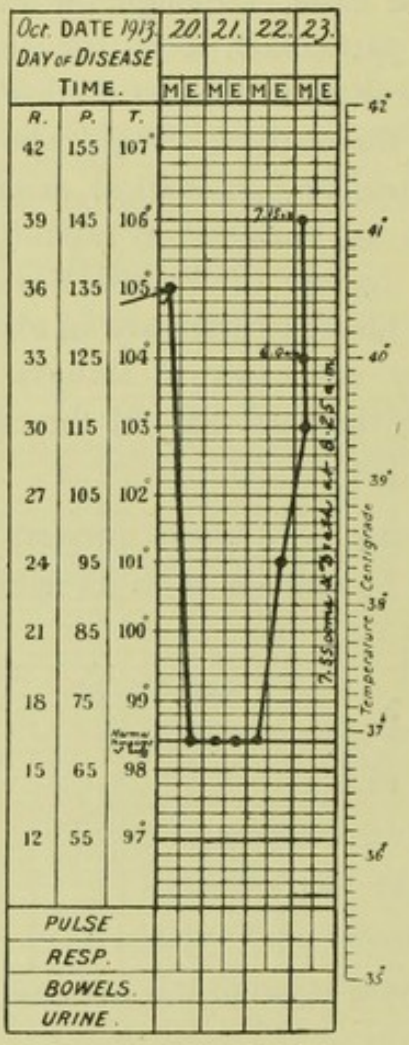


CHART 34.

Dr. O'Keeffe, Medical Officer, Government Service. Mustard was placed beneath heart and strychnine injected, but without avail, patient became comatose at 7.55 and passed away at 8.25 a.m.

"'*Diagnosis.*—Hyperpyrexia during malarial fever.'

"This case is one that must be viewed with great suspicion, as being one of yellow fever and not simple malarial fever. Unfortunately, there are no data on which any reliance can be placed in order to permit of a diagnosis being made from the above report. There are no records of blood examination, urine examination, pulse rate, and finally no post-mortem examination was made of the body in order to confirm the diagnosis. The deceased became ill in Forcados, a port in which yellow fever was known to exist. Illness was very sudden, temperature high, and vomiting apparently was present, as quinine could not be taken by the mouth. Presuming that the quinine treat-

ment was carried on during the two days preceding death, there seems to be no reason for the hyperpyrexia, delirium, coma and death other than that the illness was complicated with yellow fever as well as malaria, as, from my experience of malarial fevers in West Africa and in the West Indies, quinine properly administered cuts short the attack of malarial fever.

"Cases quoted in this report show that yellow fever can exist side by side in the same individual as malarial fever, and in the above case there seems to be very little doubt that the cause of death was yellow fever."

The following sentence in the surgeon's report is deplorably vague:—

"Temperature became normal about 11 p.m., when 20 grains of quinine were given by the rectum, patient being unable to take quinine by mouth."

This probably means, as Dr. Leonard suggests, that the patient had been vomiting previously to 11 p.m.

Whether by "when," the writer meant to convey that 20 grains of quinine were given "about 11 p.m.," or that "when 20 grains of quinine were given by the rectum the temperature became normal," is very doubtful. The fact that the temperature fell to normal on the 20th October at 11 p.m. and remained normal until the evening of October 22nd, "when it rose to 101°, but was reduced (it is not stated by what means) at 11 p.m. to normal," is clear evidence that the case was not one of uncomplicated Yellow Fever; indeed, it is strong presumptive evidence against it being Yellow Fever at all. It will be observed that there is no statement that when the surgeon was called to the case on the morning of October 23rd he administered quinine or that quinine was given at all during the period of the continued rise in the temperature which ended in the death of the patient.

If, as is suggested, the final hyperpyrexia was an expression of the presence of a Yellow Fever factor, we should not have expected that the temperature would have been so completely controlled by the quinine, as it certainly was. It appears more probable that the quinine was not given up to the end.

(*E*) Uto-Enyin, Bayloo and Bonke.

The Commission have received a considerable amount of evidence pointing to the existence in some of the West African Dependencies of a febrile disease known to the natives by the names Uto-Enyin,

Bayloo and Bonke. The word Uto-Enyin means "yellow eyes," and jaundice appears to be one of the most common symptoms of the disease. It may be that Uto-Enyin is really Yellow Fever, of the comparatively mild type, which is its most common manifestation amongst the natives, but further investigation of this disease is necessary. It is quite possible that one or other of these names is used by the natives to describe a variety of diseases attended by fever and jaundice, one of which is no doubt Malaria.

> "In September, 1910, Mr. C. Punch, District Commissioner, and Dr. A. H. Wilson, Medical Officer, were deputed to investigate the allegation that ill effects from excessive drinking were apparent in certain districts between the Calabar and Cross River. The evidence collected, while showing that excessive drinking did not obtain amongst the peoples visited, discovered that the population of the various towns and villages had decreased to a very considerable extent. The cause of this, in the opinion of nearly all the chiefs who were consulted, was a disease called Uto-Enyin. Nearly 200 people in 18 towns and villages had died from this disease during the ten months preceding the investigation. In one compound there had been 30 deaths in ten months out of a total of 400 persons; in another 20 deaths out of 700, and in yet another 18 deaths in one month out of 700 people.
>
> "The description, as given by the different chiefs, closely corresponds, and the following is an account. It may occur in two forms, 'male and female,' the 'male' type being acute and lasting a week or ten days and ending in death or recovery; the 'female' type being more subacute or chronic and lasting one to two months, leaving the patient weak and debilitated; all ages are affected, and both sexes. One attack affords no protection against another. The same person may have as many as three or four or even six separate attacks. The onset appears to be more or less sudden, with weakness (fever). Pains are specially noted in the joints, the sides of the chest, the back of the neck and small of the back. After about two or three days jaundice appears; the eyes and finger nails become yellow, also the urine, which in very severe cases may become very dark. Vomiting and cough may be present occasionally, but are not characteristic; there is neither rash, diarrhœa nor abdominal symptoms. A severe case may end in death in five or six days. The sickness is not contagious, and the natives do not fear it in this respect."
>
> "In 1910 Dr. Collet, S.M.O., of Sierra Leone, formerly of Southern Nigeria, on reading Dr. Wilson's report, recognised the group of symptoms and sequelæ described therein as a disease called by various names by the natives of Southern Nigeria. The Efik people of the Calabar District called the disease Uto-Enyin; other names are Akum, Obogu, Ebah, Ahuoku, Ibun and Atridi. He does not, however, consider that there are sufficient grounds for looking on the disease as a modified occurrence of yellow fever, or even a disease *sui generis*. He found that the disease was known amongst the Ibo, Ijaw, Bonny, Brass and New Calabar peoples as well as the Yorubas

He agrees that the morbid condition is an entity, but says that the supervention of jaundice in the course of an acute febrile disease is a matter of fairly frequent occurrence. In his opinion a certain proportion of the cases are simple malarial infections of the gastric type, in which there is more or less pronounced nausea with jaundice. Others prove to be gastric catarrh, obstructive jaundice, liver disorders, and in one case in his experience, pneumonia.

" He also considered that the promiscuous use of native bush medicines, if not actually responsible for the jaundice, at any rate in some cases assisted in its production, while the heroic doses of tartrate of antimony and santonin taken by many natives might occasionally induce jaundice.

" He does not preclude the possibility of the existence of a separate disease, or its connection with yellow fever in ' bayloo,' and thinks that the possible occurrence of epidemic jaundice should not be lost sight of."

" In December, 1910, Dr. T. M. Russell Leonard reported four cases of the disease, which is known among the natives of Calabar as ' yellow eyes ' or ' yellow fever.' The cases were all admitted into and treated in the native hospital at Calabar. The prominent symptom in all of them was jaundice; there was severe malaise, enlargement of the spleen and liver, associated with tenderness. Vomiting of a bilious character was also present, and the bowels were constipated, except in one case, where diarrhœa was present. The blood examination showed that all these cases were purely *malaria of the bilious remittent type, the blood showing malignant tertian parasites in various stages of growth.* The urine was dark coloured, due to bile present in it. *No albumen was found in any case*, showing that the kidneys were unaffected, nor was there any hæmoglobin or blood débris present. This in itself was sufficient, in Dr. Leonard's opinion, to show that these cases were purely malarial in origin and not true ' yellow fever,' in which the presence of albumen in the urine was an important and diagnostic sign. Dr. Leonard has had experience of yellow fever in the West Indies."

" In 1911 a report was received from Dr. R. H. Kennan, Senior Sanitary Officer, Sierra Leone, containing an account of his observations on a certain disease called ' bayloo ' by the Mendis, which, as described by them, bears a resemblance to yellow fever. He suggested that it may be proved to be yellow fever in an endemic form.

" This disease, according to Dr. Kennan, ' affects both adults and children, but chiefly the latter. It is believed to be infectious through contagion conveyed by the urine to persons passing over places where it has been passed on the ground or deposited. Cases arise ' one one ' (*i.e.*, singly, not in epidemics like small-pox). Its prevalence is most marked at the end of the dry season (and (?) at the very early rains). The onset is sudden with acute febrile symptoms and vomiting of yellow material which may later be green, and the urine is described as ' red,' ' dark ' or ' brown.' Prostration to a variable degree supervenes. In from four to seven days, or later, the ' eyes ' *and finger tips under the nails become yellow*, and the

diagnosis is established; but it is not pretended that the diagnosis can be made till this yellowness appears, *i.e.*, the bilious vomit and 'dark' urine are not by themselves pathognomonic. Food is not desired in the early stages, and what may be taken is usually rejected. The disease has sometimes a fatal termination, but if treatment is resorted to early, recovery is the rule. The duration of the illness varies from about ten days in children to perhaps a month or more in adults. Opinion varies in different places as to whether the same person can have the disease more than once. In some places at least it is recognised that yellowness alone (*i.e.*, without the acute symptoms having preceded it) does not justify the diagnosis of 'bayloo.' At no place was it described as the most prevalent disease or the one which caused the greatest mortality. It was in each place believed to have been 'always' in the country, and I could not find that any tradition exists regarding its first appearance. One narrator described it as a 'god's sickness,' which expression would fairly accurately describe the British matron's idea of measles, chicken-pox, or whooping cough in England.

"Inquiries were made at Mano, Baiima, Segbwema, Kasama, Pendembu, Upper Sama, Sumbuya, Tikonko, and at all these places the people knew the disease, and though the descriptions of the native chiefs vary a little in minor details, they all agree as to the main characteristics.

"Dr. Kennan understood from information obtained from some Timnehs that they knew 'bayloo' in their country by the name of 'bonkie.' He thinks that other names, such as 'wayloo,' 'burra,' etc., describe the same disease."

"In 1913 Dr. McConaghy, of Sierra Leone, reported on four cases of 'bayloo' (known amongst the Timnehs as 'bonke'). The chief symptoms were fever, vomiting, jaundice, pains in the back and legs, and 'red' eyes (by which the patients mean yellow).

"*Malaria parasites were not found.* The vomit is described as red, so are the eyes and the urine. In the cases examined *albumen was not found* at the time of examination.

"The signs and symptoms differed somewhat in the cases seen. The following were noticed:—Pains in the limbs and back, vomiting, *jaundice of the conjunctivæ and nails*, furred tongue, sometimes clean at the tip and edges, enlarged spleen in one case and enlarged liver in two; in one case jaundice was not present. There did not seem to have been any epigastric or abdominal tenderness in any of the cases. In Cases 2 and 3 the urine was actually red. In one case vomiting did not occur until the sixth day, and jaundice did not appear until the tenth, after the pains in the back and limbs had commenced."*

It is, we think, quite clear that in the cases described by Dr. Leonard the disease was Malaria; the presence of malarial parasites in various stages of growth in the blood, and, still more

* The above abstract of the evidence contained in various despatches was prepared by Dr. H. L. Burgess, Medical Secretary of the Commission.

important, the absence of albumen in the urine, negative a diagnosis of Yellow Fever.

It will, however, be noticed that in the cases reported by Dr. McConaghy, malarial parasites were not found in the blood, but again the urine, in the cases in which it was examined, was free from albumen. As we know that in mild cases of Yellow Fever albuminuria is as constant a symptom as in those of a severe type, these cases can therefore also be excluded.

There is, however, one definite point of contact between Yellow Fever and this disease or these diseases, viz., the yellow staining of the finger nails.

It will be remembered (*vide* Sporadic Cases, Section VII., p. 72) that in the case of Dr. Lundie, West African Medical Staff, who suffered from Yellow Fever at Bole, in 1913, this condition was present, and persisted during convalescence and up to the time of his arrival in London. The nails of the right hand showed hæmorrhages into the matrices, and faint traces of the same were observed in one or two nails of the left. As the nails grew the yellow stains were carried to the tips. Roughly speaking, the stains took about two months to disappear, leaving the nails thinner and with a tendency to split at the end. There was no transverse depression, as is so often observed in Pneumonia and other severe illnesses.

Dr. Mugliston, who went to Dr. Lundie's assistance at Bole, also developed Yellow Fever, but fortunately recovered. In his case the nails were not affected.

Dr. Kennan and Dr. McConaghy also mention the yellow staining of the finger nails in the cases seen by them.

Conclusions.

The following conclusions appear to be justified as to some of the epidemiological and clinical features of this disease (or ? of these diseases):—

1. That it occurs in a sporadic form and also in epidemics.
2. That at least two different types of attack are recognisable.
3. That one may cause death in five or six days.
4. That the other may assume a sub-acute or chronic form.

5. That the onset is sudden with acute febrile symptoms.

6. That all ages and both sexes are affected.

7. That it may be attended with a high mortality.

8. That in some places it is recognized that one attack affords no protection against another, whereas in other places opinion is divided upon the question.

9. That the finger nails may become yellow.

10. That the most constant symptoms are:—

(*a*) Pyrexia.
(*b*) Malaise.
(*c*) Prostration.
(*d*) Pains in various parts of the body.
(*e*) Jaundice.
(*f*) A dark colour of the urine.
(*g*) Vomiting.

11. That some, at least, of the cases are due to malarial infection.

(*F*) Weil's Disease.

This disease, which was described by Weil as occurring in Germany, may closely resemble a mild attack of Yellow Fever. Jaundice is of constant occurrence, appearing about the same period of the illness as Yellow Fever—namely, the fourth, fifth, or sixth day; and the post-mortem signs are in many respects alike. It seems to be a Septicæmia, in which the jaundice is due to a degeneration of the liver cells, and the nephritis to the injury caused to the cells of the kidney. In Weil's disease, however, a bacillus of the proteus group was found in the spleen, liver, and kidneys of two fatal cases, and in the urine of several cases during life.

SECTION XII.

MORBID ANATOMY.

No attempt will be made in this section to give a complete description of the morbid anatomy of Yellow Fever; such a labour is unnecessary, as the subject is fully dealt with in the text books and in the articles on Yellow Fever in the various systems of medicine.

The organs chiefly affected are the liver, the stomach and intestines and the kidneys; of these interest centres around the changes in the liver, owing to the recent claim of Da Rocha Lima to have demonstrated lesions therein which are characteristic of the disease.

There is not, as a rule, in cases of Yellow Fever submitted to post-mortem examination, much difficulty in deciding that the patient has died of that disease, but as the decision in sporadic cases, and in the early days of a threatened epidemic, may be a matter of such supreme importance, the discovery of a pathognomonic lesion of the liver would necessarily be a step in advance.

The Liver.

Macroscopic Appearances.

The following description of the appearances presented by the liver in Yellow Fever is taken from the late Sir Robert Boyce's work on "Yellow Fever and its Prevention":—

> "The *liver* is invariably altered in colour: most frequently it presents some shade of yellow, usually *boxwood* colour, but shades like bath-brick, tan, ochreous brown, deep yellow, pale yellow and reddish yellow are frequently recorded. The fact that there is *some shade of yellow*, with, in addition, some degree of *congestion*, the latter may be so pronounced that the liver looks like a yellow 'nutmeg liver.' Most observers agree that the term boxwood covers most accurately the shade of yellow which is most frequently seen. It is not a bright yellow such as is sometimes seen in jaundice. The neck of the gall bladder may be congested: this was seen in the autopsies made in Seccondee this year, 1910."

Sir Robert Boyce, "Yellow Fever and its Prevention," p. 228.

Carrol describes the liver as:—

> "Tense, firm and smooth, showing that its cells are swollen. The colour of the organ is variable. It may be uniform or mottled in appearance, but it is always yellowish or brownish in colour, and usually shows areas of congestion or hæmorrhages beneath the capsule. Upon section the organ is firm, pale and friable. The cut surface may also be uniform or mottled."

Osler and McCrae, "A System of Medicine," Art. "Yellow Fever," p. 749.

The variations which are observed in the appearances presented by the liver are probably mainly due to conditions antecedent to the onset of the disease to the period during its course at which death occurs, and to the mode of death.

Precedent cirrhotic changes will necessarily have a marked effect, and it is a recognised fact that Yellow Fever is specially fatal in

those who have drunk to excess. If all the organs show congestion the liver will share in that change; if hæmorrhage has been severe or if fatty degeneration is extreme it will be paler in colour. Probably the earlier the period at which death occurs, the less marked are the fatty changes. In some cases the liver is larger than normal, but rarely markedly so; in others it is smaller.

Microscopic Appearances.

The following is Da Rocha Lima's description of the histological changes in liver in Yellow Fever, which he regards as almost characteristic of that disease:—

"Archiv. für Schiffe und Tropen Hygiene," Bd. 16, 1912, pp. 192–199.

> "In yellow fever I have found without exception in contrast to nearly all diseases a *marked attack on the intermediate zone*, which in most cases, even with low magnification, is recognisable as broad rings between the more or less altered peripheral and central zones. In the cases where the zonal divisions cannot be so easily distinguished, the diagnosis will yet become possible through a knowledge of the details about to be described.
>
> "To these details, to the manner in which the different histological elements are altered and arranged, I attach as great a value as upon the above-mentioned separation of zones, because through these I am able to distinguish yellow fever from other, certainly rare, liver diseases with necrosis of the intermediate zone."

Dr. Harald Seidelin (Y. F. Bulletin, Vol. III., No. 4, pp. 269-294, p. 271) has recently discussed this question in a paper on "The Histology of the Liver in Yellow Fever," in which he accepts Da Rocha Lima's description as that of a very common, but not constant, type of Yellow Fever liver. He finds a remarkable variation between the cases and also between different parts of the same organ.

