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LEAGUE OF NATIONS

HEALTH ORGANISATION

**REPORT OF THE
SECOND INTERNATIONAL CONFERENCE
ON SLEEPING-SICKNESS**

Held in Paris, November 5th to 7th, 1928.

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AGENDA OF THE SECOND INTERNATIONAL CONFERENCE ON SLEEPING-SICKNESS.

I. THE CONTROL OF SLEEPING-SICKNESS.

1. The Final Report of the Sleeping-Sickness Commission, with Special Reference to the Conclusions of Practical Importance arising therefrom.
2. Reports or Statements by Delegations attending the Conference regarding Measures taken for the Eradication or Control of Sleeping-Sickness in their Respective Territories and the Results achieved.
3. Administrative Measures for the Control of Trypanosomiasis.
4. The Progress made and the Difficulties experienced by Administrations in giving Effect to the Administrative Measures recommended by the First International Conference on Sleeping-Sickness, held in London in May 1925.
5. The International Co-ordination of Campaigns for the Eradication of Sleeping-Sickness.

II. RESEARCH.

6. Questions necessitating further Research and Investigation in the Different National Laboratories and Research Centres in Territories in Africa where Sleeping-Sickness exists.
 7. The Co-ordination of such Research.
 8. Veterinary Problems connected with Animal Trypanosomiasis.
 9. Miscellaneous.
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REPORT OF THE CONFERENCE: RECOMMENDATIONS ADOPTED.

I.

1. On the invitation of the French Government, the Second International Conference on Sleeping-Sickness, convoked by the Council of the League of Nations, was held at the French Ministry for Foreign Affairs in Paris from November 5th to 7th, 1928, to consider the final report of the League of Nations International Sleeping-Sickness Commission and questions arising therefrom. This Commission was set up on the decision of the Council of the League of Nations, as a result of the recommendations of the first Conference, held at London in May 1925.

2. Delegations from Belgium, France, Great Britain, Italy, Portugal and Spain attended the Conference, as follows :

Belgian Delegation.

M. Halewyck DE HEUSCH, Director-General, Ministry for the Colonies ;
Dr. E. VAN CAMPENHOUT, Inspector-General, Director of the Health Service,
Ministry for the Colonies ;
Dr. RHODAIN, Professor at the School of Tropical Medicine, Brussels.

British Delegation.

The Right Hon. W. ORMSBY-GORE, M.P., Parliamentary Under-Secretary of State for the Colonies ;
Sir George S. BUCHANAN, C.B., M.D., F.R.C.P., Senior Medical Officer, Ministry of Health ;
Dr. Andrew BALFOUR, C.B., C.M.G., M.D., D.Sc., F.R.C.P., D.P.H., Director of the London School of Hygiene and Tropical Medicine ;
Dr. Arthur BAGSHAW, C.M.G., M.B., Director of the Bureau of Hygiene and Tropical Medicine ;
Dr. H. Lyndhurst DUKE, O.B.E., M.D., D.Sc., Deputy Director of Laboratory Services, Uganda Protectorate, Director of the Human Trypanosomiasis Research Institute at Entebbe, and Chairman of the recent International Sleeping-Sickness Commission of the League of Nations ;
Mr. C. J. JEFFRIES, O.B.E., Colonial Office ;
Dr. H. H. SCOTT, M.D., F.R.C.P., F.R.S.E., D.P.H., Medical Secretary, Colonial Medical Research Committee ;
Dr. W. Horner ANDREWS, D.Sc., M.R.C.V.S., Director of the Veterinary Laboratory, Ministry of Agriculture and Fisheries.

French Delegation.

Dr. COGNACQ, former Governor of French Cochin-China ;
Professor MESNIL, Pasteur Institute ;
Dr. BOYE, Inspector-General, Health Service, Ministry for the Colonies ;
Professor BRUMPT, Laboratory of Parasitology, Paris ;

- Dr. ROUBAUD, Pasteur Institute ;
Dr. Gustave MARTIN, formerly head of the French Sleeping-Sickness Mission in French Equatorial Africa ;
Dr. ABBATUCCI, representing the Ministry of Labour and Health ;
Dr. LEDENTU, ex-Director of the Pasteur Institute at Brazzaville ;
Dr. LAVIER, Professor of the Faculty of Medicine, Lille, member of the International Sleeping-Sickness Commission of the League of Nations.

Italian Delegation.

- Dr. A. LUTRARIO, ex-Director of Public Health, member of the Permanent Committee of the Office international d'hygiène publique and of the Health Committee of the League of Nations ;
Professor Aldo CASTELLANI, K.C.M.G., M.D., F.R.C.P., Professor of Tropical Medicine at Tulane University, New Orleans, U.S.A., Director of Tropical Medicine Ross Institute, London, Lecturer at the London School of Hygiene and Tropical Medicine.
Dr. PERUZZI, Privatdozent of Pathological Anatomy at Florence University, member of the International Sleeping-Sickness Commission of the League of Nations ;
Dr. Giovanni ZUCCO, Inspector-General, Ministry for the Colonies, Rome.

Portuguese Delegation.

- Dr. Aires KOPKE, Director of the School of Tropical Medicine, Lisbon ;
Dr. Antonio AIRES, Veterinary Medical Officer, Lourenço-Marques, Mozambique.

Spanish Delegation.

- Dr. Luis Rodriguez ILLERA, National Health Institute Alfonso XIII, Madrid.

3. The Conference was presided over by Professor Mesnil and by the Right Hon. W. Ormsby-Gore, M.P., until the latter's departure from Paris.

The Secretaries of the Conference were Dr. L. Rajchman and Dr. F. Norman White of the Health Section of the Secretariat-General of the League of Nations.

The Conference formed two sub-commissions dealing with administrative measures and research respectively, and presided over by M. Halewyck de Heusch and by Professor Mesnil.

4. The Conference paid a warm tribute to the members of the International Commission on Sleeping-Sickness and its Chairman, Dr. H. Lyndhurst Duke, and expressed its appreciation of the high scientific value and interest of the work accomplished and the results obtained.

5. The Conference did not recommend at present the creation of another International Commission of Research, but it has elaborated a programme of further research and investigation which in its opinion should be carried out more especially in the different national laboratories in countries in which diseases transmitted by tsetse flies prevail. This programme of research forms Part II of this report.

6. The Conference adopted a series of recommendations to the Council of the League of Nations regarding the manner in which the Health Organisation of the League might assist in co-ordinating such investigations (see Part II). It offered its thanks to the Council of the League of Nations for such initiative as it may deem it desirable to take.

7. In view of the economic and public health importance of animal trypanosomiasis in Africa, the Conference recommended that close and continuous contact between medical and veterinary research should be established and that future international Conferences should consider both the human and animal trypanosomiasis as a whole and not confine their attention to sleeping-sickness.

8. The Conference considered the international co-ordination of measures for the control of sleeping-sickness in African dependencies and reaffirmed the relevant recommendations adopted by the First International Conference on Sleeping-Sickness that was held in London in May 1925 (document C.291.1925.III).

9. The Conference further considered the general recommendations for the control of sleeping-sickness in African dependencies contained in the Final Report of the International Commission on Sleeping-Sickness (document C.H.629) and recommended their adoption in the following form :

“ Among the measures which may be recommended to Governments for application in the light of local circumstances and where measures of strict control are necessary or possible, it is agreed to propose the following :

“ (i) Control over the movement of natives. This implies :

“ (a) Enumeration of natives, carried out by the administrative authorities ;

“ (b) Adoption of an identity book, card, etc., for each native, containing particulars as to health, which could serve as a medical passport ;

“ (c) Delimitation of areas, for entry into and departure from which a medical authorisation will be obligatory ;

“ (d) Close co-operation between medical and administrative authorities—without which any prophylactic measures would be ineffective—and in special cases the conferment of police powers on medical officers ;

“ (e) The establishment of observation posts for medical examination and medical control of natives.

“ (ii) Control and treatment of infected natives, both of which should be as complete as possible ; to ensure this, there are required :

“ (a) An adequate medical personnel ;

“ (b) Powers to enforce the medical examination and treatment of natives ;

“ (c) In case of necessity, the power of withdrawal of the medical authorisation to travel.

“ (iii) Clearings, effectively maintained, at watering-places, around villages and at river crossings.

“ (iv) When the local administration considers this measure indispensable, the evacuation of heavily infected zones and the establishment of the population in a more favourable situation in the vicinity.”

10. The Conference further considered the Draft International Agreement for the Campaign against Sleeping-Sickness presented by the Belgian delegation (See page 10) and adopted the following resolution :

“ The Conference,

“ While recognising the value of the Draft Agreement presented by the Belgian delegation,

“ Considers that a general agreement between the States concerned would be difficult to achieve at present, in view of varying local conditions ;

“ And records its preference for the conclusion of bilateral agreements which would permit of the establishment of as efficacious a control as possible of sleeping-sickness on the frontiers in question.

“ These agreements would be based as far as possible on the principles indicated in the Belgian Draft Agreement and in the Report of the 1925 Conference, with the modifications necessary to suit local conditions.”

11. The Conference considered that the Health Organisation of the League of Nations could usefully add to the service it has already rendered in the study of this subject by collecting and analysing the facts obtainable in regard to the incidence of human trypanosomiasis, its relative importance in relation to other causes of morbidity, and the results of the different measures, medical and administrative, which are taken to combat the disease in different regions of Africa.

12. The Conference expressed its appreciation of the utility and interest attaching to international meetings of this kind and expressed the hope that the Health Organisation of the League of Nations will recommend the convocation of a third International Conference on Trypanosomiasis at some future date.

II.

A. RESEARCH.

The Conference recommended that a further study be carried out in different national laboratories of countries in which diseases transmitted by tsetse flies prevail on the problems enumerated below :

1. The questions of natural immunity, spontaneous cure, and of acquired immunity of man should be further studied. For this purpose, the experimental infection of volunteers would be of value. Experiments on ruminants that are relatively resistant are also recommended ; these, after recovery, should be exposed to the bites of tsetse flies.

2. The question of the natural immunity of *Cynocephalus* and of *Cercocebes* (mangabeys) should be followed up. An attempt should be made to overcome this immunity and to establish its relationship with the serum-resistance of trypanosomes. This would throw light on the possibility of man becoming infected with animal trypanosomiasis.

3. The natural reservoir of *T. gambiense* appears to be limited to man, but it is still necessary to look for other reservoirs. Such an investigation should be directed towards the discovery of new means of diagnosis. The Conference directs special attention to the observations made by Dr. Peruzzi relating to the presence of trypanosomes in serous cavities.

4. The question of the origin of *T. rhodesiense* and, in particular, its relationship to *T. gambiense* and *T. brucei* has not yet been settled and calls for further investigation.

5. Are all the characteristics acquired by trypanosomes preserved during their cyclic evolution in the body of the tsetse (resistance to therapeutic remedies, exalted virulence, high transmissibility index, etc.) ?