Dr. Seidelin is of opinion that Da Rocha Lima has correctly described necrobiotic changes as the lesion of greatest importance in the Yellow Fever liver.

He gives (pp. 296-298, Plates VIII. and IX.), on Plate VIII. four figures from the same liver in which the types represented in Figs. 1 and 3 were common, and that of Fig. 2 much less common, and Fig. 4 distinctly rare.

The figures are thus described:—

"Fig. 1.—*Irregular type of necrobiosis.*—The necrobiotic areas are quite irregularly distributed, though slightly less marked in the peripheral zone than in the central and intermediate zones. Moderate fatty change. Slight cellular infiltration in some places where the necrosis is complete. Acid hæm-alum and eosin.

"Fig. 2.—*Rocha-Lima type of mid-zonal necrosis.*—The central and peripheral zones are well marked, consisting of well-preserved cells, with a few necrobiotic cells irregularly distributed amongst the others. In the intermediate zone conditions are reversed. Same stain. Otherwise similar to Fig. 1.

"Fig. 3.—*Peripheral type.*—The cells in the inner zone are fairly well preserved, but in the two outer zones they are either necrobiotic or the seat of extreme fatty change. With this low power the specimen shows considerable similarity to typical fatty infiltration. Hyperæmia of a hepatic vein type. Same stain.

"Fig. 4.—*Central type.*—The inner zone is severely affected, the middle zone slightly, and the outer zone hardly at all. Fatty change moderate. Van Gieson stain."

"Rocha-Lima has found that the necrotic changes are of a mid-zonal type, the middle zone being wider than the others and consisting almost entirely of necrotic cells together with erythrocytes and round cells; the inner zone is narrower than the outer one, and may consist only of a few cells; fatty change is marked in the outer and inner zones, but less marked in the necrotic area. This author emphasises that the phenomena are essentially the same in all cases, differing only in intensity; in the individual case the hepatic lesions are remarkably uniform throughout the organ. He declares that it is unjustified to speak of a general disorganisation of the liver parenchyma, although occasionally the trabecular structure may be interrupted in the necrotic areas.

"It is necessary to consider carefully this question of local distribution, because Rocha-Lima claims for the mid-zonal type of necrosis a considerable diagnostic importance. I have previously stated that, in my opinion, Rocha-Lima has described a very common, but not constant, type of yellow fever liver, and a careful revision of my old specimens, together with examination of sections from recent cases, has confirmed me in this view. Once having had the attention drawn to the Rocha-Lima type, I have been able to observe its presence in some cases in which I had not noticed it before, but there are others in which it is altogether absent or so rarely seen that it cannot by any means be spoken of as the type. Thus, considering my own results together with those of Carroll, Otto and Neumann, Marchoux and Simond, and Boyce, and comparing them with the description given by Rocha-Lima, I arrive at the conclusion that mid-zonal necrosis is common and often well marked, but that other types occur in a

considerable number of cases, and that various types may be well marked in one and the same liver." (Y.F.B., Vol. III., No. 4, p. 271.)

Dr. Seidelin states (p. 291):—

"Rocha-Lima regards necrobiosis as the essential phenomenon, and is of opinion that a certain type of mid-zonal necrosis is characteristic of yellow fever. He admits already in his first papers (1912, 1 and 2)* that similar lesions may occur in other diseases, although not with exactly the same characters as in yellow fever.

"In the discussion following one of these papers (1912, 2), and in the later paper (1914), he declares that the mid-zonal necrosis is not pathognomonic, but of very rare occurrence in other infections: the few instances in which similar though not identical lesions have been demonstrated are cases of abdominal sepsis which could hardly be mistaken for yellow fever. The diagnostic importance of mid-zonal necrosis depends evidently on two factors: its common or constant occurrence in yellow fever and its non-occurrence in other diseases. With regard to the first point, I have already stated above that in my experience this type is quite common, but by no means constant, and I have quoted the descriptions by Carrol, Otto and Neumann, Marchoux and Simond, and Boyce, which do not conform to the Rocha-Lima type. To this evidence may be added that Turnbull (*vide infra*), in his two cases, has found a peripheral zone of comparatively well-preserved cells, but only in one of the cases a similar central one; in the other case the necrosis was equally marked in the central and intermediate zones. Stevenson's (1915) (*vide infra*) brief description, on the other hand, of the liver lesions in one case corresponds well to Rocha-Lima's type, so far as can be judged without further details."

*1. Rocha-Lima, H. Da (1912). Beib. Archiv. f. Sch. u. Tropen Hyg., xvi., pp. 192-199. Leipsig. 2——(1912). Verhandl. Deutsch Pathol. Ges., xv., pp. 168-182 (with discussion). Jena. 3.——(1914). Int Congr. of Med., London, 1913. Sect. xxi., pt. II., pp. 57-62, London.

Case No. 26, I. R., Vol. II, pp. 581-594 (p 593).

Dr. A. C. Stevenson, of the Wellcome Bureau of Scientific Research, was requested by the Commission to report on pathological material from a case diagnosed as Yellow Fever, which is given in detail in the Appendix to a Report by Dr. G. E. H. Le Fanu, on a "List of Fever cases investigated during the months of March and April, 1914."

The following is Dr. Stevenson's description of the microscopical appearances of a portion of the liver:—

"*Liver.*—Lobules not very defined. Liver cells around central vein show fatty change, as do also those on the outside of the lobule.

"In the zone between these is a markedly necrotic area in which cells having a markedly acidophil character appear; this zone is also much engorged with blood, which is not seen in the other zones. There is some small round cell infiltration of portal canals."

Hitherto, as Da Rocha Lima states, nearly all authors have laid stress on the importance of the fatty changes in the liver in Yellow

Fever, and rightly so, for such changes are undoubtedly present; but there is ample evidence proving that necrosis also occurs.

Specimens from two cases diagnosed as Yellow Fever were submitted by the Commission to Dr. Hubert M. Turnbull, Director of the Pathological Institute of the London Hospital, whose report and comments on the microscopical changes in the liver and other organs in these cases are contained in Vol. I. of the Reports on questions connected with the investigation of non-malarial fevers in West Africa, issued by the Commission:— I. R., Vol. I. pp. 195–206 (p. 198), (p. 202), (p. 204).

"*Liver.*—The parenchyma is the seat of conspicuous degeneration. The hepatic cells are greatly swollen, and the capillaries appear to be completely occluded or are only recognised as narrow clefts. In only a few areas are red corpuscles seen in the capillaries. In paraffin sections stained in hæmatoxylin and eosin, there is usually a zone, two to four cells broad, immediately round the portal systems, in which the cells retain a polygonal shape, are for the most part free from vacuoles and have sharply stained nuclei. Internal to this there is a broad zone in which the protoplasm of the cells contain clear vacuoles of various sizes and is to a greater or less extent hyaline and deeply eosinophil. In the majority of the cells there are no nuclei; in others very faintly stained swollen nuclei can just be recognised. Other nuclei are shrunken and deformed; chromatolysis is, however, much the commonest expression of nuclear degeneration and necrosis. Where the cells can be differentiated they are rounded in shape; in this zone, however, it is usually impossible to differentiate individual cells or even cellular columns. In approximately the central half of the lobules the cells are to a large extent rounded and show a varying degree of vacuolation and hyaline, eosinophilic degeneration of their protoplasm, and chromatolysis, but these changes are much less severe, so that the cellular columns and individual cells can be differentiated. Within the columns of this zone there is a considerable amount of bright yellow bile-pigment.

"In sections stained with sudan the outer half of the lobules, with the exception of the narrow zone in the extreme periphery described above, is occupied by a large quantity of fatty substance. The fat does not form large, round droplets which evenly distend signet-shaped cells. The bulk of it is in form of medium-sized, deeply-stained droplets which lie in groups within degenerate cells. Fine intracellular granules are also present. Occasional large masses of round or irregular shape are extracellular, and obviously formed by the disintegration of cells. In the central half of the lobules there is much less fat, it is intracellular and in the form of small granules of 'dust.' In sections stained by Nile-blue-sulphate, less fat is demonstrated than in sudan; the smallest granules are not stained; the fat, almost without exception, gives the pink reaction of neutral fat. In preparations of cells crushed in water or in acetic acid and examined with a polarisator very small doubly refractile bodies are present."

The Kidneys.

The following is Dr. Turnbull's summary of the histological changes in the kidney of case 26 (p.202):—

> "The *kidney* is icteric and shows extensive necrosis and parenchymatous degeneration. Necrosis of the first convoluted tubules is extreme and dominates the picture. Fatty degeneration is slight and is confined to the second convoluted tubules. Casts are present. There is no accumulation of iron pigment. There is no evidence of inflammatory action in the form of emigration of cells in the interstitial tissues."

Of the *kidney* in case L. 14 (p. 203) it is stated:—

> "The changes in the *kidney* only differ in detail from those in Case L. 26. Necrosis of the parenchyma is much less marked and there is a corresponding increase in the expressions of degeneration. Thus fatty degeneration is much more marked in the second convoluted tubules, and is found also in the loops of heule and collecting tubules. Casts of albuminous, fibrinoid substances, especially a deeply eosinophil substance, are very numerous.
>
> "As in Case 1, there is no evidence of inflammatory reaction, so that the term 'nephritis' is not justified."

The following is Dr. Turnbull's summary and analysis of the changes observed (p. 202):—

> "*Summary and Analysis of Histological Abnormalities.*
>
> "*Case* L. 26 (pp. 45 and 196).—The *liver* is the seat of a very severe parenchymatous degeneration and necrosis, in which an accumulation of fat is the most important feature and a hyaline alteration of the protoplasm is conspicuous. A narrow zone of hepatic case immediately round the portal systems is almost intact; the external half of the remainder of the lobule is much more severely affected than the central. The degenerate and necrosed cells compress and appear to constrict the capillaries. There is icterus and an accumulation of granules of iron pigment. There is no evidence of inflammatory reaction except an infiltration of the portal systems, which in its cytology resembles the infiltration found in the spleen.
>
> "*Case* L. 14 (p. 219).—In the *liver* there is a slight portal fibrosis. The dense and sclerotic nature of the fibrous tissue excludes recent activity of the process; the fibrosis bears no constant relation to an infiltration which resembles that in Case L. 26, and which is only found in some of the portal systems. The slight portal fibrosis is evidently an accidental complication. The other histological changes differ from those in Case L. 26 in intensity alone. The degeneration and necrosis are greater, and the central portion of the lobules is as severely affected as the intermediate. There is a greater accumulation of iron pigment."

"*Significance of the difference in the two cases.*

"Death appears to have occurred at an earlier stage of the disease in Case L. 26, and the earlier onset of death was perhaps due to the rapid and extensive necrosis of the kidney. Thus in Case L. 14 the affection of the liver is severer, and when compared with Case L. 26 appears to have advanced towards the central veins. In the kidney degenerations are much more conspicuous, and there are greater accumulations of casts; the parenchymatous degeneration appears to have had longer time to develop. In the spleen the proliferation of endothelial cells is greater and the cells have become phagocytes.

"*Comparison with the Lesions of Yellow Fever described in the Literature.*

"The general features of the pathological changes in yellow fever, as described in the literature to which I have had access, are found in the two cases under discussion. These general features are:— Icterus. Severe parenchymatous degeneration and necrosis of the liver, in which fatty degeneration plays the most conspicuous *rôle*. A variable degree of parenchymatous degeneration and necrosis of the kidney, in which fatty degeneration may be very slight. Engorgement and hæmorrhage in the intestine, the hæmorrhage being greatest and usually very conspicuous in the stomach. A variable degree of inflammation and necrosis of the mucosa of the intestine. Engorgement of the pulp of the spleen. No constant nor characteristic change in the lung.

"Further, such details as are given in the descriptions of the histological changes are almost all found in the two cases under discussion. Thus, in the liver, Carroll (1905) describes a zone of cells round the portal systems in which degenerative changes are slight. He specially mentions a hyaline, deeply eosinophil, necrosis of the hepatic cells. Marchoux and Simond (1906) describe compression of the capillaries by swollen hepatic cells in cases in which death occurs between the fifth and tenth day. Carroll says that this compression is so constant and peculiar a feature that it can indeed be considered as characteristic of the disease. It may, however, be found in other diseases." (*Ibid*, pp. 204-205.)

It has possibly been too readily assumed from the presence in the urine of albumen and casts of the urinary tubules that there is a true nephritis in Yellow Fever. The evidence from two fatal cases showing the absence of such a condition is not of course conclusive, but it is sufficient to show that both albumen and casts of the renal tubes may be present in the urine in Yellow Fever, apart from inflammation of the kidneys. The point is also of importance in the differentiation of Malaria and Yellow Fever. In the section on that subject mention is made of the fact (*vide* p. 171) that in

America albuminuria has been frequently observed in severe cases of malignant tertian infection, and that nephritis follows in about 1·7 per cent. of such cases. This is relied on by those who seek to minimise the importance of albuminuria as a symptom of Yellow Fever, but we are not aware that nephritis has been observed as a sequela of Yellow Fever; indeed, it is remarkable how quickly the albumen and casts disappear from the urine in cases of that disease which recover. If the albuminuria and the casts were the expressions of a true nephritis, this would hardly be so, but if there is no inflammatory change it is easily understood.

Before a pathological lesion can be accepted as typical of a disease it must be shown to occur with such frequency that its absence in any given case is strongly presumptive against such a diagnosis. This obtains with regard to the lesions of Peyer's patches in Typhoid Fever, although it is true that cases have been reported in which they were normal yet such cases are extremely rare.

We do not think more can be claimed for Rocha Lima's mid-zonal necrosis than that it is a valuable and accurate observation, but the absence of that change in any case should not outweigh the evidence derived either from the clinical course of the disease, or from other post-mortem appearances; indeed, Rocha-Lima himself does not claim that it is invariably present.

SECTION XIII.

THE BLOOD IN YELLOW FEVER.

It is practically certain that the virus of Yellow Fever primarily infects the blood, and that, either therein or elsewhere in the body, it develops toxic products which circulate in the blood. The fact that by the inoculation of blood serum from a patient in the first three days of the illness it is possible to transmit the disease is sufficient proof of this.

Stitt, "Philippine Journal of Science," Vol. I., No. 5, June, 1906.

Carrol, in the paper to which the reference is given, quotes Stitt as having observed a marked contrast between the condition of the blood in Dengue and Yellow Fever.

In Dengue he found a polymorphonuclear, as well as a general leucopenia, with a marked relative increase in the mononuclear

leucocytes, whereas in the early stage of Yellow Fever the total leucocyte count was practically normal, and there was no diminution in the proportion of polymorphonuclear leucocytes, this, on the contrary, was frequently found to be increased.

In the Report* prepared by Dr. Horn and Dr. Mayer, and issued by the Colonial Office in 1913, which deals with the epidemics in 1910 and 1911, a synopsis of the cases is given (pp. 88-91) and under "The Circulatory System, Blood and Ductless Glands" (p. 89), a table showing the differential leucocyte count in six cases (Nos. 41-46). This is here reproduced, with, for comparison, the average numbers in normal blood: —

Normal Percentage.		Case 41.	Case 42.		Case 43.	Case 44.	Case 45.		Case 46.
65 to 75 ...	Polymorphs ...	82·25	86·07	74·50	71·00	67·25	71·00	67·25	77·00
1 to 2	Large mononuclears ...	4·00	4·70	5·75	6·25	5·00	6·25	5·00	6·00
25 to 35 ...	Lymphocytes...	12·00	7·64	12·00	17·00	24·00	17·00	24·00	11·75
1 to 2	Eosinophiles ...	0·50	0·19	1·25	4·25	4·25	4·00	2·75	0·50
2 to 4	Transitionals...	1·25	0·76	6·25	1·50	0·25	1·50	0·25	4·75
$\frac{1}{4}$ to $\frac{1}{2}$	Mast. cells ...	—	0·38	0·25	—	1·75	—	1·75	—
		100·00	99·74	100·00	100·00	102·50	99·75	101·00	100·00
	Malaria Parasites ...	Nil.	Nil.	Nil.	Nil.	Nil.	Nil.	Nil.	Nil.
	Pigmented mononuclears	—	—	—	Nil.	Nil.	—	—	Nil.

Case 41.—A fatal case of Yellow Fever in a European, aet. 24. Death occurred on the fifth day of the illness, and on the day following admission to hospital. The count was therefore made on the fourth or fifth day of the disease. Accra, May 23rd, 1911.

Case 42.—A fatal case of Yellow Fever in a European, aet. 27. The first count was made on the fourth day of the disease; the second on the seventh day. Death occurred early on the eighth day. Accra, May 23rd, 1911.

Case 43.—A mild attack of Yellow Fever in a native labourer, age (?), who was at the time in a segregation camp, under observation as a contact. The blood count was made on the second or possibly on the third day of the disease. Accra, May 23rd, 1911.

* See footnote, p. 25.

Accra, May 24th, 1911.

Case 44.—A mild attack in a native labourer, aet. about 30 years, who was also in the segregation camp under observation as a contact. The blood count was made on the second day of the disease.

Christiansborg, Accra, May 22nd, 1911.

Case 45.—The patient was a native clerk, aet. about 40 years. Recovery took place after an illness lasting 12 days. The first blood count was taken on the fourth day of the disease, the second on the seventh day.

Accra, June 22nd, 1911.

Case 46.—A fatal case in a European, aet. 35 years. Death occurred on the fifth day of the disease. The blood count was probably taken on the second or third day.

I.R., Vol. I., pp. 207–307.

The following blood counts are from fatal cases recorded by Dr. T. M. Russell Leonard in a report on "Certain Outbreaks of Yellow Fever in Lagos, 1913, and January and February, 1914":—

Case.	E—European. N—Native.	Age.	Day of Death.	Day of Count.	Result of Blood Examination.
No. 1. L 14 ...	E	28	5th	3rd	No malaria parasites present Leucopenia present. Polymorphonuclear, 71%. Mononuclear, 20%. Lymphocytes, 4%. Eosinophil, 5%. Hæmoglobin, 85%. Blood pressure, 125
No. 7. L 37 ...	E	34	5th	2nd	No malaria parasites present. Pigmented leucocytes present. Polymorphonuclear, 78%. Mononuclear, 7%. Lymphocytes, 13%. Eosinophil, 2%. Leucopenia present.
No. 8. L 38 ...	Syrian	40	5th	2nd	No malaria parasites present. Pigmented leucocytes present. Polymorphonuclear, 78·7%. Lymphocytes, 12%. Mononuclear, 8·3%. Eosinophil 1%
No. 11. L. 41 ...	Syrian	35	5th	2nd	No malaria parasites present. Pigmented leucocytes present. Polymorphonuclear, 76%. Mononuclear, 7%. Lymphocytes, 13%. Eosinophil, 4%.