6. The evolution of different polymorphic trypanosomes in the body of the tsetse, chiefly those which naturally infect domestic animals and game in areas in which *G. morsitans* is prevalent. Investigation of the factors of environment, climatic or other, on the cyclic transmissibility and pathogenicity of polymorphic trypanosomes by glossinæ.

7. Anatomopathological investigations.—It would be of the greatest interest to verify in man the anatomopathological findings of Peruzzi in monkeys, chiefly in so far as lesions of the myocardium, of the brain and of the serous membranes are concerned. The comparative pathological anatomy of trypanosomiasis of cattle and wild animals should be carried out at the same time. For this investigation, use should be made of monkeys, animals suitable for this purpose.

8. Biological studies of tsetse flies should be carried out concurrently with epidemiological and epizootic investigations, and each should be carried out, preferably by specialists, on similar lines in *T. rhodesiense*, *T. gambiense* and *T. brucei* areas respectively.

9. The most important factor in determining the infectivity of a trypanosome being its faculty of cyclic transmission, its evolution should be followed in individual subjects throughout the course of their infection. It should be determined whether the infectivity is liable to increase, decrease or disappear altogether ; whether the cyclic transmissibility may, after a latent period, develop anew in chronic cases, and under what conditions it may disappear altogether. A knowledge of such conditions might lead to an effective method of prevention.

10. A study of the nature of the blood ingested by tsetse flies in game areas where *G. morsitans* prevails should be pursued with the object of ascertaining the rôle of animals in the biology of glossinæ with special attention to such animals as may act as reservoirs of the virus. For this purpose, the morphological examination of the ingested blood, supplemented where necessary by the precipitin or some similar test, might be employed. It is important, therefore, to study the relative value of such tests and the conditions which limit their applicability.

The part played by the hippopotamus as a reservoir of the virus calls for further study ; this can best be done by the experimental infection of young animals with infected flies.

11. Morphological studies should be extended to all members of the polymorphic trypanosome group, more especially to trypanosomes of the type *brucei* where *palpalis* prevails and to trypanosomes of the *pecaudi* type in *palpalis*, *longipalpis*, *tachinoides* and *morsitans* regions.

12. Therapeutic researches are of the highest importance. Chemiotherapy is at the present time the soundest basis for preventive measures in the central regions of tropical Africa. Investigations into the curative effects of tryparsamide, tryponarsyl Fourneau 270, etc., should be continued. It is to be hoped that other still more effective, and at the same time cheaper, substances may be discovered, and, *if possible, substances which would be effective when administered by mouth*. Moranyl (Bayer 205 or

Fourneau 309) would appear to be in a separate category in that they afford protection over a long period ; they should be employed for the protection of healthy individuals, at the same time as the sterilisation of the blood of patients is being carried out by the judicious use of atoxyl or of the other remedies mentioned above.

B. CO-ORDINATION OF TRYPANOSOMIASIS INVESTIGATIONS.

The Conference considered that the Health Organisation of the League of Nations might render useful service by keeping the workers in the different national laboratories in touch with one another, for which purpose the following recommendations are made :

“ 1. Laboratories and research centres in Africa which are engaged in research work on trypanosomiasis might find it useful to communicate to a small expert committee appointed by the Health Organisation for the purpose, say once a year, an account of the work done, together with publications. This committee would in its turn from time to time circulate, and where necessary translate, the collected papers, with a short general review of the progress made in trypanosomiasis research and prevention, to the institutes and centres referred to, as well as to interested administrations.

“ 2. To encourage the co-operation of the different institutes in such a scheme, the committee referred to might be empowered to make recommendations to the Health Committee, say once a year, for the award to one or other of these institutes of a *bourse individuelle*, which would enable a member of its staff to visit some other country or countries where work of special interest to the laboratory selected is being carried out.

“ 3. In view of the considerable differences that characterise the trypanosomiasis in different localities, the Conference recommended individual “interchanges”, which would enable research workers in African laboratories to become acquainted with trypanosomiasis investigations being carried out in other laboratories.”

DRAFT INTERNATIONAL AGREEMENT CONCERNING MEASURES AGAINST SLEEPING-SICKNESS

Presented to the Conference by the Belgian Delegation.

Article 1.

The provisions of the present Agreement are applicable to the Colonies, Protectorates, mandated territories and other areas in Africa which are under the authority of the Contracting States, for such portions of their territories as are situated between° North and° South latitude.

Article 2.

The Contracting States undertake mutually to exchange, through the intermediary of their medical services, at least twice a year, information concerning the appearance and the progress of sleeping-sickness throughout the territories under their authority. Such information will indicate as far as possible the number of cases, the extension of the disease and its tendency to increase or decrease in intensity.

Article 3.

Each year the Contracting States will transmit to each other the following maps, tables and reports relating to the territories over which they exercise control :

- (a) A map showing the areas infested with tsetse flies, with indications as to the degree of intensity of such infestation ;
- (b) A map showing the distribution of sleeping-sickness and the intensity of its prevalence in different areas ;
- (c) A statistical table indicating by areas the approximate number of infected persons and their proportion to the population ;
- (d) A report concerning the migrations of the native inhabitants and any other circumstances of a nature to favour the transmission of sleeping-sickness ;
- (e) A note detailing the administrative and other measures taken to control sleeping-sickness, as well as the results of such measures.

Article 4.

The Contracting States undertake from time to time to convoke conferences of public health workers with the object of improving the defence against sleeping-sickness of the territories mentioned in Article 1, and to arrange for closer collaboration of the medical officers with this end in view.

In the interval between these meetings, the medical officers of common frontiers will exchange all useful information and will meet as often as an exchange of views appears to them to be necessary.

Article 5.

The Contracting States will instruct their medical services in the frontier region of territories under their authority to pay special attention to :

- (a) The curative and prophylactic treatment of sleeping-sickness ;
- (b) Clearing measures for the elimination of tsetse flies ; and
- (c) All other measures having as their object the protection from infection of uninfected areas.

Their Administrations will arrange to organise simultaneously, in a region divided by a common frontier, medical missions and to take such measures therein as are necessary for the effective control of sleeping-sickness.

Article 6.

The Contracting States will establish as soon as possible, or will complete where necessary, a network of observation posts and sanitary posts on either side of such of their frontiers as separate areas infected with, or threatened by, sleeping-sickness. Such posts will be placed by preference along roads used by the native population, in such a manner that the natives cannot pass the frontiers without being examined by the health authority and need not make a long detour to present themselves to such authority.

Article 7.

In the areas referred to in the previous article, no native will be authorised to cross the common frontiers unless he is provided with a passport or booklet, which shall contain, in addition to such indications as are necessary to establish his identity, a declaration that he is not infected with sleeping-sickness or that, being infected, he has had his blood recently freed from trypanosomes.

The passport or booklet will be made out by the health authority of the last place of residence of the bearer in his country of origin, and will be visaed in the country of destination on the entry and on the departure of the emigrant. The passport or booklet should be visaed by the health authority of the country of origin each time the frontier is crossed, unless the second journey is undertaken within the three months immediately following the date of the previous visa.

Article 8.

All infected persons who have not been treated, or persons whose blood harbours trypanosomes, will be prevented from crossing the frontier from one to another of the countries under the jurisdiction of the Contracting States. Infected persons who are apparently cured may be allowed to cross the frontier into another country, but only for a stay of short duration, the length of which is to be determined by the medical authority of the country visited.

Article 9.

Whenever natives of a territory under the authority of a Contracting State have been found infected with sleeping-sickness in territory under the authority of another Contracting State, the medical authorities who have diagnosed the disease will do everything possible at the time of repatriation to hand such infected persons over to representatives of the medical authorities of the first State. Should this be impossible, they will send to the medical authorities of the first State all the information they have been able to obtain with regard to the identity and the place of residence of such patients.

Article 10.

The Contracting States agree that all differences which may arise between them with regard to the interpretation or the application of the present Agreement will be solved by arbitration if they cannot be settled by direct negotiations.

Article 11.

The present Agreement, of which the French and English texts are equally authentic, will, for a period of 180 days from the date which it bears, be open to the signature of all States which exercise authority over territory situated within the area prescribed in Article 1.

After the expiration of this period, any other such State will be able to adhere to this Agreement by means of a formal communication to the Secretary-General of the League of Nations, who will notify immediately the reception of such adhesion to the other Contracting Parties.

Article 12.

The present Agreement will be ratified and the ratifications deposited with the Secretary-General of the League of Nations, who will notify the Contracting States. It will enter into force ninety days after the date on which the Secretary-General of the League of Nations will have notified the Contracting Parties that three States have ratified, or adhered to, the Agreement. For States which may ratify or adhere at a subsequent date, the Agreement will enter into force ninety days after the notification by the Secretary-General of the League of Nations of such ratification or adhesion.

Article 13.

On the expiry of a period of three years at least from the date on which this Agreement comes into force, the Contracting States may renounce the Agreement by a written notification to the Secretary-General of the League of Nations, who will communicate immediately a certified copy of such notification to all other Contracting States. Such denunciation will only affect the State which will have notified it and will not be operative until one year after the notification has been received by the Secretary-General of the League of Nations.

ADDRESS BY THE RIGHT HON. W. ORMSBY-GORE, M.P.,

PARLIAMENTARY UNDER-SECRETARY OF STATE FOR THE COLONIES.

As I had the honour of presiding at the previous International Conference held by the League of Nations in London in May 1925, I naturally commence by welcoming the holding of this further Conference under similar auspices. I am sure I am expressing the pleasure of all my British colleagues when I say that, however much we might have wished to welcome the representatives of other countries interested in this great African problem a second time to London, we are delighted to accept the invitation of the French Government to meet in Paris. We are most grateful for the welcome accorded by the French Authorities and by our distinguished Chairman, M. Mesnil.

Quite apart from the value of the scientific work which can be helped forward by holding an International Conference of this kind, the meeting in different capitals between workers of many nations interested in the attack upon a particular problem is of the utmost value in forming personal contacts, and in exchanging experience and formulating projects for the future.

We in Great Britain hold very strongly that the establishment of the League of Nations has provided the much needed machinery whereby we can come more frequently together for the general advancement of human welfare in many fields. I am quite satisfied that the work of the Health Committee of the League, and of its distinguished officers, has already done much to promote not merely international co-operation in the task of preventing and treating those diseases which know no political frontiers, and which are the common menace of the human race, but has also been the means of stimulating the furtherance of fundamental research and the application of the results of research, which to me, at any rate, is the essence of what we mean when we use the word civilisation.