The following cases of a milder type ending in recovery occurred in contacts under observation:—

Case.	E—European. N—Native.	Age.	Day of Death.	Day of Count.	Result of Blood Examination.
No. 9. L 39 ...	Syrian	24	—	2nd	No malaria parasites were found. Pigmented leucocytes. Polymorphonuclear, 75·5% Mononuclear, 6%. Lymphocytes, 15%. Eosinophils, 3·5%.
No. 14. L 44 ...	E	30	—	—	No malaria parasites present. Differential count : Polymorphonuclear, 80%. Mononuclear, 2·5%. Lymphocytes, 17%. Eosinophil, 0·5%.
No. 19. L 52 ...	N	20	—	2nd	No malaria parasites present. Pigmented lencocytes present. Leucopenia present. Polymorphonuclear, 68·5%. Lymphocytes, 18·5%. Mononuclear, 8·5%. Eosinophil, 0·3%. Transitionals, 4·2%.

Dr. J. M. O'Brien visited Guayaquil, Ecuador, in October, 1913, with a view to study Yellow Fever in an endemic area. In a report* on his visit furnished to the Commission, he gives (p. 320) the results of his microscopical examinations of the blood in the Yellow Fever cases which he observed there:— I.R., Vol I., pp. 317-352.

"Differential leucocyte counts present the following points of interest:—

"The percentage of polymorphonuclears is nearly always high.

"The number of large mononuclears is generally normal.

"The lymphocytes sometimes diminish almost to disappearing point, but, on the other hand, in some well-defined cases of yellow fever, maintain their percentage normally high.

"Eosinophils are frequently absent, but the same may be said of natives of Ecuador in other diseases.

"The percentage of transitionals varies between the usual limits of my counts. Mast cells are commonly present. The differential counts in general suggest an increase in the percentage of polymorphonuclears, rather than a decrease in the other elements.

* NOTE.—This report is also published in the "Annals of Tropical Medicine and Parasitology," Liverpool, December, 1914, Vol. VIII., pp. 369-378, with plate, but without the appendix

"With regard to the occasional very low percentage of lymphocytes, judging from the small number of slides I have been able to examine, I think that a low lymphocyte count is normal to the people of this country.

"As convalescence progresses the percentages adjust themselves to the normal."

Y.F.B., Vol. III., No. 4, pp. 358-361.

Dr. Seidelin, in a review of Dr. O'Brien's results, writes as follows:—

"These results differ from those obtained by other recent observers, but correspond fairly well to the leucocyte counts given by Arevedo and Conto."

Dr. Seidelin analyses the 47 differential counts contained in the Appendix to Dr. O'Brien's paper, and finds that (p. 359):—

"In thirty the percentage of polymorphonuclear cells is above 70, whilst in three it is between 65 and 70, and in fourteen below 65. Amongst the latter we find two in which the percentage is 44 and four in which it lies between 45 and 55. On the other hand, the percentage of mononuclears, as distinct from lymphocytes, and therefore presumably 'large mononuclears,' is given as 10 or higher in twenty-three cases, and in several other cases it is close to 10; in some cases the percentages are as high as 24·3, 25·3 and 28·6.

"This is very far from normal conditions. According to these figures, O'Brien's results do not differ very materially from those obtained by the reviewer in Yucatan. Some of the mononuclear percentages are probably the highest hitherto recorded."

A Change in the Polymorphonuclears.

I.R., Vol. I., pp. 317-352.

Dr. O'Brien describes (p. 321) a change in the polymorphonuclears, which he thinks may prove to be of diagnostic value. He believes that in a very large proportion of Yellow Fever cases these cells are acutely degenerated and in a wholesale manner:—

"In a typical case, about the third day of the fever, some half of the polymorphonuclears lose the brown, stippled, staining reaction which their protoplasm has towards giemsa; by the fourth day all have lost this colouring; only faint dots may be seen in the cytoplasm, in others the cytoplasm is obviously unstained and hardly discernible. The nucleus in this stage remains normal.

"In the next stage the protoplasm edge looks torn and ragged, the nucleus becomes splayed out and lightly stained; without having seen the various stages of the transformation, it would be difficult to recognise the cell.

"Later, the protoplasm contracts, assumes a rounded form and takes on a light pink colour. The nucleus is round and small—its stain becomes intense.

"In the most advanced stage observed the nucleus is round, with perhaps one or two drop-shaped fragments of nuclear matter near it. The cytoplasm is circular, and about twice the size of a red corpuscle. It has a pinkish stain. More than anything else it suggests in shape a small *amœbacol*. This form is scarcely scattered in the slides."

Dr. Seidelin, in the review just mentioned, expresses a doubt whether the cells shown in the plate,* which accompanies Dr. O'Brien's paper, except a very few, are really polymorphonuclear leucocytes.

*"Ann. Trop. Med. & Paras." Liverpool, December, 1914, Vol. VIII., pp. 369-378.

The Hæmoglobin in Yellow Fever.

The following account of the condition of the blood in Yellow Fever is from the "Manual of Tropical Medicine" by Castellani and Chalmers:—

"*The Blood.*—There is no marked alteration in the numbers or appearance of the erythrocytes, even in fatal cases. A few normoblasts are said to be present at times. On the other hand, there is a decided loss of hæmoglobin, though this is rarely much reduced in the first three or four days; and hæmoglobinæmia is said to occur in fatal cases before death. But this does not appear to coincide with the fall of specific gravity, which may be present without loss of hæmoglobin. The leucocytes do not appear to be distinctly increased in numbers, varying from 3,200 to 20,000 per cubic millimetre, the increase, when present, being largely caused by polymorphonuclear leucocytes. The coagulation of the blood is diminished, and ammonæmia is thought to be present in bad cases."

Castellani & Chalmers, "Manual of Tropical Medicine," 2nd Ed., p. 1,009.

Carrol writes as follows (1):—

"Guiteras (2) * * * * * * lays special stress upon the value of the estimation of hæmoglobin, the percentage of which in yellow fever is rarely below 90 in the first three, four or five days. He states that if the percentage is found to be below 80 in the first few days in a case of yellow fever some complication will always be found or the patient will have previously suffered from malaria."

(1) Osler & McCrae, "A System of Medicine," Art., "Yellow Fever" by James Carroll M.D. Vol. II, p. 753.

It may, however, be pointed out that on the West Coast of Africa it is very unusual indeed to find in a European in a normal state of health for that region such a high percentage of hæmoglobin as 90 per cent. or even 80 per cent.

(2) "Medical Age," Detroit, Vol. XXIV., No. 6, March 25, 1906.

The reason for this is, no doubt, as Guiteras suggests, that they have previously suffered from Malaria, but it follows that as an aid to diagnosis in Yellow Fever the observation is of restricted value in that part of the world. It might, however, be useful in the case of a European who had recently arrived on the Coast.

SECTION XIV.

MOSQUITOES.

In December, 1909, the Advisory Medical and Sanitary Committee for Tropical Africa passed the following resolution:—"The Committee recommend that the attention of Governors should be drawn to the necessity of its being laid down as a *sine quâ non* that at least a part of an officer's quarters be protected against mosquitoes; and that the Secretary of State should express a strong opinion that where mosquito protection is afforded, it should be used"; and in accordance with their recommendation a report was called for, by the Secretary of State, from the Governors of the East and West African Dependencies on the subject of rendering mosquito-proof at least a part of an officer's quarters.

In October, 1910, following on the outbreaks in that year of Yellow Fever in Freetown, Seccondee and elsewhere, a despatch was sent to the Governors of the British Colonies and Protectorates in West Africa, asking for information as to the progress made during the preceding six months in the elimination of the *Stegomyia fasciata* from the various towns concerned.

In Northern Nigeria the native Emirs manifested great interest in the matter, and the Emir of Kano issued a Proclamation, of which the following is a translation. It is worthy of being placed on record:—

"From the Emir of Kano Abbas to all the People of Kano.

"(Translation from the Arabic.)

"Know that my command is as follows:—

"Whereas we have been informed by the Governor's physician of four important matters; every one must take notice of these matters.

"First of all, the sick infect the healthy, so that they become sick in turn.

"The mosquito sucks the blood of the sick man, and then goes to the healthy and bites him and infuses the blood of the sick into the healthy. The blood of the sick infects the blood of the healthy, and in the most cases the healthy becomes sick by the power of God and His will, since the affairs of the world are regulated by cause and effect. Truly the world is subject to these laws.

"Therefore we should take measures to reduce the number of mosquitoes and kill them off. The mosquito, as is known, breeds in wells and pits, and old pots, and earth holes; we should not make a pit near houses. Whoever has a pit or hole or old well near his house, let him fill it up.

"Secondly, we are informed that the common fly bites lepers, and then bites the healthy, and then leprosy is conveyed to the healthy by the power of God and His will, so that the healthy man becomes a leper.

"Therefore, we must take steps to reduce the flies. The fly, as is known, breeds in middens and refuse heaps and garbage and filth and places where blood is collected, like shambles.

"We must get the people to clean up and bury all refuse of this sort.

"Every butcher must cover the blood of oxen and sheep, and must slaughter far away from markets, and wash the meat, and clear the blood away, and bring the clean meat to the market to avoid attracting many flies.

"Thirdly, as regards venereal disease—many women here are diseased. If they cohabit with the healthy, the healthy become infected.

"I command all my alkalis to punish severely any person who conveys infection to another, either man or woman.

"Fourthly, concerning the wells, which, when the water is infected, convey dysentery and guinea-worm.

"We order that all owners of wells shall surround the mouth of the well with a parapet, to prevent infection being conveyed into the well and the well being spoilt.

"Nor should the excrement of cattle be allowed to get into wells, for this pollutes the wells.

"But, you are informed, if water is boiled, that kills the infection in the water.

"Those who have sense and respect their health should attend to this advice and boil drinking water.

"You, my brothers, do not forget the words of the Prophet in the Hadith's, which are full of learning and wisdom. He says, 'All that God wills for man has its cause writ plain.' From God we obtain help and on Him do we rely. There is no strength or help save in God Most High.

"PEACE."

The Commission are indebted to the Imperial Bureau of Entomology for information as to the distribution of mosquitoes in West Africa, as shown by records in the possession of the Bureau and by material preserved in the British Museum.

From this it appears that *S. fasciata* is present in nearly all the places from which cases of Yellow Fever have been reported.

Frequent reference has been made in the course of this Report to the Abeokuta case (*vide* p. 54).

Dr. E. J. Wyler, who reported on that case, gives the following description of the

I. R., Vol. I., p. 14.

"*Conditions as regards* Stegomyia *in Abeokuta and other places visited by patient, especially near residence of, and places frequented by, patient.*

"The conditions throughout Abeokuta are very favourable to breeding of *Stegomyia*. Water is obtained from wells by the natives (only those living in that part of the town which is nearest the river use river water), and is carried and stored in uncovered earthenware pots varying in capacity from one to eight gallons. (The manufacture of these pots is an important local industry.) Practically every compound contains large numbers of these vessels; in one selected at random in which ten persons lived there were thirty-three.

"Some of these pots are sunk in the ground (often nearly to the brim) and are therefore never completely emptied. Moreover all wells (except three) are privately owned, and a charge, varying with season, is made for water. Hence it is to the financial interest of the native to economise water and to empty his water pot as slowly as possible. In one compound, for example, there were twelve pots, eleven of which contained larvæ. In three compounds chosen at random there were fifty-two pots; thirty-five of these contained larvæ, largely *Stegomyia*, nine were dry, and eight contained water without larvæ. These compounds were within 200 yards of the patient's house.

"I have examined forty compounds in widely separated parts of the town and have found larvæ in all of them without exception. *Stegomyia fasciata* are present in considerable numbers, and form a large proportion of all larvæ. This I have ascertained by actual hatching out. I have examined a number of water-tanks (filled by rain from the roof) attached to European dwellings, and found larvæ in most of them (88 per cent.).

"In most cases no serious attempt at mosquito proofing has been made. In others the proofing has been allowed to fall into disrepair. In the deceased's house, which stands in a thickly populated part of the town and is surrounded by native dwellings, the nearest European house being over half-a-mile distant, I found a cooler (a native earthenware vessel containing water, which, by evaporation of water through its walls, cools syphons, &c., immersed therein) in which *Stegomyia* larvæ were numerous. This was an experience which I repeated in other European houses.

"These water pots, whether in the houses of careless Europeans or in native compounds and houses, are the chief source of *Stegomyia* breeding during the dry season. The tins, broken bottles, and vessels of all kinds which are thrown down at random and apparently never cleared away doubtless form ideal breeding places in the wet season, lying free from disturbance among the rank grass and bush that abounds throughout the town.

"There had been very little rain in Abeokuta up to the time of my investigations there, and I did not find larvæ elsewhere than in the earthenware pots mentioned, in water-butts, and in one tin in which water had been placed.

"Except in some of the better class native houses there are no latrines for natives in this town of 51,255 inhabitants (official census, 1911), the patches of uncleared bush and grass being used for this purpose.

"One such patch, with the usual accretion of tins, bottles, &c., I found situated within a few *feet* of the patient's house.

"The sanitary conditions generally which obtain in Abeokuta may, without over-statement, be described as deplorable, and as being calculated to foster not only yellow fever, but also enteric disease and (as already been demonstrated) small-pox.

"I have elsewhere mentioned that the native houses, though roofed with corrugated iron, are almost invariably devoid of gutters, so that this source of water-stagnation is not significant. I examined seventeen wells and nine ponds in widely distant parts of the town, but did not find *Stegomyia* larvae in any of them. The water was very low at the time in consequence of the retardation of the rains."

It should be pointed out that Abeokuta is situated in the native State of Egba, and that the responsibility for the insanitary conditions described above rested with the native government of that State. It must not be concluded that no efforts have been made to remedy these conditions during the period which has elapsed since the issue of that Report.

On August 22nd, 1913, a patient, whose case is described on p. 57 of this Report, was admitted to Lagos Hospital for observation, and the diagnosis of Yellow Fever was made on the following day. He had been staying for one month at Ogbomosho, and had travelled to Lagos *viâ* Oyo, Fiditi and Ibandan, and thence by rail to Lagos. He was removed from the train at Lagos as he was found during the routine examination of passengers to be suffering from pyrexia (103° F.).

Dr. E. J. Wyler proceeded to Ogbomosho, and made the following Report as to the conditions: —

I.R., Vol. I., pp. 31-33.

"*Conditions as regards* Stegomyia *breeding in Ogbomosho and other places visited by patient, and near his residence.*

"I found from actual breeding out of larvæ that *Stegomyia fasciata* is present in Ogbomosho, Oyo, Fiditi, and Ibadan.

"The conditions in all these towns for *Stegomyia* breeding are favourable, there being numerous water-pots in the native compounds. Larvæ are abundant.

"*S. fasciata* larvæ were numerous in the patient's compound at Ogbomosho."

Dr. Wyler discusses the question as to the place where this patient acquired his infection in the following paragraph of the Report: —

"*Conclusions.*

"I conclude that the patient must have acquired his infection either in Ogbomosho or in Oyo. He *might* have acquired it at Fiditi; but in that case the incubation period must have been fifty-four hours or less. It is scarcely possible that he became infected in Ibadan, since the number of hours between his arrival in that town and his detention at Lagos on the following afternoon would connote an incubation period of (at the most) thirty hours, and the number of hours between sunset on the day of his arrival in Ibadan and the time of his detention in Lagos would imply an even shorter incubation period (twenty-two hours). In spite of the fact, however, that infective *Stegomyia* bite only after sunset, this latter period of twenty-two hours seems here hardly to be of significance, for native houses are, as a rule, exceedingly dark, the interiors being in very many instances maintained in such a state of perpetual night that persons frequenting them would be liable to become infected at any period of the twenty-four hours.

"These conclusions as to the locality in which the patient was infected are based on the supposition that the date of his admission to hospital coincided with the first day of his illness. When I questioned him in hospital he denied having any subjective symptoms, or having experienced any in the past few days, though I understand that when previously interrogated by the Resident Medical Officer he gave the impression that he was, on admission, in the fifth day of the disease. In this latter case he must have acquired the disease in Ogbomosho. Statements of native patients regarding their health are, of course, frequently of doubtful value. Since in none of the towns visited by the patient within a month of the onset of his illness have there been any suspicious European cases, it appears to be clear that (excluding a hypothetical animal source of infection) the patient acquired the disease from another native.

"E. J. W.

"*6th September*, 1913."

In May and June, 1913, there was an outbreak of Yellow Fever at Warri (*vide* p. 60) when two Europeans engaged in a factory (store) contracted the disease, one of whom died.

The following extracts are from Dr. E. J. Wyler's Report on the

"*Conditions as regards* Stegomyia *Breeding at Warri, especially near residence of and places frequented by the patients.*" I.R., Vol. I., pp. 70–72.

"I inspected a large proportion of the compounds of European officials, native officials, and the general native population, and found them very free from breeding places.

"This was also the case in regard to the premises of the mercantile firms, all of which I inspected. Only once did I find larvæ in Warri during my inquiry: in one of the trader's compounds on the river bank. They were in the zinc lining of a packing-case that was in use as a receptacle for rubbish.

"I inspected sixty-three native dwellings; eleven canoes (not in use); thirty-three water-tanks (in five the gauze was defective), twelve rain gutters; and eleven receptacles for water, such as metal pots, barrels, &c., all taken at random. There were no larvæ in any of them. The wells were covered in with one exception, and in this also I failed to find larvæ.

"There are two villages of moderate size within approximately half-a-mile of Warri. I inspected thirty-six of the houses and found larvæ in none, in spite of the fact that some water pots raised on wooden tripods in the streets in connexion with fetish worship were swarming with them. These villages are subject to frequent visits by the Sanitary Inspector.