Thinking of Africa, my mind goes back to the first school atlas with which I was furnished when a small boy, thirty-five years ago. There were some outlines, mainly dotted lines, traced in different parts of a vast and practically unknown continent. The cartographer had had some brave guesses at the position and shapes of the great lakes of the interior. How different are the modern maps of Africa, what strides have been made during the space of the last thirty-five years! The various European Powers have undertaken the great responsibility of penetrating and establishing their administrations throughout the greater part of the Dark Continent. They have found nature bountiful in her resources, but guarding those resources with formidable armaments in the way of malaria, yellow fever, blackwater fever, filariasis and sleeping-sickness. It is only with one of these terrible adversaries that we are called upon to deal this week, and I should like at the outset to say something of a general character regarding its significance and the situation as we find it to-day.

In every single territory under British administration, from Gambia in the north-west to Zululand in the south-east, the tsetse fly has been encountered. The high rate of mortality among men and domestic animals came as a rude shock both to our ignorance and to our endeavours.

Let me at once emphasise what I emphasised in opening the last Conference, that the problem of trypanosomiasis is very varied, but must be regarded as a whole. The fact that the human and the animal diseases are conveyed by the same family of blood-sucking flies—the glossinæ—and that the protozoan organisms which the flies carry are so similar, makes it absolutely essential that both the medical and veterinary problems should be discussed in their widest ecological bearings. There is another point. In a very large part of the Continent affected by the presence of the tsetse fly, the life of the population is so intimately bound up with that of their cattle and their domestic stock that the veterinary side of our problem has a sociological significance, which in turn has its importance in considering what might appear at first to be purely medical problems.

The movements of African tribesmen which lead to the spread of human sleeping-sickness are sometimes the result of the killing of their cattle by the advance of tsetse infected with the animal trypanosomes. We are faced at this very moment in both Nyasaland and Northern Rhodesia by menacing new migrations of tsetse fly into areas where it has been previously unknown. The cause and nature of these apparently massed migrations are as yet unknown. In Nyasaland we have attempted to deal with them by the construction, at considerable expense, of a cleared barrier in order to try and stop the rapid southward movement of the fly. Unfortunately, it now seems as if we may have been too late, the fly has crossed our system of defences and we are, as it were, compelled to throw up a great new line of trenches further south in the hope that they will withstand the advance of the oncoming hosts.

Since the last International Conference, the British dependencies in tropical Africa have been fortunate in that there have been no very large scale epidemics of human trypanosomiasis. That it is still exacting its annual toll in practically every one of those dependencies is clear from our annual medical reports. The number of cases in which Europeans have been attacked in the last few years in British territories is, I am glad to say, comparatively small, but foci of the disease keep appearing, now here, now there, in West and Central Africa. If we add up the total number of native deaths due to the disease, even those we know of, and there are still many we do not know of, the annual toll of human lives may seem small compared to the mortality resulting from other diseases, such as malaria, but is still some thousands.

From the wider point of view, from which I, as a lay administrator, must look upon it, animal trypanosomiasis in the British dependencies is still a tremendous factor in stopping the development of Africa. It is not merely the many tens of thousands of cattle that are being annually killed by trypanosomiasis, but the virtual depopulation, or, if not de-population, stagnation, of vast areas of tropical Africa, both east and west, that is the result of animal trypanosomiasis. This is particularly true of Northern Rhodesia and Tanganyika Territory. Further, there are other areas, though comparatively densely populated, such as the Gold Coast Colony, Ashanti, and southern provinces of Nigeria, where the main reason why there are no animals for transport, for manure, for meat supplies or for milk, is prevalence of the tsetse, and the disease which they convey.

Let me describe the position in the Gold Coast, a country approximately the same size as Great Britain. In the northern half of that territory there are considerable quantities of cattle. In the southern half there are none. There is consequently a steady stream of cattle sent down on the hoof from the north to the south for slaughter for food. These cattle have to pass through at least three distinct belts of tsetse fly. A large number are killed by trypanosomiasis on the journey. A still larger number arrive at their destination in a dying condition.

In the northern part of the northern provinces of Nigeria there are probably something like four million head of cattle. In the southern provinces of Nigeria, inhabited by some eight million people, there are probably not 100,000 cattle. Incidentally, the few cattle there are in the southern provinces of Nigeria are particularly interesting in connection with trypanosomiasis research, in that they are either immune to or, to a considerable extent, tolerant of the infection. The degree of toleration varies considerably among different breeds, and one interesting feature revealed in connection with veterinary work in Northern Nigeria is the relation of such partial toleration as there obtains to other diseases. The chief efforts of the Veterinary Department in Northern Nigeria have been concentrated in recent years on the reduction of mortality from rinderpest. It has been found, however, that the very successful methods of inoculation for rinderpest practised in that territory cause the animals to die of trypanosomiasis. They are brought for inoculation infected with trypanosomiasis but comparatively tolerant of its effects, but the treatment for the prevention of rinderpest diminishes their power of resistance to the trypanosomes already in their blood, and they die of nagana.

In Tanganyika and Northern Rhodesia, approximately half the total area is uninhabitable for cattle and other domestic stock—a very serious fact in the lives of the natives of those territories.

You have had circulated by the British delegation a printed summary of the progress of investigations into human sleeping-sickness in recent years, and this, I hope, will absolve me from any attempt to cover the field described in this document. There are, however, one or two points to which I must refer.

In the first place, I should like to congratulate Dr. Duke and his colleagues on the work they have carried out as an International Commission with headquarters at Entebbe, in Uganda. I feel that the collaboration of the scientific workers of six different nationalities has been of value not only in the scientific and technical field, but as a signal example of happy co-operation in a common endeavour. As Dr. Duke and some of his colleagues are present, I shall leave to them any elaboration or explanation of their reports.