"The water supply in Warri for both Europeans (rain-water tanks) and natives (mainly well-water) is, I am informed, adequate, so that there is no necessity for undue economy and protracted storage.

"The occurrence of cases of yellow fever would naturally have the effect of greatly stimulating anti-mosquito measures, so that the conditions as I found them some time afterwards probably afford no adequate indication of the state of affairs at the time. I therefore quote the following remarks from a report made in June by the Acting Sanitary Officer:—

"'Distribution of *Stegomyia*. They are found more or less all over the station, but were undoubtedly very much more numerous along the river front in the European traders' compounds than anywhere else. In some of these, *Stegomyia* larvæ were found in large numbers in roof gutters, packing-cases, barrels, tins, &c., and ***'s compound had by far the largest number of breeding places. There was a large collection of empty packing-cases piled up behind ***'s shop, and the rains had caused the wood to swell so much that the lower tiers were capable of containing six or more inches of water. *Stegomyia* larvæ were found in these in large numbers.

"'Two or three days after the removal of this breeding place, the shop, which had been infested with mosquitoes, was comparatively free from them. In the Government Rest House, which is situate next to * * *'s compound and to leeward of it, there were also many mosquitoes, with a fair number of *Stegomyia* amongst them, which had doubtless come from Messrs. * * *'s compound.*

"'The compounds of the European officials, native clerks, and general native population were remarkably free from breeding places. In the pond and numerous water-holes on the golf course there were enormous numbers of mosquito-larvæ; considerable numbers were collected and hatched out but none proved to be *Stegomyia*. Those hatched out were species of *Culex* and *Pyretophorus*.'†

"I was informed by the Agent of a trading company that the number of mosquitoes, especially during the first half of the year, appeared to be much in excess of previous experience.

"On inspecting their premises I observed a number of canoes (eleven) moored at their wharf (see Plan I.). These canoes were laden for the most part with native food-stuffs. I was informed that there is a constant succession of craft which make this wharf their stopping place. They come from widely separated parts of the Niger Delta, and frequently remain alongside overnight. I was unable to discover any larvæ in the water which they nearly all contained to a greater or less extent, probably because canoes in use have frequently to be baled out. (In canoes which are not in use larvæ may often be found.) The presence of infected natives in such canoes would, however, constitute a perpetual danger to the European inhabitants of the firm's compound.

"The firm's agent informed me that canoes from Burutu (*vide* Section II.) usually go to Ogbe Ijoh (New Warri) and do not stop at their wharf, but that natives disembark from the bi-weekly launch from Forcados and Burutu opposite their premises, which often remains moored to the wharf until the following day. The facilities, therefore, for the transport of infection direct from Burutu and Forcados, where cases in natives were occurring at the time of the Warri outbreak (Section II.) were considerable. It will be seen also (Section II., paragraphs VI. and VII.) that launches and steamers which moor alongside the wharves may play no small part in the reinforcement of the supply of *Stegomyia* mosquitoes in Warri.

"* This Rest House has since been rendered mosquito-proof.—E.J.W."

"† In view of the fact that Dr. Laurie, the Junior Sanitary Officer, had found *Stegomyia* breeding in pools at Forcados—Section II.—I carefully investigated the possibility of similar conditions existing at Warri. I failed, however, to find larvæ in any pools, or in swamp near the town. The pools mentioned above by the Acting Sanitary Officer as existing on the golf course had dried up at the time of my visit.—E.J.W."

"The following are the mosquito indices (all varieties) for the years 1912 and 1913, based on the observations of Native Sanitary Inspectors :—

	1912.	1913.
"Quarter ending 31st March ...	0·2	0·23
" " 30th June ...	0·48	0·51
" " 30th September ...	0·45	0·36
" " 31st December ...	0·23	—"

In Dr. E. J. Wyler's "Fourth Report on Yellow Fever in Ships and in the Central Province," the following were the

"*Conditions as regard* Stegomyia *Breeding in Forcados and Burutu.*

I.R Vol. I., pp. 42–196, pp. 151–154.

"*Stegomyia fasciata* is present at both Forcados and Burutu.

"The native houses in those towns are disposed on a definite plan.

"They stand, for the most part, in rows, are therefore easily inspected, and only a small proportion of them have compounds (inclosures), in which, in other towns, one so frequently finds collections of standing water and agglomerations of garbage. It is to be remarked, however, that in some parts of Forcados, notably in the area where Cases 22, 33, 36, 38, 41 occurred, the sanitary conditions were deplorable, and due entirely, I was informed, to the want of financial means to carry out some most essential and even elementary improvements. I inspected both Forcados and Burutu, in which the conditions as regards *Stegomyia* breeding are similar, and the following statistics represent the sum of my observations in both places, made before any exceptional anti-mosquito measures had been taken.

"Out of 115 houses taken at random in different parts of the towns, including those in which the cases described occurred, no water at all was found in 32, while in four larvæ were found These larvæ, on being hatched out, proved to be *Stegomyia fasciata*.

"My inspection, it should be remarked, was made at the termination of the rainy season, when the water supply is sufficient and there is no temptation to store it unduly inside the houses. The conditions which obtain in the dry season may possibly be less favourable, for, at that period of the year, I am informed, there is often a considerable shortage of water, which has then to be brought a long distance by river and economized as much as possible. This shortage, I am further informed, is due to the inadequate supply of rain-water tanks. I learned from the Medical Officer that the outbreak of four cases (Nos. 10, 11, 12, 15) in one house at Burutu was ascribable to the breeding of large numbers of *S. fasciata* in some barrels of water in the compound which had been overlooked by the Sanitary Inspector.

"Out of fifteen wells I found that six were safely screened; in one the mosquito gauze was in disrepair; in one (upon private ground) no attempt at screening had been made, in one (upon Government property) *Stegomyia* larvæ had been found according to the Sanitary Inspector. This well was unscreened and had since been oiled.

"I examined 37 rain-water tanks. Of these 29 were effectively screened. In eight the gauze was defective. Out of 34 barrels used for the storage of water, 15 were effectively screened, there was a defect in the gauze in 11, whilst 8 were open.

"In seven roof-gutters there was some standing water. In none of the wells, tanks, barrels, or roof-gutters, whether screened or not, did I find any larvæ whatever. The mosquito-index in Forcados, based on the observations of native sanitary inspectors in April, May, and June, 1913 (wet months), was 0·61, 0·46, 0·55, respectively.

"In December, 1912, and January and February, 1913 (dry months), it was 0·27, 0·61, 1·06, respectively.

"I inspected both the native villages, the nearest of which, as already stated, is about one furlong from a European residence (non-official).

"These villages are situated amidst unreclaimed swamp. The huts, which, even in the dry season are practically surrounded by water, are built of reeds and are raised, some upon piles, others upon platforms of earth. They are connected with one another and with the town by raised paths which slope down to the water on either side through a zone of black mud. The picture presented is that of a diminutive, primitive, and infinitely hideous and squalid Venice. The water is, for the most part, tidal, and I found no larvæ therein, but there are numerous ponds and pools where earth has been excavated to form platforms for houses. These are only reached by high tides, and in some (but in only one of the villages) I found an abundance of mosquito larvæ.

"Dr. Laurie, the Junior Sanitary Officer, had, I was informed, found some of these larvæ to be *Stegomyia fasciata*, but though I collected and bred out a large number, none of them proved to belong to this species. His observation is, of course, of the highest importance as indicating a probable source of supply of this insect to Forcados port.

"I obtained some of the water from the pond in question for analysis by the Government chemist, Mr. Ralston, in order that the degree of its salinity might be ascertained. He reported that the chlorides present were equivalent to 4·74 per cent. of common salt, and he informed me that, in a series of experiments carried out by him in 1904, he found that in water containing under 1 per cent. common salt mosquito larvæ developed freely.

"In consequence of the vigorous house inspection that had taken place in these villages, and the strict injunctions issued to the inhabitants concerning water storage prior to my visit, further examination would not have yielded any useful results.

"Twenty houses, taken at random, contained no larvæ; indeed, in a considerable proportion of these no water whatever was stored.

"From consideration of the foregoing facts it would appear that the river craft, and perhaps also, as regards Forcados, the native villages, constitute the principal source of supply of *S. fasciata* in

Forcados and Burutu.* As is well known, the insect breeds freely in the bilge water of river boats. Shallow, transverse steel girders, projecting a variable distance inwards from the inner surface, divide the hulls into compartments that form ideal pools for *Stegomyia* propagation. In the transomes and chain-lockers these pools are particularly difficult of access.

"I inspected one 'stern-wheeler' and two launches, and in all three *Stegomyia* were numerous.

"It may here be remarked that cases 6, 21, 35, were employed on river craft. This would necessitate their frequent presence on board at night. Case 31, though employed on ship-board, was probably infected ashore."

In a Report entitled "Notes on a visit to Sherbro District," by Drs. J. M. Dalziel and W. B. Johnson, it appears that at the date of the visit, January 27th to February 12th, 1913, no rain had fallen for two months, and that as a consequence no *Stegomyia* larvæ were found in the bottles, tins, etc., which were utilised for the purpose of filling up the numerous burrow-pits and hollows everywhere met with: — I.R., Vol. II., pp. 527–540.

"At the present season mosquitoes are not a pest—a few Europeans even dispense with the mosquito-net at this time of year—but one has no difficulty in observing a few every evening. *During the rains everyone admits that they are abundant*, but there is no record of the species found or of which are the most prevalent. Small domestic receptacles being so abundant and carelessly disposed of, one naturally suspects the *Stegomyia* to be predominant, *and this is vouched for by previous medical officers who have worked at Bonthe. Our search in the present month of February, however, has not revealed a single specimen of* Stegomyia." p. 529.

"Turning now to the search for mosquitoes and larvæ in Bonthe, the chief fact to record is the apparent absence at the present season of *Stegomyia*. One cannot, however, lay stress on this, and we may point to a similar absence of *Anophelines*, although there is no lack of enlarged spleens, and malaria parasites were readily found in a considerable proportion of the blood examinations. Both types are probably abundant in Bonthe during the rains, but there is no record of a mosquito survey, and one cannot therefore tell which are actually the prevalent species.

"A complete house-to-house inspection of the whole town was not made, but each day a number of compounds and lots were gone over in all the different quarters, and thus a total of 82 came under

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"* Mosquitoes have also been found to breed in the numerous tortuous burrows of crabs. These may perhaps be a not inconsiderable source of *Stegomyia*, especially in the dry season, when they are not, as in the wet season, subject to constant flushing. The level of the subsoil water at Forcados, to which the burrows may extend, is within one or two feet of the surface.—E.J W."

examination. Mosquito larvæ were found five times—once in a surface well or uncovered water-hole which had fallen into disuse, twice in shallow wells with ill-fitting covers, once in a barrel, and once in domestic utensils (one bottle, and one earthen jar).

"All the larvæ found were other than *Stegomyia*. These figures give a larva index of 6 per cent. (wells being included). The available figures for the larva index taken on previous occasions are given below, but it is to be noted that the earlier figures at least exclude wells:—

"LARVA INDEX.

	"Bonthe.	York Island.
"March, 1911	12%	—
"May, 1911	11·8%	3·3%
"August, 1912	7%	—
"December, 1912	5%	—
"March, 1913 (quarter) ...	—	—
"June, 1913 ,, ...	3%	2%

"No figures are given for the larva index during the rains subsequent to June, 1913, but the sanitary gang appear to have become slack in their duties and lacked close supervision. The number of summonses for all breaches of sanitary laws fell suddenly from 40 in July to 6 in August and zero in September and October, so that it is more than probable that domestic mosquitoes again multiplied, and all residents admit that they were very numerous a few months ago.

"As stated above, our search failed to reveal a single *Stegomyia* larva, yet on looking over past sanitary reports we are confronted with the following, which is also a dry season record:—

> "'On May 1st, 1911, Dr. Burrows, Medical Officer of Health, Sherbro, reported on a '*Stegomyia* census' of 105 houses (75 in Bonthe and 30 in York Island). The resulting figures were:—
>
> "'Percentage of 'Larvæ Houses' in Bonthe—11·8
> ,, ,, ,, ,, York Island—3·3.'

"The larvæ found were stated in every case to be *Stegomyia*, and in one case mixed with *Anopheles* larvæ. The prevailing weather was dry, but Dr. Burrows remarks: 'An increase of 75 per cent. might safely be anticipated during the rains, as I found *Stegomyia* larvæ (which bred true) in every house I inspected in Bonthe in August last year (1910).' In the following year, in the height of the rains (August, 1912), Dr. Orpen recorded a larva index of only 7 per cent., and in his report comments on the unexpected difference between this figure and that predicted above. His house-to-house inspection was very carefully and completely worked out, and he suggests as possible explanations of the reduction of larvæ to such a low figure in the wet season, the following:—

> "(1) Heavy rainfall (36·6 inches) during the said month, perhaps 'flushing and keeping flushed the various articles capable of holding water.'

"(2) A vigorous campaign during the previous week against dirty compounds, resulting in a series of summonses.

"(3) The vigilance of the occupants (as a result of the sanitary campaign and its penalties), who immediately bustle about and empty every tub, barrel, pot, etc., leaving the yard still wet, when the cry 'Doctor do come' is raised.

"It is probable that the second of the above suggestions holds the key to the solution, and that in Bonthe, as in Freetown and everywhere else, the strict enforcement of regulations for domestic sanitation and a well-maintained supervision are essential, and are generally effective in reducing domestic-breeding mosquitoes to a proportion which probably ceases to be dangerous.

"It may be added that in Sherbro, as in Freetown and elsewhere in Sierra Leone, a common hedge plant is a variety of *Dracæna*, which retains water in the axils of the leaves. In Freetown a few months ago *Stegomyia* larvæ were found in this situation in many compound fences, and in Bonthe the plant has been proved to be a prolific source of mosquitoes during the rains."

"*No specimen of* Stegomyia *or of any* Anopheline *species was found, either adult or larvæ, in any compound.*" 533, p. 53.

Two visits were made to York Island, which is near Sherbro, and consists of a smaller settlement on another reach of the branching creeks.

Here "*Again no* Stegomyia *were found, either larvæ or adult.*"

The following also occurs in the same Report, and is headed "Notes on a visit to Yonni on Sherbro Island":—

"Mosquitoes swarm in the village at night, but of 65 specimens which I (W. B. J.) caught during an hour or so in my house in the evening, 64 were *Mansonioides uniformis* and one was *Culex consimilis*. The former is a mangrove-breeding mosquito; and the absence of *Stegomyia* larvæ in the village shows that *in the dry season no disease depending upon that mosquito could occur.*"

These statements, which we have italicised, are important and suggestive.

It has perhaps been too readily assumed that because *Stegomyia* have been found in a certain place at a certain season of the year, whether during the rains or the dry season, they are therefore always present during that season in every year.

It appears that this is certainly not the case at Bonthe, possibly, therefore, not so elsewhere.

If, for the sake of illustration, we assume that Bonthe had been an endemic focus of Yellow Fever from a certain date up to

February, 1913, it is possible that in that year it would have ceased to be so owing to the complete absence of the carrier in any form, assuming that the absence lasted for a sufficiently long period.

It may therefore be that one of the causes of the disappearance of the disease from any place where its presence has been observed, either in a sporadic or epidemic form, is due to some exceptional condition leading to the complete absence of the *Stegomyia* from that place.

We know that without the carrier the disease cannot continue to exist, and that where this absence has been the result of human efforts the disease has disappeared; it is, therefore, a legitimate conclusion that the same result must follow where Nature and not man has been the agent at work.

In July, 1914, the Commission entrusted to Mr. A. W. Bacot, F.E.S., of the Lister Institute, whose work on the bionomics of the rat flea, in connection with Plague, is well known, a research at Sierra Leone on the life history of the *Stegomyia fasciata*, and the results are embodied in an admirable Report, which will be found in the third volume of the Investigators' Reports. The conclusions at which Mr. Bacot arrived are thus stated:—

"SUMMARY OF CONCLUSIONS.

"(1) Adult mosquitoes are scarce within the central area of Freetown, but the larvæ of *Stegomyia fasciata* are found in greater numbers than those of other varieties within the town.

"*Eggs.*

"(2) The dark spindle-shaped eggs of *S. fasciata* vary so considerably in shape and size, that it is not practical to distinguish them from the other species of the genus, which are distinct from each other. The bosses with which the eggs are studded are not mere structural excrescences of the shell, but are pockets containing small masses of a substance which is possibly of service in enabling the eggs to regain lost moisture.

"(3) Eggs on a water surface are usually deposited so close to the margin as to become stranded by capillary action on the sides of pools.

"(4) Incubation seems to invaribly follow laying within 30 to 40 hours, but the hatching of any given batch may be distributed over a lengthy period.

"Cooling to the extent of 5° or 10° F. acts as a stimulus to induce the hatching of eggs that would otherwise have remained dormant for a longer period.

"Bacterial action also appears to be an important factor in hatching and in some instances may be essential.

"(23) Eggs are laid on fallen leaves lying in water holes.

" (5) The longest period of viability observed was 260 days. When kept continually immersed, some eggs did not hatch for periods of from two to five months.

" (6) Eggs brought back from Freetown and those laid in England hatched after exposure to 28° and 30° F. for 24 hours; but none hatched after an exposure of 25 days.

" All the eggs of a batch placed at 108° F. for 24 hours failed to hatch.

" (7) The only active enemy discovered was a species of book-lice (*Psocidæ*). Ants seemed strangely indifferent to eggs of *Stegomyia*.

" *Larvæ.*

" (8) The larval period is conditioned by temperature and food.

" Under the most favourable circumstances the larval life is passed within four days; with a scarcity of food it may be prolonged for upwards of 70 days.

" (9) Shortage of food results in the production of small sized adults.

" Well-covered cleanly cisterns require covers of specially small mesh wire gauze (not less than 18 × 18) as eggs may be washed in from gutters during rain.

" (10) There is an apparent association between the speed of larval growth and the development of bacteria.

" (11) The upper limit of temperature at which larvæ and pupæ may survive lay between 112° F. and 115° F.

" Half the larvæ reared at 80° F. became stiff and immobile at 50° F., irrespective of size.

" At 40° F. all the larvæ became immobile at the bottom of a large tin, and nearly all the pupæ, which remained at the top, also lost all power of movement, but the large majority of both larvæ and pupæ recovered when the temperature was allowed to rise.