Quite apart from the work in Africa, I think the Conference may be interested to know that, as a result of the International Conference of 1925, for the last three years we have had a special Committee in London, known as the Tsetse Fly Subcommittee of the Committee of Civil Research, meeting regularly to stimulate and encourage the work going on in different parts of Africa.

Last year we created in the British Colonial Office a new Colonial Medical Research Committee under my chairmanship for the purpose of reviewing and advising on various questions of medical research engaging the attention of workers in different parts of the British Colonial Empire. Trypanosomiasis is, of course, only one of the many problems which we have to tackle, and this Committee is composed of representatives nominated partly by the Secretary of State for the Colonies and partly by the Medical Research Council of Great Britain. The Medical Secretary of this new Committee, Dr. Scott, is present at this Conference as a member of the British delegation.

Further, since the last meeting of the International Conference, we have appointed as Medical Adviser in the Colonial Office Dr. A. T. Stanton, who was formerly Head of the Medical Research Institute of the Federated Malay States. I regret that he is not present at this Conference, but he only returned to London from a tour of the British West African Colonies the day before yesterday.

To turn to Africa again. Apart from the work that has been carried on in Uganda, which will be brought prominently before you, I should perhaps mention one or two of the more notable activities in other parts of Africa.

In West Africa our principal effort has been concentrated at Sherifuri in Northern Nigeria under the able leadership of Dr. W. B. Johnson, assisted by Mr. Lloyd as senior entomologist. The investigation has determined the areas of prevalence of the chief glossinæ—*morsitans* and *tachinoides* in the drier northern districts, *palpalis* and *longipalpis* in the wetter southern districts, all four in the intermediate zone. Experimental transmission work has been carried on in regard to the two principal human and the two principal cattle trypanosomes. The bionomics of the various tsetse have been investigated, their degree of infection both in relation to man, baboons and domestic stock. The records now extend over a period of more than four years and, apart from the medical and veterinary investigations, experiments have been tried regarding the effect of excluding game from a given area by means of fencing, grass-burning, bush-clearing, etc.

In connection with these administrative or reclamation experiments, attempts have been made to estimate statistically the effects of these local measures of fly control. A good deal of definite reclamation has been carried out under the supervision of officers from the political services seconded to the investigation and working in close collaboration with Dr. Johnson.

In February 1927 we arranged for Dr. du Toit, the Head of the famous Veterinary Research Institute at Onderstepoort, near Pretoria, in the Union of South Africa, to visit Nigeria in connection with the development of veterinary research generally in that country. Among his recommendations was a proposal that two special veterinary research officers should be appointed and seconded to the tsetse investigation and attached to the staff of Sherifuri. He regarded veterinary research work on the problems of trypanosomiasis as far more important at the moment than control work in the field, as the latter would have to follow the results of the former. We consequently decided that, in addition to the medical and entomological work proceeding at Sherifuri, experimental work is now to be undertaken on cattle immunology and resistance.

In passing, I may mention one interesting achievement. It has been discovered that it is possible for the salivary glands to be removed from the fly by a surgical operation which in no way incommodes the creature.

I should perhaps add two further points in connection with the Sherifuri work. About a fortnight ago, Dr. Johnson left Nigeria for the Belgian Congo in order to establish contact with the Belgian authorities and workers. He will proceed across the centre of Africa, returning to England via the Anglo-Egyptian Sudan. His visit is being greatly facilitated by the welcome extended to him by Professor Van Campenhout and the Belgian authorities, and I take the opportunity of referring to that welcome, not only to express gratitude, but also to call attention to it as yet another example of international co-operation.

I am not sure whether the next point is a matter for congratulation or regret. I am afraid it will not be possible to second Dr. Johnson any longer for direct work at Sherifuri on the conclusion of his tour, though indirectly he will remain in control, as we have decided to appoint him to the headship of the whole Medical Services in Nigeria on the occasion of the retirement of the present holder of that important office. The element of congratulation lies in the promotion to so important a post of a scientific worker who has devoted so much of his great ability to work on trypanosomiasis.

I turn now to East Africa and, while much might be said about each of the territories there, I propose to confine myself to Tanganyika Territory, where the problems of trypanosomiasis, both human and animal, are so varied and extensive.

In 1926 a special branch of the Tanganyika Medical Department was inaugurated for the special purpose of dealing with human trypanosomiasis. Six medical officers were seconded for whole-time work on sleeping-sickness. Administratively, the policy has been to endeavour to concentrate the threatened population in fly-free clearings. In the first year of this work, fly-infested forest to the extent of 7,500 square miles was evacuated, and the inhabitants numbering approximately 14,500 removed to special fly-free clearings. In each case, tribal organisation was maintained and the people still live under the control of their own chiefs. This is an interesting experiment, but I do not see how to assume that it is capable of universal application. One of our medical officers from the Research Institute at Dar-es-Salaam, seconded for duty in connection with an outbreak of sleeping-sickness, himself became infected in 1927 with *Trypanosoma rhodesiense*, but has happily recovered.

I will not go further into the medical work, but I must say something about the continued work of Mr. Swynnerton and the considerable staff working with him on the various lines of attack on the fly. His work entails a series of very important and interesting investigations into the ecology of the different varieties of glossinæ, involving co-operation with botanical and forestry work, the destruction of breeding-places, the parasitisation of flies, investigation into the cheapest and most permanent method of clearing, the effect of spraying, etc. One thing is clear from the work that he has now carried on for the last five years, namely, that no one form of attack upon the tsetse fly is universally practicable. Measures which will prove effective barriers to the advance or increase of one variety of glossina are quite ineffective in the case of another variety. The collection of a series of negative results is as important as the collection and relation of positive results.