" (12) When submerged in a wire gauze tube of 18 × 18 mesh, for 20 hours, 8 per cent. of the larvæ and 27 per cent. of the pupæ survived.

" (13) The larger larvæ of *S. fasciata* apparently consume the smaller ones.

" *Adults.*

" (14) Adults in captivity were observed to pair and feed at any hour of the day or night, late afternoon being perhaps most favoured.

" A single male may serve ten females more or less effectually, and fertilise 750 eggs.

" (15) A single full meal of blood is sufficient for egg production in many cases, possibly for all, though the eggs are sometimes retained for many days before being laid under these circumstances.

" (16) Females in their period of greatest vigour tend to develop and lay their eggs in masses at about three-day intervals, feeding on the first and second days after depositing their eggs, and fasting while the ovaries are full.

" One female laid 837 eggs in twelve batches, exclusive of odd eggs; another laid 712 eggs in fifteen batches during 22 days.

" (17) The kitchen and boys' quarters are the places most often chosen for the deposition of eggs.

" (18) Eggs are not laid by fertilised females regularly fed on human blood except on wet surfaces or on water.

" (19) A female lived for 95 days and was then killed by ants. The longest life of a male was 50 days.

" (20) No evidence was obtained that *S. fasciata* can habitually, or is likely, save under very exceptional circumstances, to tide over the dry season in the adult stage.

" (21) *S. fasciata* probably suffers more from wingless than winged foes once it has gained entrance to a dwelling. This is owing to its retiring habits.

" Ants proved to be deadly foes to caged mosquitoes.

" Two species of spiders in the mosquito house practically lived on *S. fasciata*.

" A small flattened scorpion ate large numbers of adults confined in the same box with it, and a slender wall haunting lizard quickly cleared a large cage of *S. fasciata*.

" (22) The only parasites encountered were a gregarine *Lankasteria culicis* Wenyon and a species of yeast.

General Observations.

" (24) The early tornadoes, which herald the breaking of the dry season, begin as dry squalls with but little rain, and may bring mosquitoes from the outlying districts into Freetown.

" (25) At the onset of the rains breeding is necessarily restricted to a few pools in favourable situations; these should be scheduled and treated at short and regular intervals at the very commencement of the rains.

" (26) Emulsions of soft soap and petroleum in combination are more effective larvicides than when used separately, and with naphthalene added kill all larvæ and pupæ at a strength of 1 in 20,000.

" Petroleum and soft soap emulsion at 1 in 8,000 is not effective in killing larvæ within submerged eggs, but causes many of the less resistant eggs to hatch at once, when the young larvæ are killed.

" (27) Salt water (from Freetown Harbour) speedily kills the larvæ of *S. fasciata*, but does not destroy the pupæ.

" Although it does not destroy the eggs it causes a high percentage of the less resistant ones to hatch at once, and a considerable percentage of the specially resistant.

" The young larvæ after hatching are speedily killed by it. The use of salt water for flushing culverts and gutters, and watering roads might, if practicable, prove very beneficial.

" (28) Adult mosquitoes of normal size were not observed to pass through 16 × 16 wire gauze, but there is little doubt that the dwarf specimens caused by scarcity of food could do so. A mesh of not less than 18 × 18 is essential for safety."

Mr. Bacot sent home some dried leaves of the West African cotton-wood tree, on which were eggs of *Stegomyia fasciata*. These leaves were entrusted for examination to Mr. Malcolm Evan MacGregor, of the Wellcome Bureau of Scientific Research, and a full account of his results is contained in a paper entitled "Notes on the Rearing of *Stegomyia fasciata* in London" (in the "Journal of Tropical Medicine and Hygiene" (No. 17, Vol. XVIII., pp 193-196). The leaves had been a fortnight in transit and had remained in a box at the Colonial Office for three months; nevertheless, when placed on tap water in glass containers, and kept at a temperature of 18° C., crowds of larvæ hatched out between 11.30 a.m. on April 29th, 1915, and 9.30 a.m. on the next day. About 75 per cent. of the eggs had been observed to be dried up, with their shells crinkled and shrivelled, whilst the rest appeared to be normal, yet the number of larvæ produced convinced Mr. MacGregor that the shrivelled eggs, as well as the normal, had been viable. They were kept in water in containers contaminated with straws from horse manure, and the organic matter and bacteria thereon, and were found to flourish best in water at a temperature of from 23° to 26° C.

On emergence the male and female mosquitoes were transferred to a cage, and mating took place usually in mid air.

The female mosquitoes readily fed on a black guinea-pig, and showed a marked preference for an animal of that colour. When a white guinea-pig was substituted the one or two which settled upon it, even when the hair on the back was shaved, were instantly disturbed by the slightest movement of the animal, and flew off to the far end of the cage and remained there, whereas by no amount of movement was a black guinea-pig able to dislodge them.

The males under the conditions obtaining in the laboratory lived between ten days and three weeks, whilst the females lived from a month to six weeks, and some have lived for nearly three months.

For the complete account of these interesting observations, the reader is referred to Mr. MacGregor's paper. We must here be content to record his conclusions:—

> "By the demonstration once more of the remarkable resistance of the eggs of *S. fasciata* to desiccation, attention is called again to the fact of what this may mean, very easily mean, in the distribution of this mosquito, and hence its bearing on the spread of yellow fever.

"It is clearly conceivable that dried leaves with the eggs attached might by wind alone be spread over immense distances, while by export of raw materials in bales of all sorts, dried leaves with eggs adhering could very well be distributed to the ends of the earth. Moreover, the hardiness of *S. fasciata* would permit of its establishing itself in many places where it is not found to-day, and with the sector of yellow fever present the living virus—if such it prove to be—need only be introduced into the infested area for the danger of an epidemic to be made manifest."

MOSQUITOES ON BOARD SHIPS.

At the request of the Commission a careful examination was made of vessels of every class trading to various ports, with a view to determining the presence, and, when present, the degree of prevalence, of the *Stegomyia* mosquito, both in the larvæ and adult stage.

The third volume of the Investigators' Reports contains an account of this investigation as carried out at Freetown, from the 8th April to the 24th May, 1914.

Twelve ships were boarded and examined, but in only three were mosquitoes found.

In the first of these, the s.s. "Patani," which made a voyage from Freetown to Sherbro and back, twenty-four mosquitoes were captured, and identified as follows:

Culex decens	12
Pyretophorus costalis	11
Ochlerotatus (? sp.)	1

It appears probable that they had come on board when the vessel was lying in the Sherbro River, about 400 yards from the mangrove swamps which there line the river.

The second vessel, the "Henrietta Woermann," had come from Assinie, and had touched at eleven ports, the last before Freetown being Sherbro Island, where the mosquitoes probably came on board, as at all the other ports the vessel had not been nearer to the shore than half-a-mile.

Two mosquitoes caught were *Culex duttoni*, both females.

The third vessel was the s.s. "Warri," from Sapeli and Warri. This ship had touched at thirteen ports on the coast, but at all except the two first named she had lain at least a mile and a half from the shore. The ship had been nineteen days on the voyage from Sapeli, and sixteen days from Warri. Identification showed the captured mosquitoes to be:—

Culex duttoni	3
Stegomyia fasciata	1
Culex pipiens	2
Culex (? *pipiens* type)	6
Culex (? sp.)	1

All the mosquitoes were females, except the *Stegomyia;* this was captured in the cabin of the second officer.

Mosquitoes were not found in the holds of any of the vessels examined.

The places on the coast named by the sailors as most infected with mosquitoes were:—

1. Forcados and the various creeks thereabouts.
2. Opobo and its creeks.
3. Benin.
4. Brass.
5. Okrika.
6. Port Harcourt.

The two latter were mentioned by all as the worst. As soon as the vessel gets out to the open sea the mosquitoes almost invariably disappear, but in calm weather, and when keeping near the coast, they may remain on board for many days.

The great variation in the extent to which vessels sailing up these infected creeks are troubled by mosquitoes is interesting to note. For instance, those on board the s.s. "Warri" were greatly tormented by them; whilst the s.s. "Boma," which covered exactly the same ground about ten days later, was hardly troubled at all. Possibly the presence or absence of wind or the direction from which it is blowing, may account for this more or less.

Amongst the twelve ships there were fourteen cases of illness, as follows: —

Malaria	9
Yellow fever	1
Intestinal disorder	1
Pyrexia of uncertain nature, with headache	3
	14

Two cases died, one, according to the ship's surgeon, of Malaria and hyperpyrexia, and the other was the case of Yellow Fever. The latter patient was taken ill and after five and a half hours' illness, died. The vessel, the "Nembe," was then at Burutu.

Assuming that these results, as regards mosquito transference fairly represent what usually happens along the coast at that period of the year, they do not indicate that steamships are then to any considerable extent responsible for conveying mosquitoes from one part of the coast to another; one male *Stegomyia* was not a great catch.

PART IV.

Synopsis.

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SECTION I.

ENDEMIC FOCI AND ENDEMIC AREAS OF YELLOW FEVER IN WEST AFRICA.

The Commission favour the view that in that portion of West Africa which extends from Senegal in the north to the French Congo in the south there are always some areas in which the infection is temporarily manifesting itself, and in this sense the West Coast is an endemic area. It is also probable that there are localities or areas in which the infection is more permanent or from which it is never wholly absent. This view is in opposition to that which regards Yellow Fever as a disease of almost universal prevalence in that region.

If this former view is correct, it is obviously of the greatest importance to locate these foci and areas, as until this is done and adequate measures of sanitation are adopted, it is highly improbable that the disease will ever disappear from the country as a whole.

We have already seen how in the past communities have resisted the acknowledgment of infection with Yellow Fever, and it is not likely that their opposition to the inclusion of their locality in a "black list," implying the continued presence therein of that disease, will be any less strenuous now; more particularly as they will be able to point out that the existence of any such foci is a matter of theory and not of fact, and they will possibly urge that, although

the disease may have been present at a particular place in which they are interested in the past, it cannot be proved to be there at the present moment.

The Commission have shown by much evidence that, in the past, this disease has again and again appeared in certain places, and that it continues to manifest its presence from time to time in those localities, and also that there is no evidence of its introduction from without as each successive sporadic or epidemic outbreak occurs, and from this evidence they have been led to the conclusion that these areas are responsible for its continued presence in the various Dependencies concerned; holding this opinion they conceive it to be their duty to give effect to it.

Sierra Leone.

Sierra Leone was undoubtedly at one time the most important focus of distribution of Yellow Fever on the West Coast of Africa, but, owing in part to improved sanitary conditions, it has long since ceased to deserve that evil reputation.

In a discussion held in the Section of Tropical Diseases at the annual meeting of the British Medical Association in 1903 (B.M.J., September 20th, 1902), a medical man, well acquainted with the Colony, stated that he had never seen a case of Yellow Fever in Sierra Leone, nor had his predecessor. This statement of fact may be accepted, but history hardly supports what immediately follows, viz., that "if Yellow Fever ever existed on the West Coast of Africa, in all probability it was imported from the West Indies"; or that of a subsequent speaker, who "thought the existence of Blackwater Fever on the West Coast of Africa was greatly responsible for the notion that Yellow Fever prevailed there."

The last epidemic at Freetown was in 1910 (*vide* Second Report, p. 110), since that date no cases have been recorded in Freetown; but in 1914 a patient infected at Boia, 60 miles distant by rail, was removed to Freetown, and recovered after a moderately severe attack (*vide* p. 79).

There is therefore no longer reason to regard Freetown as an endemic focus.

Senegambia.

The history of Senegambia certainly justifies the conclusion that the following places in that region should be regarded as endemic foci or areas: —

(i.) Dakar.
(ii.) Goree.
(iii.) Rufisque.
(iv.) Bamaku, in Upper Senegal.
(v.) Louaga, and other places on the Dakar-Saint Louis Railway, mentioned on p. 46 of the Second Report of the Commission.
(vi.) Various places on the Thiès-Kayes Railway, mentioned on the same page.
(vii.) Dinguira and Satadougu, in Upper Senegal and the Niger Territories.

The evidence as regards the above places is fully set out in the Second Report of the Commission, pp. 43 to 47.

Portuguese Guinea.

The Bissagos Archipelago.

The following extracts from the Second Report of the Commission are of importance: "At Bissau Island and Boulama it is stated that cases of Yellow Fever have occurred which did not come under official notice;" also, "It appears that 'epidemics are constantly occurring' at Bissau;" also, "The close attention of the Government of Portuguese Guinea should certainly be given to the sanitary condition of the Colony and the Islands, as they may be a source of danger to other Colonies on the West Coast." It was from Boulama that the disease acquired the name of "Bulam Fever." Bissau Island and Boulama are probably endemic areas and, possibly, very important ones.

The evidence as regards Portuguese Guinea is given on p. 64 of the Second Report of the Commission.

Soudan.

The line of the Kayes-Kita railroad is almost certainly an endemic area.

The history of the French Soudan as regards Yellow Fever will be found on pp. 65-67 of the Second Report of the Commission.

Ivory Coast.

Grand Bassam is certainly open to grave suspicion.

The incidence of Yellow Fever at Grand Bassam and other towns on the Ivory Coast is given on pp. 68 to 70 of the Second Report of the Commission.

Gold Coast.

A full account of the various appearances of Yellow Fever at Accra, Quittah, and other towns of the Gold Coast is given on pp. 70-76 of the Second Report of the Commission.

The epidemics of 1910, 1911 and 1912 are analysed on pp. 115, 119 and 124 of that report.

On reference to the account of the occurrence of sporadic cases (*vide* p. 64) given in this Report, it will be seen that the disease reappeared at Accra in 1913, and at various places in 1914. It has been continuously present in the Colony since 1910.

Northern Territories.

In the Northern Territories there is probably an endemic area in the neighbourhood of Bole. The hinterland surrounding the northern end of the Northern Territories may be the source of infection of Bole on the west, and of Tamale on the east.

The evidence as regards Bole, Tamale and Kintampo is given on pp. 72, 79, 85 and 104 of this Report.

Togoland.

The views of the Commission on the past history of Togoland in relation to Yellow Fever are sufficiently clearly stated on p. 51 of this Report.

In Appendix H. to the report* issued by the Colonial Office in 1913, pp. 103-108, a full account is given of Yellow Fever in Togoland up to 1911 by Dr. G. E. H. Le Fanu. The following table

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* See footnote, p. 132.

and comments, dealing with the occurrence of twenty-seven cases, are taken from the same report :—

"Besides these cases of yellow fever, two suspicious fatal cases in natives occurred at Sansane-Mangu in September, 1910, and one at Sokode in September, 1911, in a European, who died after a very short illness. As these cases have not been confirmed, they are not included in the following table, which sets forth the details of the twenty-seven cases already referred to :—

"YELLOW FEVER IN TOGO.

Year.	Date.	Sex.		Race.		Died.		Recovered.		Place.	Infected in.	Recorded by
		M.	F.	E.	N.	M.	F.	M.	F.			
1905	Jan. 27	1	—	1	—	1	—	—	—	Anecho ...	Anecho ...	Dr. Külz.
	,, 31	1	—	1	—	1	—	—	—	,, ...	,, ...	,,
	Feb. 2	—	1	1	—	—	1	—	—	,, ...	,, ...	,,
	,, 10	1	—	1	—	1	—	—	—	Lome ...	,, ...	Külz and Krüger
	,, ?	1	—	1	—	—	—	1	—	Anecho ...	,, ...	Dr. Külz.
	Mar. 23	1	—	1	—	1	—	—	—	,, ...	Grandpopo	,,
	April 10	—	1	1	—	—	1	—	—	,, ...	Agoué ...	,,
	,, 19	—	1	1	—	—	1	—	—	,, ...	,, ...	,,
	,, ?	1	—	1	—	—	—	1	—	,, ...	Grandpopo	,,
	,, ?	1	—	—	1	1	—	—	—	Lome-Land	Lome-Land	Dr. Sunder.
	,, ?	1	—	—	1	1	—	—	—	,,	,, ...	,,
1906	April 23	1	—	1	—	1	—	—	—	Lome ...	Badja ...	Dr. Krüger.
	,, 26	1	—	1	—	1	—	—	—	,, ...	,, ...	,,
	,, 28	1	—	1	—	1	—	—	—	,, ...	,, ...	,,
	May 3	1	—	1	—	1	—	—	—	,, ...	,, ...	,,
	,, ?	1	—	—	1	—	—	1	—	,, ...	,, ...	,,
	Aug. ...	1	—	—	1	1	—	—	—	,, ...	Tovega ...	
1907	Mar. ...	1	—	1	—	1	—	—	—	Palime ...	Anecho ...	,,
	? ..	1	—	—	1	1	—	—	—	Anecho ...	,, ...	Dr. Günther
	? ...	1	—	—	1	—	—	1	—	,, ...	,, ...	
	? ...	1	—	—	1	—	—	1	—	,, ...	,, ...	
	? ...	1	—	—	1	—	—	1	—	,, ...	,, ...	
1910	Jan. ...	1	—	—	1	—	—	1	—	,, ...	Sebe ...	,,
	Aug. ...	—	1	—	1	—	1	—	—	Anima ...	Anima ...	Dr. Zubitza
	,, ...	—	1	—	1	—	—	—	1	,, ...	,, ...	,,
	,, ...	1	—	—	1	—	—	1	—	,, ...	,, ...	,,
1911	June ...	1	—	—	1	1	—	—	—	Misahöhe...	Misahöhe	Dr. Sunder.
		22	5	14	13	14	4	8	1			

"The table shows a striking rate of mortality (66·6 per cent.), especially among the Europeans (85 per cent.); a marked diffusion of cases over the Colony, from the coast-line to beyond the ninth degree of latitude in the north. No direct connection can be traced between the various outbreaks, and the only conclusion possible is the endemicity of the disease in the native population. Külz (1905) was unable to discover cases among the natives, but it is significant that as time went on cases in natives have been reported, two in 1906, four in 1907, four in 1910, and one in 1911.

"That yellow fever occurs among natives, often in a slight and almost unrecognisable form, is the opinion generally held by the medical authorities in Togo. With regard to this, it is interesting to find Krüger (Annual Report, 1905-1906) referring to the 'massed appearance of icterus, with or without fever, which is very common amongst the natives, and frequently suggests infection through contact by the successive occurrence of it in people who share the same house.'

"Sunder, in an article entitled 'Yellow Fever among Negroes' (*Gazette*, 8th January, 1907), concludes: 'It is to be hoped that the assertion that negroes are immune to yellow fever, which has for a long time been in contradiction with the known facts, may be regarded as finally disposed of. The black race is as little immune to yellow fever as it is to malaria.'"

Cases have since occurred in Togoland (*vide* p. 51 of this Report).

Dahomey.

There is good reason for believing that cases of Yellow Fever are of frequent occurrence in this Colony, although the exact localities which should be named as foci or areas are not known.

Nigeria—Southern Provinces.

Lagos must be regarded as open to grave suspicion. It is extremely probable that mild cases amongst the natives of that town occur without their presence being reported to the authorities.

Abeokuta, or the neighbouring native town of Aro in the Egba State, is an endemic focus; the only other hypothesis it is possible to account for the case of Mr. Brooks at Abeokuta is that the disease was imported from Lagos by rail, of which there is no evidence.

There have recently been outbreaks at Onitsha and at the Engenni Concessions Camp near Degema.

The history of Lagos as regards Yellow Fever is given on pp. 80-118 of the Second Report, and in the Report by Dr. T. M. Russell Leonard in Vol. I. of the "Investigators' Reports," pp. 207 to 307, Warri, Forcados and Burutu are dealt with in Dr. E. J. Wyler's Fourth Report, I.R., Vol. I., pp. 42-86, and Appendix I., p. 187, and Burutu in Dr. J. C. M. Bailey's Report, I.R., Vol. I., pp. 88-154.

SECTION II.

QUARANTINE.

Having regard to the general state of war now prevailing (December, 1915), it is probable that a very considerable period will elapse before the Governments possessing Colonies on the West Coast of Africa will be disposed to consider the revision of the present international regulations respecting quarantine for Yellow Fever.

It is, however, the duty of the Commission to deal with this question, as in a despatch from the Secretary of State to the Governor of the Gold Coast the following occurs:—

> "I agree with you in thinking that it will be necessary to wait for the result of the investigation which is being carried out by the Yellow Fever (West Africa) Commission before a decision can be arrived at in this matter."

That despatch was in reply to the following:—

"Government House,
"Accra,
"23rd July, 1913.

"Sir,

"I have the honour to inform you that on the 21st instant a telegram was received by the Acting Colonial Secretary from the Acting Colonial Secretary, Lagos, informing this Government that a second case of yellow fever had occurred at that place, that the first case had terminated fatally, and that Lagos had been declared an infected port.

"This telegram was duly passed to the Principal Medical Officer and the Senior Sanitary Officer for their information, and for their advice as to the action to be taken, and I enclose, herewith, copies of a letter from the Senior Sanitary Officer, and of a minute by the Principal Medical Officer, bearing date the 22nd instant, on this subject.

"Personally I share to the full the opinion of the Senior Sanitary Officer as to the futility and inutility of declaring quarantine against a neighbouring West African Colony merely because two non-immune subjects have contracted a disease which is certainly endemic in parts of this Colony, and is almost certainly endemic in other parts of West Africa. Moreover, it may justly be contended that there is actually less danger of yellow fever being imported from an endemic area at a moment when the existence of the disease is attracting attention owing to its occurrence in non-immunes, than there is at any other time. At such seasons, of course, vigorous anti-*Stegomyia* measures are being adopted, and contacts are being isolated, whereas ordinarily such precautions are not being taken to anything resembling the same extent. None the less, I have ordered quarantine to be declared

against Lagos, as failure to do so might, not improbably, cause other West African Colonies to declare quarantine against this Colony. At the same time, I venture to bring to your notice the opinion which my advisers in the Medical Department have expressed on this subject.

"These frequent declarations of quarantine cause a great deal of inconvenience to the general public; they discourage and dislocate trade; they quicken the excessive apprehension with which far too many Europeans already regard the known risks of life in West Africa; and they inevitably advertise the less satisfactory features of our health conditions in a way which cannot fail to be detrimental to the material prosperity of a Colony. If the declaration of quarantine on the occurrence of two cases of yellow fever in any part of West Africa be a real protection to the public health, or an efficient barrier raised against the spread of the disease, all these inconveniences and disadvantages can be accepted with some measure of philosophy; but if, on the other hand, the Principal Medical Officer and the Senior Sanitary Officer are right, and no additional security or practical benefit be gained by our present procedure, it would seem to be advisable to reconsider the whole matter, and to endeavour to persuade the Governments of the French and German Colonies in West Africa to agree to some radical modification of the existing practice."

A Sub-Committee of the Advisory Medical and Sanitary Committee for Tropical Africa was appointed in 1910 to consider the assimilation of the Quarantine Law and Practice of the British West African Colonies, to frame a model ordinance, and to draft Regulations and Instructions in connection therewith.

After consideration of the views of the Governments of the four maritime colonies on the West Coast of Africa, the Sub-Committee recommended the following Instructions in connection with the Quarantine Ordinance and the Quarantine Regulations, both of which latter, *i.e.*, the Ordinance and the Regulations, are contained in the First Schedule of their Report—

"INSTRUCTIONS IN CONNECTION WITH QUARANTINE ORDINANCE AND REGULATIONS.

"1. Every Colony shall as soon as possible notify by telegram to the other Colonies the first appearance within such Colony of recognised cases of infectious or contagious disease as defined in the Quarantine Regulations. Such notification shall be accompanied or promptly followed by detailed information on the following points:—

"(1) The locality in which the disease has made its appearance

"(2) The date of its appearance, its source, and the type which it presents.

"(3) The known number of cases and deaths.

"(4) In the case of plague, whether that disease or any unusual mortality has been observed among rats or mice in the locality.

"(5) In the case of yellow fever, the existence and the degree of prevalence of *Stegomyia* in the locality.

"(6) The measures adopted immediately upon the first appearance of the disease.

"2. The notification and the particulars specified in paragraph 1 shall be followed by a weekly telegram notifying the occurrence of all new cases and by information systematically furnished in such fashion as to ensure that the other Colonies be kept acquainted with the progress of the disease. This information shall be sent at least once a week if practicable, and shall be as complete as possible. It shall, in particular, indicate the measures adopted with a view to checking the spread of the disease, and shall specify what steps are being taken.

"(1) in the way of medical and sanitary inspection, isolation and disinfection:

"(2) in the case of plague, to secure destruction of rats; and protective inoculation of persons:

"(3) in the case of yellow fever, to secure destruction of *Stegomyiæ* and their larvæ in the infected place:

"(4) in the case of small-pox, to secure vaccination and re-vaccination:

"(5) to prevent transmission of the disease to other Colonies.

"3. Every Colony shall immediately inform any Colony within which there is an infected place as defined in the Quarantine Regulations as to the measures which it is proposed to take against arrivals from that Colony or place; and shall, in like manner, inform such Colony as to the modification or withdrawal of these measures. Similar information shall immediately be communicated to every British dependency in West Africa."

As regards Yellow Fever, with which disease they are alone concerned, the Commission do not entertain any doubt as to the wisdom of these Instructions, or as to the necessity for the Government of an infected Dependency affording the information, as described under 1, 2 and 3 above, to the Governments of all other Dependencies on the Coast.

This is, however, not the real point at issue. Regulation I. of the Quarantine Regulations, *inter alia*, defines an "Infected Place," viz., as:—

"Any place where any infectious or contagious disease exists. Provided that a place shall not be regarded as an infected place because of the existence thereat of imported cases of such disease, or because of the occurrence of a single non-imported case."

The Quarantine Ordinance is as follows: —

"2. Where a place is an infected place within the meaning of Regulation I. of the Schedule to this Ordinance, the Governor may by order declare such place to be an infected place.

"3. (i) (a) The Governor in Council may from time to time make, and, when made, may vary or revoke, regulations for the purpose of preventing the introduction of disease into the Colony or Protectorate, or any part thereof, from an infected place or for the purpose of preventing the transmission of disease from the Colony and Protectorate into any other country or Colony."

The more important questions which the Commission have had to consider are, briefly: —

(1) What measures, in their opinion, should be adopted by the Governor in Council when *two* cases of Yellow Fever are officially recognised in any Colony?

(2) What measures should be adopted by the Governments of other Colonies on receiving such information?

It may be recalled that the First Report of the Commission, issued at a very early period of their work, contains the following (p. 5): —

A Sub-Committee of the Medical and Sanitary Advisory Committee for Tropical Africa.

"24. In the report of the sub-committee already referred to (Section 5) some of the problems before the Commission are stated; of these the first is: —

"The nature of the disease which during the years 1910-11 and 1912 has been locally diagnosed as Yellow Fever, and which has been the cause of a heavy case mortality.

"Bearing in mind that accuracy of diagnosis is not at present possible, in the opinion of the Commission that disease was extremely probably Yellow Fever.

"25. The second is stated thus: —

"Was it probably the same disease which is recorded in literature under the name of Yellow Fever as having occurred from time to time in the West African Colonies?

"In the opinion of the Commission the answer is 'Yes.'"

The Second Report of the Commission contained (pp. 5-80) a Historical Retrospect of the occurrence of Yellow Fever (1) on the West Coast of Africa as a whole, (2) of "Fever" in the ships of the British Navy on the West African Station, and (3) of Yellow Fever in the Colonies, both British and Foreign, on the West Coast of Africa.

In that Retrospect it is clearly shown that from 1778 to 1910 epidemics of Yellow Fever, affecting both Europeans and natives, have occurred at various periods and in various British and other Colonies on the West Coast of Africa.

The Second Report also contained a review of the "Health Conditions in the West African Colonies during 1862, a year of Exceptional Prevalence of Yellow Fever." *Ibid*, pp. 83—107 (pp. 106-7).

"*Commentary on the Epidemic of* 1862.

"It is evident that about the year 1862 Yellow Fever was a widely spread disease in Africa. It by no means follows, however, that because it was present in a great many centres fifty years ago it is to be found in those places to-day; nevertheless, it ceases to be surprising that from time to time it should reappear in one or more of them or in new centres. Like other transmissible diseases, it requires for its continued presence certain conditions, some of which may fail and so lead to its disappearance, and this in a given centre may be either temporary or permanent.

"So far as these records go there is no evidence to show that it was imported into any African settlement from the West Indies or elsewhere in the year 1862, and we have the statement of the Medical Board, whose report (1884) is given on page 34, that whenever it appeared in Sierra Leone (except in 1872) it was 'the undoubted product of Freetown itself.'

"Like some other diseases, it certainly spreads along the lines of human travel, but these records do not show that in 1862 it was carried from one Colony to another. Also, like other insect-borne diseases, it requires for its continued extension the presence of its intermediary host, and so far as our present knowledge goes it is only by the destruction of the carrier that we can hope to wipe out the disease."

The following also occurs in the Second Report (p. 108) as an introduction to an analysis of the epidemics of 1910, 1911 and 1912:—

"A general survey of the position as regards Yellow Fever in West Africa, immediately preceding and at the time of the first outbreak in May, 1910, at Freetown, may be useful as an introduction to an analysis of these epidemics.

"It is unlikely that a knowledge of the past history of the West Coast in relation to this disease, such as now appears in the Retrospect forming part of this Report, was then present to the minds of many of those concerned.

"The memory of the long history of epidemics at Sierra Leone, and elsewhere, had been buried in a happy oblivion, and much of the information on the subject now available has been obtained since that date.

> "On this as on other occasions no evidence was obtained, although careful search was made, that the disease had been introduced by an infected ship from the West Indies or some non-African port, and this remains true of all the outbreaks which have occurred since 1910 in the British Colonies on the Coast."

It is obvious from the foregoing that the caution which characterised the replies to the questions quoted in the First Report, which, as already stated, was issued for special reasons shortly after their appointment, is no longer necessary, and that as a result of their investigations the Commission are able to state without any hesitation that Yellow Fever is an endemic disease of West Africa, using that term in the sense of a *maladie habituelle*, and with the limitations clearly stated in this Report.

These preliminary observations appeared to be necessary in order to make clear, without reference to other sections of this Report, the grounds upon which the Commission base their recommendations as to the action to be taken (1) when one or more cases of Yellow Fever, not imported, are recognised officially in any Dependency, and (2) when a notification to that effect is received by the Government of another Dependency.

The Commission do not share the opinion expressed in the despatch quoted above as to "the futility and inutility" of one West African Colony in which endemic foci or endemic areas of Yellow Fever may exist declaring quarantine against another Dependency similarly circumstanced, although they fully appreciate the inconvenience to the public and the injury to commerce which are entailed by frequent declarations of quarantine.

(1) As already stated, they are of opinion that it is of great advantage that all the Dependencies concerned should be kept fully informed as to what is occurring amongst their neighbours in connection with this disease.

(2) There are Dependencies, *e.g.*, Sierra Leone, in which the disease has either ceased to be endemic or has at any rate ceased to show any signs of activity.

(3) By the introduction of fresh cases of the disease from a neighbouring Dependency new foci or areas may be created in a Dependency in which, although such foci are still existing, a determined effort is being made to stamp out the disease.

(4) It is possible that under certain conditions the necessity for declaring quarantine acts as a stimulus to efficient sanitary administration.

(5) They are, however, of opinion that the recognition of the fact that the disease is endemic on the West Coast of Africa creates a new situation which requires that the existing regulations should be modified, as soon as the cessation of the war renders it possible for attention to be given to the subject.

Recommendations.

The Commission recommend the following procedure in connection with the notification of cases of Yellow Fever and the declaration of a place as an infected place and the declaration of Quarantine: —

(1) On the occurrence of a single case or of two or more cases of Yellow Fever, affecting either Europeans or natives, the Government of the infected Dependency shall notify the Governments of the other Dependencies, British and others, in accordance with the present Instructions 1, 2 and 3 set out above.

(2) On the occurrence of two cases of Yellow Fever, non-imported, either in Europeans or natives, the Government of the infected Dependency shall exercise its discretion as to declaring any place to be an infected place, as defined in the Quarantine Regulations, having regard chiefly to—

(i) the distance of the place or places infected from the coast or frontier;

(ii) the interval, both in time and distance, between the first case and the second, as indicating the existence of a single focus of infection or of more than one such focus;

(iii) the efficiency of the measures already taken to prevent the further spread of the disease within the Colony or Protectorate and the transmission of the disease to any other country or colony.

(3) On the occurrence of three cases of Yellow Fever in any Dependency, the Government shall forthwith declare the Dependency an "infected place" within the meaning of Regulation 1 of the Schedule of the Quarantine Ordinance.

(4) On the receipt of the information described in the Instructions, as to the existence of one case or of two or more non-imported cases of Yellow Fever in any Dependency, the Governments of the other Dependencies shall exercise their discretion as to a declaration of quarantine against the infected Dependency, having regard (1) to the efficiency of the measures already taken to prevent the further spread of the disease, (2) to their knowledge of the sanitary conditions prevailing in the infected Dependency and the reputation of its administration, and (3) to the probability of the disease being transmitted to their own Dependency.

If it is objected that to give a discretionary power as to declaring a place an "infected place" up to three cases, instead of two as at present, is likely to favour the spread of the disease, it may be pointed out that, speaking generally, medical and sanitary administration is becoming increasingly efficient and the recognition of cases correspondingly more accurate; and also that the larger number is a presumptive indication, either of the existence of more than a single focus, or that the outbreak has not been brought under efficient control.

Moreover, many declarations of quarantine would have been obviated by the change recommended, and the experience of the last few years has shown that no harm would have resulted had it been in force during that period. It may be pointed out that the suggested change does not limit the powers as to a declaration of quarantine by the non-infected Dependencies; it merely allows the exercise of their discretion.

There is no doubt that, in the past, cases of Yellow Fever have been concealed in order to evade the necessary declaration of infection, and that at least one of the Governments concerned, whilst declaring quarantine according to the present regulations, has established a land cordon against its neighbours contrary to the regulations dealing with the adoption of that measure.

Possibly any Power which has acted thus in the past will continue to act in the same manner, but this should not, in the opinion of the Commission, prevent the adoption by the British Dependencies of less stringent regulations which, at least as between each other, they may feel certain will be honourably administered.

SECTION III.

SUGGESTIONS FOR FURTHER RESEARCH.

It may be of service to indicate the directions in which, in the opinion of the Commission, further research in connection with Yellow Fever may usefully be undertaken.

Appendix III. of this Report contains the outlines of a scheme for a systematic research on Yellow Fever, for which the Commission are indebted to Dr. A. Connal, Director of the Medical Research Institute, Lagos, and one of their Investigators. The Commission have decided to print it as an illustration of the kind of research which it had been their intention to prosecute had their labours not been interrupted by the War.

Clinical.

(1) Amongst the "General Conclusions" in their Second Report the following occurs: —

> "The mild nature of the attack in certain cases of yellow fever makes the identification of such cases a matter of great difficulty. It is therefore essential that in the future all cases of fever should be carefully observed and classified in order that, so far as possible, such mild cases of yellow fever may not pass unrecognised."

(2) Also the following: —

> "The attention of all workers at this subject should be specially directed to the discovery of a clinical test for yellow fever."

(3) The diagnostic value of the presence of bile-stained casts in the urine in Yellow Fever.

The Commission are still of opinion that all possible methods should continue to be employed in the clinical study of the disease.

Epidemiological.

(4) The nature of epidemics of disease simulating Yellow Fever occurring in the interior of the country and giving rise to considerable mortality.

(5) The existence of new endemic foci and endemic areas of Yellow Fever.

Pathological.

(6) The nature of the jaundice, whether hepatogenous or hæmatogenous.

(7) The value of Da Rocha-Lima's observations on the zonal arrangement of areas of necrosis in the liver.

The value of Palacio's observations.

The Blood.

(8) The diagnostic value of a high hæmoglobin index in the first three days of a case of Yellow Fever.

(9) The differential leucocyte count in Yellow Fever.

(10) The diagnostic value of the changes in the leucocytes described by Dr. J. M. O'Brien (*vide* p. 218).

The Urine.

(11) Chemistry of the urine in Yellow Fever.

Diagnosis from Malaria.

(12) The association of Malaria and Yellow Fever, and the significance of the absence of Malaria parasites and of pigmented leucocytes in cases of fever assumed to be due to Malaria.

(13) The occurrence of albuminuria in Malaria, apart from any urethral affection.