Thirdly, we have recently arranged that Dr. Hornby, the very able veterinary research worker who is head of our Veterinary Research Laboratory at Mpapwa, shall be seconded from ordinary duties during his present tour of service in Tanganyika Territory, so as to devote his whole time and energies to various problems connected with trypanosomiasis. When last on leave in England, he spent some time in testing out by the Van den Bergh reaction (a test of liver efficiency) the quantities of various antimony preparations which can be used with safety or without risk of producing liver necrosis in the inoculation of cattle infected with trypanosomes. He has been given a very free hand to pursue various lines of investigation both in game animals and domestic cattle, notably the distribution of infection and its mortality rate, the modification of strains of trypanosomes resulting from passage through different hosts, the exact mode of transmission, and, in particular, the significance of mechanical transmission, the degrees of immunity or toleration enjoyed by different game animals and breeds of cattle and whether the immunity is hereditarily transmissible. He has also included in his scheme of work such questions as the establishment of the complement-fixation test, the effects of dipping cattle in various dips on the attack by different glossinæ and the treatment of infected cattle by various drugs. Such a formidable list is worth quoting if only to show what a tremendous lot of further research work into the problems of animal trypanosomiasis is needed.

I hardly dare detain the Conference at this stage by opening up any further subjects. Important administrative work has been done in the Sudan, and is now commencing in Uganda, in regard to the administrative control of African natives threatened with infection, by control of their movements, by the issue of medical passes and the like. All I can say on this is that no one method can be universally applied, but each

administration faced with the problem has much to learn from the experiments carried out by its neighbours. I find this is true not merely between territories under the administration of different European Powers, but even between different British administrations. Sociological, and sometimes economic, questions render the applicability of a particular form of control impracticable, even within the confines of a single administration. Nigeria is an example of a country where the type of control possible in some other parts of Africa would be quite impracticable.

Last year I read a paper to the Royal Geographical Society in London entitled "Some Contrasts in Nigeria", in which I emphasised that there was, within the single dependency of Nigeria, a far greater range of races and civilisations than there is in the whole Continent of Europe. In approaching the problem of trypanosomiasis we have to bear in mind that, varied as are the glossinæ and varied as are the climatic and other conditions under which the tsetse flies live, *homo sapiens* is more varied still.

One other point before I conclude. We are dealing with trypanosomiasis in tropical and sub-tropical Africa mainly carried by tsetse flies. We have to bear in mind, in looking at our task as a whole, that the glossinæ are not the only carriers of trypanosomiasis, and that the tropical African forms of trypanosomiasis are not the only forms. There is allied the problem of surra in French North Africa, in Mauritius, in British India, in the Dutch East Indies and elsewhere in Asia; there is a form of trypanosomiasis even in the New World. I only refer to them because the more I, as a lay administrator, travel about in the world the more I am convinced that the whole progress of tropical development in every field depends on the devotion of far more attention to scientific research. Such research, however detailed its immediate object, must always be carried out with some realisation of the widest and most comprehensive purview of the relation of the particular investigation to the whole problem. It is only by piecing together the accumulation of all the available data that we can see in what direction the next steps to be undertaken must go.

If I were asked to sum up what is the main contribution which Europe has henceforward to give to the solution of the problems of the tropics, now that the reign of peace and law has been established, I should say that it is in one sphere of knowledge—bionomics—a knowledge of the laws of life.

I take it that the chief object of this Conference is to discuss together how best we can advance our still restricted knowledge of these laws of life by further research and by practical administrative action based upon such limited knowledge as we already possess.

REPORT SUBMITTED BY THE BELGIAN MINISTRY
OF THE COLONIES.
TRYPANOSOMIASIS IN THE BELGIAN CONGO.

The present position is as follows : of 1,704,477 negroes examined, 1,068,516 examinations were made in Congo Kasai. Of these, 210,493 were made by Government medical officers attached to medical posts and stations on the occasion of the issue of passports or visits to dispensaries ; 521,370 by Government Medical Missions in Mayumbe, Congo Kasai and Dibaya districts ; 32,992 by the Protestant doctors at the Northern Cataracts ; 62,866 by missionaries of various denominations belonging to the Native Medical Service, and 235,795 by the independent Mission de la Forminière in the Kasai. It should be pointed out that this mission, which has always obtained trypanocidal drugs from the Government, is coming to an end after two years' existence ; the Government has already taken back part of the stock.

On the whole, the work accomplished may be regarded as very satisfactory. The table hereunder gives an idea of the position :

	Examined	Punctures	New cases	Old cases	Total number under treatment
Congo Kasai Province	1,063,516	123,812	14,530	59,606	31,492
Equator Province	180,523	21,751	1,583	4,066	3,306
Eastern Province	213,786	47,260	362	5,193	5,621
Katanga Province	166,014	2,500	1,335	800	2,349
Ruanda-Urundi Territory	80,638	3,347	1,266	1,278	2,544
Totals	1,704,477	198,670	19,076	70,943	45,312

There were treated by the H.C.B. 305 cases, of which 131 were at the Tango dispensary ; at Lusanga, the travelling medical service, composed of a medical officer and a sanitary assistant, reported 82,573 examined and 68 cases plus 2 in the final stage of the disease. These figures should be added to those given above.