(14) The incidence of the Bilious Remittent Type of Malaria in West Africa. Whether more often a primary or a secondary manifestation of Malaria.

Diagnosis from Uto-Enyin.

(15) The nature of the disease known as Uto-Enyin and by other names.

(16) The occurrence of yellow pigmentation of the nails in Yellow Fever and in Uto-Enyin.

Mosquito Transmission.

(17) Repetition of the experiments of Marchoux and Simond on the hereditary transmission of the virus from one generation of mosquitoes to another.

(18) The changes which the virus may undergo in the mosquito.

(19) Whether other varieties of the genus *Stegomyia* besides *S. fasciata* are capable of transmitting the disease.

The Virus of the Disease.

(20) The nature of the virus, and, generally, the means by which the continuity of the disease is maintained on the West Coast of Africa, either (1) by man, or (2) by the mosquito, or (3) by animals.

SECTION IV.

GENERAL CONCLUSIONS.

In the three Reports already issued by the Commission certain conclusions are stated which, with others contained in this Report, are here summarised for purposes of reference: —

(1) That the following fevers, other than Yellow Fever and Malarial Fever, are met with on the West Coast of Africa, viz.: — Typhoid Fever, Paratyphoid Fever, Pappataci Fever, and (possibly) Undulant Fever and Seven Days' Fever, and possibly also Dengue Fever in a sporadic form, but that there is no evidence of the occurrence of widespread epidemics of any of these fevers in recent times.

(2) That Malarial Fever is the most widely spread of the fevers met with in West Africa.

(3) That Yellow Fever is an endemic disease of the British and other Dependencies on the West Coast of Africa. No sufficient evidence has been obtained that the disease occurs in the Republic of Liberia.

(4) The number of cases diagnosed in the British Dependencies as Yellow Fever has not exceeded sixty in any one year during the last six years, nor one hundred and eighty in all; but the Commission are of opinion that many more cases have occurred.

(5) That probably the continuous presence of the disease is maintained by the existence of endemic foci and areas or otherwise, rather than by its almost universal prevalence amongst the native population.

(6) That the native population is not immune to Yellow Fever, although, as a rule, when attacked, the natives suffer from a milder type of the disease than the Europeans.

(7) That the nature of the virus of Yellow Fever remains unknown.

(8) That there is no evidence that Yellow Fever has been brought to West Africa during recent periods from outside Africa.

(9) That epidemics of a disease have occurred in other parts of Africa presenting some features of a character similar to those met with in Yellow Fever, and that in these epidemics the mortality amongst the natives appears to have been much greater than usually now occurs when natives of the Dependencies on the West Coast are attacked by Yellow Fever.

(10) That a disease of uncertain nature, known to the natives by various names, as for example, Bayloo, Uto Enyin, or Yellow Eyes, prevails in certain Dependencies, usually at a distance from the coast.

(11) That the knowledge of the diseases, other than Malaria, common amongst the natives, both children and adults, inhabiting the "bush" is very defective.

The Commission feel that it is hardly necessary to emphasize the prime importance of a vigorous prosecution of anti-mosquito measures against all mosquito-borne diseases.

SECTION V.

ACKNOWLEDGMENTS OF ASSISTANCE.

The Commission desire in conclusion to acknowledge the great assistance they have received from those gentlemen named on pp. 2, 3 and 4 of this Report, who kindly attended their meetings and placed their knowledge of Yellow Fever, and other matters cognate to the inquiry, at their disposal. Also to the others there named, and particularly the appointed Investigators, all of whom carried out the inquiries entrusted to them with marked ability and zeal.

The thanks of the Commission are also due to Dr. Harald Seidelin for assistance in seeing through the press Volumes I. and II. of the Investigators' Reports.

The Commission have received much assistance from many members of the West African Medical Staff, to whom also they tender their grateful thanks.

The Commission desire to repeat here their appreciation of the valuable services rendered to them at the commencement of their inquiry by Dr. T. F. G. Mayer, West African Medical Staff, the first Medical Secretary, who returned to West Africa at the conclusion of his period of duty as staff officer attached to the Colonial Office.

Dr. H. Lynch Burgess, West African Medical Staff, who succeeded him, took up the work, and continued to the close of the inquiry to perform his duties to the very great satisfaction of the Commission. All the records of the Commission were kept by Dr. Burgess in a manner which greatly facilitated reference to the various papers and reports as they were required from time to time. The Commission desire to bring the services of Dr. Burgess to the notice of the Secretary of State.

To Mr. Alexander Fiddian, their Secretary, the Commission are specially indebted for his unvarying courtesy and for the sound judgment which he has shown at all times during the progress of their work. Mr. Fiddian's advice and assistance have throughout the enquiry proved of the greatest service to the Commission.

JAMES KINGSTON FOWLER.
W. J. SIMPSON.
RONALD ROSS.
W. B. LEISHMAN.
ANDREW BALFOUR.

ALEX. FIDDIAN,

Secretary.

31*st March*, 1916.

APPENDIX I.

ON YELLOW FEVER.

By L. G. Chacin Itriago, M.D. (Venezuela), M.R.C.S., and L.R.C.P. (Lond.).

At the suggestion of the Chairman of the Yellow Fever Commission, I have put in writing the observations I have made and the conclusions at which I have arrived from my experience of Yellow Fever in Venezuela.

I regret not to have at hand the numbers of "Gaceta Médica de Caracas" ("The Medical Gazette of Caracas") where I have published two articles on this subject.

Preliminary remarks.—As compared with European towns, the towns of Barcelona, Piritu, Clarines, Anoto and Zaraza are quite small. Their relative position to each other, and to the sea, is given in the annexed diagrammatic map.

Venezuelan country is true country, with plenty of woods and only scattered houses.

By the word *natives* I mean all inhabitants of the country born in it. They are divided into two groups:—

1. The Indian or original inhabitants.
2. The white people, descendants of European—mainly Spanish —races.

Malaria prevails in Barcelona, Zaraza, Clarines, and Onoto, but much more intensely in the last two; which are also smaller than the first two.

In Barcelona and Zaraza Malaria is mainly observed in the outskirts. In Clarines and Onoto Malaria is seen with the same intensity all over the town; perhaps this is due to the fact that both are narrow towns, which means that all the houses are near the open country in two directions.

From 1901 to 1909 I practised in Clarines, with occasional short absences to Zaraza, Onoto, Barcelona, and Piritu. In the course of the year 1907 there was an outbreak at Clarines of what may be called typical Yellow Fever, which at the same time was ravaging the towns of Barcelona, Zaraza, and Onoto. I was struck by the fact that at Clarines

the disease was only to be seen in children. and the same fact was observed in Barcelona and Zaraza. The only adults who caught the disease were :—

1. Those coming from some of the neighbouring towns, villages, or country.
2. Those whose residence in the town was less than five years.

In Onoto the disease did not respect any age; both children and adults were equally attacked.

After careful inquiries I found that about 25 years ago an epidemic of *vómito negro* (black-vomiting = Yellow Fever) had ravaged the town of Clarines, and that from time to time there were observed special cases of fever which the practitioners labelled pernicious malaria.

From what I saw during my eight years' experience, as well as from the results of my inquiries, I arrived at the following conclusion :—

In the town of Clarines and at intervals of from five to seven years there are epidemics of the mild form of Yellow Fever, which is called "fièvre bilieuse inflammatoire." These epidemics have been going on unrecognized and labelled Malaria, as this last disease is extensively prevalent, and the practitioners in malarious countries are too much inclined to see Malaria at the bottom of all febrile and even non-febrile complaints. Most of the cases are very mild, but a few assume a serious character and are accompanied by brown or black speckled vomiting, hæmorrhages from the gums, or nose, or elsewhere, and other well-marked signs of Yellow Fever. These last cases are labelled pernicious Malaria. Of course, this does not mean that there are no cases of pernicious Malaria; as a matter of fact, though not so often as most practitioners are inclined to think, pernicious Malaria is to be seen in the town, but the features are quite different.

As the town of Clarines is a small one and the coming in of non-immune persons is very limited, the disease ceases after attacking all susceptible individuals, but it remains latent, I do not know under what conditions, to be aroused afresh when new human material (all born since its last appearance) is available, and certain unknown conditions present themselves.

Every twenty or more years, and under certain conditions, the epidemics assume a very serious character.

Even the most characteristic cases of Yellow Fever, where there is no room for the least doubt, some practitioners label Malaria, partly on the ground that text-books—written when our knowledge of Yellow Fever was in its infancy—state that Yellow Fever is frequent in adults and rare in children!

On no other ground than that stated above, which is based mainly on first-hand knowledge can we explain why, in certain parts, Yellow Fever is only to be seen in children, while in others, both children and adults are equally liable to it.

In my opinion, it is almost certain that the town of Onoto had never previously been visited by Yellow Fever. Probably, in the future, the behaviour of the disease there will be the same as in Clarines.

Country immunity.—I had occasion to see for myself that Yellow Fever is not to be found in the country districts. The only cases I saw in the country were imported from the town, and the disease did not spread. It was only necessary to reside a little away from town to be quite free of the disease.

Racial susceptibility and racial and climatic immunity.—As far as my experience teaches me, special racial susceptibility to, and racial or climatic immunity against Yellow Fever are non-existent. In this respect there are no differences whatever between Europeans and Natives. In those regions where Yellow Fever is endemic the Natives do not acquire the disease, for the simple reason that they have had it before. The inhabitants of those parts of Venezuela (both white and Indians) where Yellow Fever is unknown, are as liable to it as the Europeans. This is an undisputed fact.

If Europeans come into a town at a time when a mild form of Yellow Fever is prevailing, and if they do not take measures to prevent themselves from being bitten by mosquitoes, they will probably develop a mild form of the disease and will become immunized, as happens with Natives.

Clinical diagnosis and treatment of Malaria and Yellow Fever.—With the exception of the mildest form of Yellow Fever which no one can recognize, and assuming that the possibility of the presence of that disease is borne in mind, Yellow Fever is quite easily differentiated from Malaria and quite recognizable clinically. Of course, I am speaking of the rule and not of the exceptions; an experienced eye will make very few, if any, mistakes. As far as my experience tells me, hæmorrhages (as from the stomach, bowels, gums, nose, etc.) and albuminuria, both of which in a lesser or greater degree are the rule in Yellow Fever, are the exceptions in Malaria. The remission of the temperature about the third day and the rising again about the fourth day, the special aspect of the patient, and the initial frontal headache and backache, are very characteristic features.

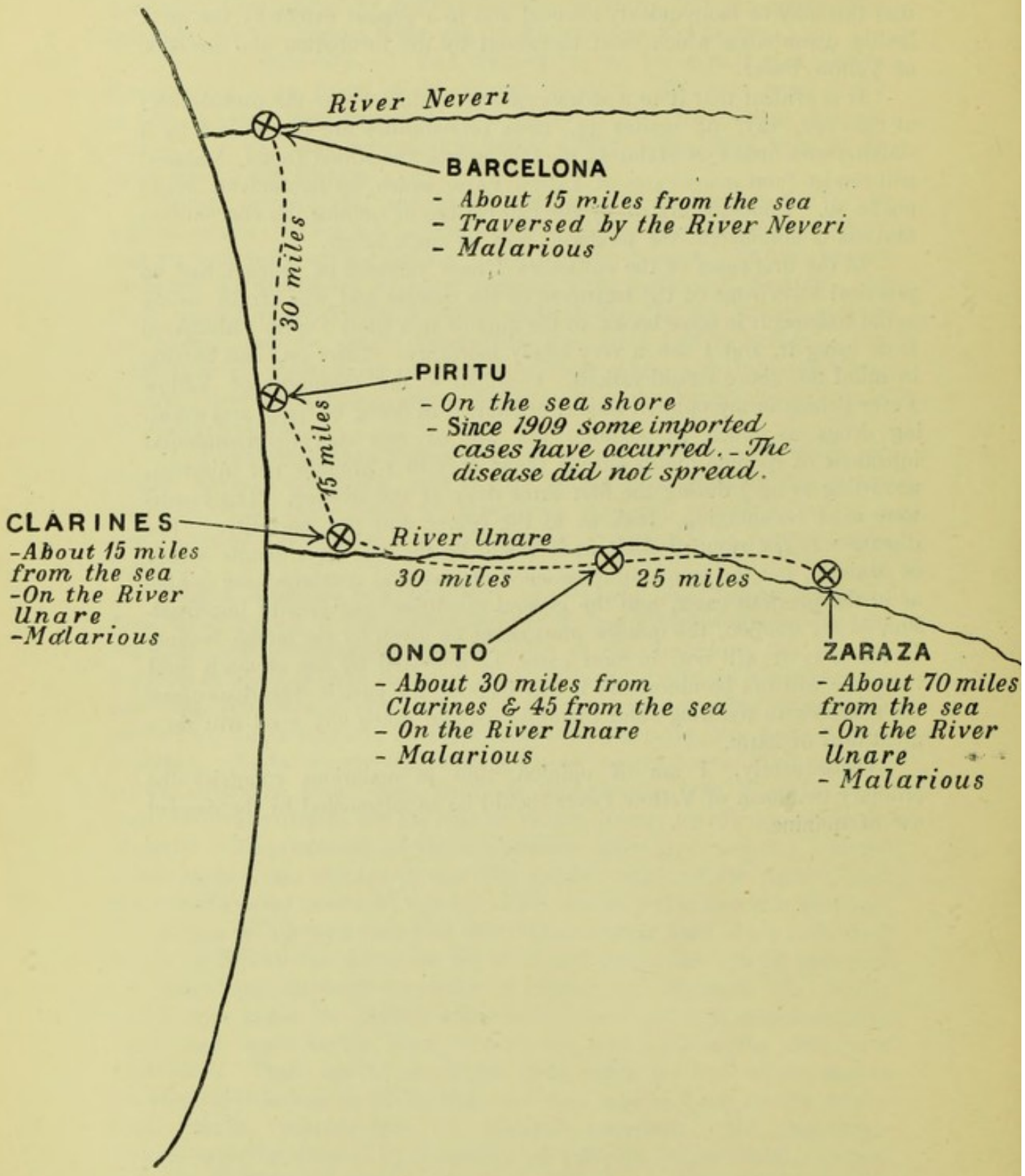
It is a well-known fact that once Malaria takes hold of an individual it is very difficult for him to get rid of it, and that unless special measures are taken and thorough treatment is carried out, although the febrile attacks may cease, the disease will remain latent and will manifest itself again and again at the least disturbance which diminishes the body resistances. These are the conditions under which the bulk of the people residing in malarious countries live, and they explain quite readily why a fresh febrile manifestation of Malaria—sometimes mild, sometimes serious—may be aroused by a number of different, often trivial, causes, such as a blow, a fall, a fracture, slight gastro-intestinal disturbances, excesses of any kind, and so on. If a trivial cause is powerful

enough to arouse the apparently dormant Malaria, it is easy to understand that this may be more quickly effected and to a greater extent by the great bodily disturbance which must be caused by the incubation and invasion of Yellow Fever.

It is evident that if in a serious case of Yellow Fever the probabilities of cure are, say, 67 against 33, these probabilities are diminished by a simultaneous attack of Malaria; in other words, the added factor, Malaria, will render fatal many cases of Yellow Fever which, by themselves, would not be so. Consequently, if by the careful use of quinine the concomitant Malaria is eliminated, the prognosis will be much better.

In the first cases of the epidemics I have referred to, when I had no practical knowledge of the treatment of the disease and was afraid, owing to the statements in some books, to use quinine in Yellow Fever, I abstained from using it, and I saw a very heavy mortality. Later on, and bearing in mind the above considerations, I added to the treatment of Yellow Fever (which in my opinion should be limited to doing no harm and avoiding drugs as much as possible) the use of two daily intramuscular injections of quinine hydrochloride (from 0·25 to 1 gramme per injection, according to age) during the first three days of the disease. The results were most encouraging, both as to the course and the mortality. The disease was not stopped short as it would be the case in a simple attack of Malaria, but the temperature lessened at once and continued not so high as in the previous cases, and the general condition was greatly improved. But, in my opinion, the quinine must never be given by the mouth because in this way it will not, in most cases, be tolerated by the stomach and therefore will not be absorbed; it will increase the gastric disturbance and the tendency to vomiting; and therefore without doing any good will do a great deal of harm.

Consequently, I am of opinion, that in malarious countries the ordinary treatment of Yellow Fever should be supplemented by the careful use of quinine.


River Neveri
BARCELONA
- About 15 miles from the sea
- Traversed by the River Neveri
- Malarious
30 miles
PIRITU
- On the sea shore
- Since 1909 some imported cases have occurred. - The disease did not spread.
15 miles
CLARINES
-About 15 miles from the sea
-On the River Unare
-Malarious
River Unare
30 miles
25 miles
ONOTO
- About 30 miles from Clarines & 45 from the sea
- On the River Unare
- Malarious
ZARAZA
- About 70 miles from the sea
- On the River Unare
- Malarious

APPENDIX II.

The Commission print the following paper, which has been abbreviated and put into the form of a continuous narrative, as it is, in the opinion of the majority of the Commission, a unique description of an attack of Yellow Fever by a patient, and brings out in a very striking manner the leading symptoms of that disease. Moreover, the remarks on treatment are of great clinical value.

RECOLLECTIONS OF AN ATTACK OF YELLOW FEVER.

By Alexander Lundie

(*Temporary Captain R.A.M.C.; late West African Medical Staff*).

On the 6th of September, 1913, Captain Short was relieved at Bole, Northern Territories, Gold Coast, by Mr. Sherriff. A large gathering of chiefs came to welcome back Mr. Sherriff. At night, Captain Short invited me to dinner, but during the course of the dinner my interest suddenly flagged. Everything had lost its taste, and I felt queer. Asking the host's permission, I took my temperature and found it to be 101°. I retired to bed at once, as a matter of precaution.

I slept very well and next day was in exactly the same condition, and kept in bed all day, feeling very drowsy, but quite satisfied with my condition. My host called to say "good-bye," and settle some affairs, and I got up out of bed most unwillingly to get something for him. On returning I felt a stinging at the side of my left knee, and caught a tse-tse fly fastened on the spot. I recognised it easily as *Glossina tachinoides*, and remember being extremely annoyed at it. This was a Sunday morning, and I spent the day and the next two in bed, thinking I had a low malaria. The temperature scarcely varied, and I had no discomfort, and by Wednesday morning I felt justified in getting up early, and going to attend the patients. I had, moreover, many cultures of *trypanosomes* going on, and an interesting *œcidiomycete*, whose life history I was working out. There was also cattle disease, which I looked on as akin to Yellow Fever, and I did not want to miss any chances to dissect a dead animal.

These three days of fever were uneventful, and I was immensely surprised on finishing hospital duties that I had scarcely power to get back to my house. On getting back, however, I took out the microscope and was horrified to find I could not attend to or take any interest in what I was doing. Luckily, the new District Commissioner came over, and distracted my attention, and I put away the microscope. On Thursday and Friday, and the most of Saturday, I made slight progress. No rise of

temperature ever took place, but I noticed that I could get a rise to 103° easily by putting the thermometer in my mouth immediately after a meal. This rise was very transitory, and I regarded it as evidence that all was not well, as the greatest rise I could ever get in apparent health on the West Coast in this way was to 101°, and even then I was not sure that there was not some malaria about me, as I was taking quinine very steadily. On Saturday I managed my duties so well that I consented to go out for a long walk with Mr. Sherriff, to the south of Bole. We reached old ruins, which we discussed. Bole had been overrun by Samory, not so very long ago, and it is still full of dead men's bones. We were speaking of these things and our own adventures, when the sun began to set, and we saw it would take us all our time to get home by six p.m. We set out and got on a little way when I said, "I am in for rheumatic fever, and it is a mystery how that should be, as I have not got a chill or wetting at all." I discussed the symptoms and said, "It can't be malaria, at all events." When we got within sight of my house I gathered my remaining strength and rushed for it, and on arriving shouted for the boy, who helped me to undress, and then I collapsed in the bed and was tucked in carefully by the boy. Mr. Sherriff came over in half an hour and took the temperature and prescribed quinine. The temperature was 102°. The headache was simply appalling, and the pains in the stomach were indescribable. Bilious vomiting commenced, and I decided to have some more quinine and mist. Alba. My skin was horribly dry, and I had grave suspicions that I had not malaria at all, but something incurable, so I took the quinine merely to prove that it was not malaria. I vomited incessantly, but my mind was exquisitely alert, and no sleep came till about 3 a.m., when I was drowsy.

The 14th inst. was dull and uninteresting. At 6 p.m. I had reached 102°, and at 8 p.m. 106°. Mr. Sherriff then took a grave view of the case, and I was startled at 9 p.m. by the arrival of a dozen police with his own bed. Meanwhile, I announced that I had not malaria at all, but in all probability Yellow Fever. I got him to bring me a sealed tube with a solution of quinine in it, and my hypodermic case, and I injected a dose into my flank

I then explained the *rationale* of the proceeding. I said: "This will be my last dose of quinine, if it does not make a very appreciable improvement in my condition in a very short time." I explained that the vomiting might have prevented an effective dose reaching the blood, but the injection would obviate this difficulty, and if unsuccessful, would prove that the disease was not malaria at all. He agreed, and said he would treat me exactly as I desired. That night was spent in the most exquisite agony. The vomiting was so sudden and so urgent that I was thrown violently across the bed in my hurry to turn round and keep the bed clean. Mustard plasters were applied all over me and cold water cloths to the head. Later on in the early morning, I opened my eyes and

saw my nurse dozing, and his whole face seemed to be black with mosquitoes. Nevertheless he refused to leave me, when the mere misery of the bites alone would have been sufficient justification for beating a retreat to bed.

Next morning I told Mr. Sherriff finally that I really had Yellow Fever, and would just have to put up with it. I next asked him to wire to Wa, and to Kintampo for help, as he could not go on alone. I then asked him to bring my notes from Sir Patrick Manson's lectures, taken at The London School of Tropical Medicine, and with my own finger pointed out the words: "TREATMENT:—Common sense and nursing. Hot fluid must be supplied as required, but on no account must food be given. The patient won't die of starvation in five days." "Now," I said, "no food for me for five days. And further, no medicine either. You can get a pill box of soda bicarbonate from the dispenser, but don't let him attempt to make Sternberg's mixture, I would rather die a natural death than have perchloride poisoning added to my tortures. The boys can keep the sparklets going all the time as I have bulbs to last a year, and they know how to manage the filter." I then pointed out the following words in my own handwriting, copied from Sir P. Manson's own dictation:—"Mortality varies. 30 per cent. is the average. 50 per cent. to 90 per cent. in an epidemic, or as low as 10 per cent. A drunkard never recovers. A temperate liver usually recovers. If thermometer does not rise over 103°, recovery is invariable. Above 106° F. all die." "Now," I said, "you see I don't drink at all and I have not reached 106° yet." I did not know that the previous night I had done so, or that I was to reach 106·7° in less than 24 hours. This was a very busy day for me, vomiting being apparently incessant, but I had time to notice that everything I saw in broad daylight was brilliant yellow, and was very glad I had diagnosed the case even before getting so broad a hint as that. I was highly alert also, and called my steward boy and scolded him for allowing a hole to wear in the mud floor, and had it filled up at once. That day was really too awful to bear any description at all. About 8 p.m. I was so hopelessly spent that I called Sherriff and gave him instructions how to make normal saline, and asked him to prepare three pints, as I intended to have a rectal injection, slowly, to try to make up for the loss of water from my blood caused by the constant vomiting. I see it has been noted that it took effect in a few minutes. I was never nearer death than then. I had administered it much too fast, and when I got back into bed I seriously wondered if I would ever be able to turn on my back again or would just die on my face. However, I pulled through so fast that I slipped out of bed again that same night and arranged all my correspondence, so that there would be no trouble left for other people who had to look for things.

That night was really the worst I passed. I had been making a new medium from fresh blood serum, and had a good many cultures of

trypanosomes going on. The Petri dishes I used were claret glasses covered with champagne glasses. I have mentioned that I hoped to recover, as I took no alcohol at all, but I had a full case of wine glasses. These glasses made good media dishes, and I used most of them for that. The tornadoes were in full swing just then, and every night one tore through the house from end to end, carrying away papers and books and smashing things I prized highly. Rain poured through the roof into my eyes every night and added to my troubles. The boys were there on the very first distant moaning of the wind and covered up my bed with a ground sheet, and so saved me from the dripping through the roof, which worried me much more than the fever. The champagne glasses went the way of all the world at that time, and the crash was terrible. They got on my mind, and when I vomited next time, in my delirium, thought that they had stuck in my mouth. Then a calm came. I opened my eyes. It was dawn. My nurse was sitting over me with a bath sponge dripping with cold water. I did not dare to move or sit up. I knew acutely what had happened. I had, in fact, not dared to sit up for some time before, fearing instant death. But I looked around and felt my arms and legs tugging violently. I was horrified. I was in convulsions. I shouted, "Come quickly. Look at my legs. I'm about done. I can't stop these twitchings, and if they don't pass off in half an hour, I will just have to die. Get my keys from below my pillow, and show them to me." He did so, and I showed him the key of the box I wanted opened. He opened it, and got a box of hypodermic tabloids. I said "I am quite clear now, I know I was delirious last night but I am not now. This is my last chance probably, and if I pull through the next half hour I will get better, but it will take some time, and you must not give me any food until I ask it. You will find a tube of morphine hydrochloride tabloids in that box. Each is $\frac{1}{4}$ grain. If you break one into two and give me one half that will be $\frac{1}{8}$ grain. You see I understand perfectly what I am talking about. If the morphine acts, good and well, if not, you can't be blamed." He did as I asked. In 15 minutes I felt easier, and in half an hour felt sure of recovery. Nothing seemed so plain to me all my life as the action of this morphine, and everything that had happened to me in the last few hours.

In spite of my injunctions, I see it in the official report that I was persuaded to take Benger's food twice that very day, but it soon was rejected, and did more harm than good. Another attempt to palm off tea upon me was made late that night, with the same result, but still I felt sure of recovery, and I do not blame my attendant for his endeavour to get me to retain something.

The next two days were dull and uninteresting. Vomiting was so frequent that the resolution not to take food was not defeated. Dr. Mugliston arrived on the second of these days, the 18th September. He had gallantly ridden seventy miles at a stretch through swamps and

tornadoes. His transport had been effected by hammock and by our horses. All these unhappy animals have sleeping sickness, and ours were no exception. My horse got washed from under Mugliston's feet into a torrent, and got under a bridge. Mugliston just managed by superhuman efforts to push it out with a stick, and save its life, while he himself stood waist deep on the bridge, to his own great risk.

Next day I took some champagne and Valentine's beef juice, but I did not like either. My urine was exactly like the beef juice, and I shivered to see it, and wondered if I would die in that doleful place, or go home with chronic nephritis.

The morning of the 20th opened bright and cheerily. I was as happy as could be. It was Sunday, a totally different day from all others, even though I did the same work, as a rule. I remember clearly saying, notwithstanding the horror of the previous day, that I would recover without any complications. The 21st passed quietly, and Dr. Watt arrived next day.

Next day I had time to examine myself more carefully, and noted that my fingers had been bleeding beneath the nails and were all black in consequence, and my skin was guinea gold.

I waited on for recovery, having an occasional moment of anxiety when my stomach was rebellious. I drank vast quantities of cold soda water, going right in the face of Sir Patrick Manson's warm drink *régimé*. My "Osler and Macrae" was consulted, and it was found good to give calves' foot jelly and iced champagne. We had none of these dainties. I fed on tinned milk and sparklet water, and managed to use it up. It is absolutely amazing to think what will support human life that is determined not to be put out.

The ten days of my convalescence, from the 20th September to the day I got up, were extremely happy, but I had a few night terrors. A brain so excessively active as mine had been, exercised with superintending my own treatment, could not fail to be tired.

No sooner had I closed my eyes to compose myself for the night's sleep, for the days were unclouded, than visitors arrived. Six other selves, all of them me, sat at my right shoulder on the pillow and worried me with their disputes. They disappeared whenever I opened my eyes.

No doubt this was just at the time when the kidneys were most severely taxed, for it was quite a late symptom. Another night I thought that all the chiefs of the district sat around my bed.

For sheer agony and prolongation of torture Yellow Fever must take first rank. It surpasses rheumatic fever in the exquisiteness of the pains, their variety, and incurability. It is madness to give drugs to relieve them. Any drug able to do it would have to be given in an almost fatal dose. In cerebro-spinal fever stupor sets in, and although the patient goes raving on, he ceases to feel as acutely. Not so in Yellow Fever, he keeps alert till nearly the end. There is a limit to the power to feel pain, and

whether it is caused by heated irons, or jagged knives or disease, it ceases to increase beyond that. The sense organs then become exhausted and actually feel less than is going on, but it takes about six days for that to happen. In Yellow Fever, aspirin sodium salicylate and phenacetin never reach the blood or the seat of pain or the brain. They are not absorbed at all. They are not even vomited out, they are shot out with explosive force, and there is danger of rupturing the blood vessels of the brain with the violence of the action. It is cruel to force drugs in through the skin, in the delusion that they may do good. Quinine is useless, and if the blood has been proved free of malaria parasites how on earth can the subsequent giving of quinine be justified? Pilocarpine is worse than useless, as the blood is already too dense, and if the fetish of a moist skin is needful then water must be supplied by rectum. Indeed, it is a wise thing to do. It would flush out the kidneys, and reduce toxæmia, and make up for water lost in vomiting. No water is absorbed by the stomach, but it should be drunk constantly to clean out the blood and acid in the stomach, otherwise there will be dry retching which will soon kill the patient. It is good to put sodium bicarbonate in the water and to have it ærated too, as it neutralises the excessive acidity of the stomach secretion. The headache is intractable by any safe dose of any drug. Cold water cloths help it distinctly. The abdominal pains are peritoneal, and mustard at least distracts one's attention from them. There is much tympanites, and a turpentine and soap enema would do good, and pave the way for a saline infusion. After one good evacuation of the bowels there is no need whatever for another for about nine days, in a bad case, for no food has been taken, and there is no difficulty in starting the bowels with absolute regularity as soon as food is resumed.

When hyperpyrexia sets in cold sponging is excellent. If the pathology of Yellow Fever were constantly borne in mind, the futility of drugging would be realised and many more recoveries than at present would take place. Saline, soda, sponging, and starvation, will increase the recovery rate immensely, and to these I attribute my recovery, for stronger men than I, with a better record of Coast sickness, have gone down with Yellow Fever who might have made a better fight if they had not persecuted their attendant to relieve their agony by some drug or other, and we all know how hard it is to refuse. They should be taught that it is almost certainly fatal, and that any chance they have is in their own hands. They need expect nothing to relieve their pains, or shorten their disease, in the way of drugs, but they will make things very much easier if they will lie still and drink only water, and never worry about food for days on end.

The Sequelæ.—There are no regrets left; no bitterness. The hair falls out, the nails are black and crack and become permanently thin. There are patches of anæsthesia and hyperæsthæsia all over.

In conclusion, I must once again express my gratitude to Mr. Sherriff for his self-denying, ungrudging attendance on me, and for saving my life.

APPENDIX III.

SCHEME FOR A RESEARCH ON YELLOW FEVER.

Attempted Transmission of Yellow Fever to Monkeys and other Animals.

(*A*)—By direct inoculation with blood from a case of Yellow Fever :—

(1) Inoculation of different amounts of blood (amount of blood infective ?).

(2) Inoculation of blood collected by day, and also by night (periodicity ?).

(3) Inoculation of (i) whole blood.
(ii) washed red cells only.
(iii) ,, white ,, ,,
(iv) serum only.
(v) filtered serum only.
} (*Habitat* of virus ?)

(4) Blood collected on different days of illness (duration of infectivity ?).

(*B*)—By indirect inoculation per infected *Stegomyia fasciata* :—

(1) *Stegomyia fasciata* fed on a case of Yellow Fever on different days of illness.

(2) *Stegomyia fasciata* fed (i) by day only.
(ii) by night only.

(3) *Stegomyia fasciata* fed (i) on whole blood.
(ii) on washed red cells only.
(iii) ,, ,, white ,, ,,
(iv) ,, serum only.
(v) ,, filtered serum only.

(4) *Stegomyia fasciata* put to feed on experimental animal at different periods after infecting-feed on patient (length of time mosquito infective ?).

(5) Similar experiments with other common domestic mosquitoes, *e.g.*, *Culiciomyia nebulosa*, *Ochlerotatus irritans*, *O nigricephalus*, *Uranotænia bilineata* (var. *fraseri*), *Culex decens*, *C. duttoni*, *C. insignis*, *Stegomyia sugens*, *S. africana*, and others.

Observation of the Inoculated Animals.

(*A*)—*Symptomatology.*

Attention should be directed to the following :—

Incubation period.
Prodromal signs.
Signs of illness.
Loss of appetite.
Lassitude.
Irritability.
Temperature.
Pulse.
Loss of flesh.
Vomiting (frequent, violent, contents).
Tongue.
Gums.
Jaundice (conjunctivæ, oral mucous membrane).
Stools (frequency, contents).
Hæmorrhages.
Urine (catheter specimen), usual analysis.
Tenderness (epigastrium, liver, spleen, loins).
Enlargement of liver or spleen.
Blood examination (day and night) (cell counts, presence of parasites, degenerations of cells, &c.).
Other abnormal signs.

(*B*)—*Post-mortem Observations.*

Direct examination, and injection into other animals of emulsions of the following organs and tissues :—

Liver.	Spleen.
Lung.	Heart.
Kidney.	Suprarenals.
Thyroid.	Salivary glands.
Brain.	Cord.
Superficial lymph glands.	Bone-marrow.

Animals to be killed and examined on different days of the disease. Fresh smears from and sections of all organs to be examined, and routine post-mortem examination made, noting macroscopical appearances of the various organs and tissues.

Controls.

(*A*) Observations, over a long period, of the normal standards in the various experimental animals in respect of the pulse-rate, temperature, blood, and urine.

(*B*) Observations on the conditions produced by other diseases natural to monkeys and the other experimental animals employed.

(*C*) Inoculation of the experimental animals with blood from normal human beings and from those suffering from diseases other than Yellow Fever, and also with emulsions prepared from organs of various mosquitoes.

(*D*) Examination of fresh and fixed specimens of the organs of mosquitoes of the age and species of those used in the infecting experiments; and of similar material from mosquitoes fed on patients suffering from diseases other than Yellow Fever.

Reservoir Hosts.

Bats are very common in the native towns. Some prefer trees, others the eaves and rafters of houses, but all are more or less domestic as regards their resting-places.

Their habit of sleeping during the day in shady or dark places renders them likely to be the source of the blood-meal of the day-biting mosquitoes.

Blood Cultures.

The blood to be cultivated by various methods and at various temperatures.

Bass' and Ziemann's methods to be employed, with and without removing leucocytes.

Different amounts of glucose and of other sugars to be added to the media.

Addition to the media of bile and of other substances.

Solid media; " N.-N.-N. " medium; ascitic fluid.

Addition to the media of pieces of sterile tissue.

Aërobic and anaërobic cultivations.

Mosquitoes.

Insects used in the transmitting experiments should be bred from ova or from larvæ.

Microscopical examination and injection into experimental animals of emulsions of the following parts:—

Salivary Glands.	Thoracic muscles.
Proventriculus.	Ova.
Stomach.	Larvæ.
Hind-gut.	Pupæ.
Ovaries.	Filtered juices.
Malpighian Tubules.	

Provided that a susceptible animal is found, it ought to be possible, by the means outlined above, to determine:—

(*a*) The *habitat* of the virus, whether in the red cells, the leucocytes or the serum, or whether it is always filterable.

(*b*) When and for how long the blood is infective, and if by day only or by night only.

(*c*) When and for how long the mosquito is infective.

(*d*) Whether any mosquito other than *Stegomyia fasciata* can transmit Yellow Fever.

(*e*) In which part of the mosquito the stage of the virus infective to man occurs.

(*f*) Those organs of the infected animal in which the most virulent form of the virus is found.

(*g*) The practicability of cultivating the virus.

(*h*) The possible existence of a reservoir host.

Sir,

I have the honour to be,

Your obedient servant,

A. CONNAL.

The Secretary,

Yellow Fever Commission (W. Africa),

Colonial Office,

London.

APPENDIX IV.

BIBLIOGRAPHY OF YELLOW FEVER.

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