The 45,500 cases shown in the statistics were actually under treatment at the end of the year ; this includes new cases and old cases undergoing a second or third treatment.

When reinspections are made, after a period of three months, a certain number of patients are sent away to rest and are replaced by others completing their period of rest. Thus, with the new cases discovered, the number of patients remains approximately the same throughout the year.

In view of the report to be submitted to the League Conference, it would be useful to give a detailed account of the position in the various localities.

CONGO KASAI PROVINCE.

MAYUMBE SLEEPING-SICKNESS MISSION.

The mission was composed of one medical officer, three sanitary assistants, seven qualified native assistants and twenty-six injectors.

The Forminière medical service worked at centres in the neighbourhood of *Tchela* and the railway medical service in the chieftaincies and plantations along the line.

Individuals examined	173,158
Punctures made	74,445
New cases	1,851
Old cases	11,540
Under treatment	5,533
Percentage, new cases.	1.1
Percentage, old cases	6.6
Normal spinal fluid	1,962
Altered spinal fluid	686

In 1926, the percentage of new cases was 1.3 ; in 1927, it was 1.1 ; the percentage shows a sharp rise in certain places and considerable decreases in others.

There were examined :

In 1925, 137,225 natives.
 In 1926, 152,059 natives.
 In 1927, 173,158 natives.

In the *Tchela* sector, the results were as follows :

	%
Maximum	34.1
Minimum	0.7
Mean	6.4

In the *Lukula* sector :

	%
Maximum	66.2
Minimum	0.2
Mean	10.0

More women were infected than men ; this is because women work in plantations on the river banks.

The general percentage is as follows :

	%
Maximum	66.6
Minimum	0.2
Mean	8.2

The medical director is not satisfied with the work of the native injectors.

Treatment by tryparsamide alone in maximum doses of 2 grammes, at the rate of twelve injections per cure, gives the best results from the symptomatological as well as from the moral point of view.

To the results obtained by the Mayumbe mission should be added those obtained by the Government staff in the *Boma, Banane, Malela, Matadi* sectors and by the medical service of the Swedish Mission at the Northern Cataracts, which is directed by Dr. PALMAER, assisted by five European nurses at medical posts at *Kimbunzi, Kinkenge, Kingoie, Makimbungu* and *Sundi Lutete*.

I. *Government Medical Service.*

	Examined	Cases	%
Banane	5,596	93	1.3
Malela	2,473	76	3.07
Boma	17,161	1,484	8.64
Matadi	6,770	48	7.1
	<u>32,000</u>	<u>1,701</u>	<u>6.89</u>
			%
Maximum			8.64
Minimum			1.3
Mean			6.89

2. *Medical Service of the Swedish Missions.*

	Examined	Cases	%
Kimbunzi	6,807	185	2.7
Kingoie	10,884	236	2.16
Kinkenge	7,304	254	3.47
Makimbungu	4,330	206	4.7
Sundi Lutete	3,091	116	3.7
	<u>32,416</u>	<u>997</u>	<u>3.07</u>
			%
Maximum			4.7
Minimum			2.7
Mean			3.07

These percentages are calculated on the patients actually under treatment, taking both old and new cases. The position is continually improving. In fact, at Boma the percentage was 13.5 in 1926 and 8.64 in 1927 ; at Kimbunzi it was 3.95 in 1922 and has fallen every year till in 1927 it was 1.07 for new cases and 2.7 for old and new cases.

To complete the survey of the Lower Congo, the work in the Southern Cataracts and in the Madimba region must be considered. Only one medical inspection was made by a Government medical officer in the *Benga* region (Southern Cataracts) : 11,709 natives were examined and 274 cases discovered, giving a percentage of 2.34.

The missions in the regions of *Kionzo, Tumba, Madimba* and *Thysville* have examined 49,662 persons, treated 1,180 cases ; percentage, 2.3.

The maximum percentage was 6.5, the minimum 0.4, or an average of 2.3.

SLEEPING-SICKNESS MISSION IN THE CONGO KASAI.

At the beginning of 1927, the mission was composed of Dr. DAVID, medical director, Dr. LUDIG, and five senior sanitary assistants.

Two sanitary assistants went on leave during the first part of the year and were replaced by a junior medical officer and a junior sanitary assistant.

In addition, there were three qualified male nurses and thirty-five microscopist-injectors.

Three Catholic mission centres are giving valuable aid to the medical mission, namely, those at Yasa, under the direction of Père GREGGIO; at Djuma, under Père LANGE, and in the Lower Kwilu, under Père SADIN.

The H.C.B. and C.K. medical services have not carried out any work of particular note.

The method of microscopic examination is at present in general and complete use in all the villages for all gland cases, except cases in the last stage of the disease.

Treatment has been carried on exclusively by means of tryparsamide emetic; three injections every three days, series repeated twice at an interval of a week; maximum dose of 2 grammes for a normal adult. At the dispensary, Dr. DAVID uses the method of three injections of 2 grammes or 6 grammes in three days, followed by seven weekly injections of 2 grammes. For children, he uses Bayer, repeated at two-day and afterwards at three-day intervals.

Persons examined	<i>Kikwit Territory.</i>		Total	Annual index
	Cases	Comatose		
55,833	371	39	410	0.96
	<i>Kandale Territory.</i>			
32,412	276	24	300	1.1
	Improving considerably.			
	<i>Lukula Territory.</i>			
43,060	1,692	160	1,852	4.3
	Epidemic prevalence. C.K. expected to intervene.			
	<i>Bulungu Territory.</i>			
40,197	108	30	138	0.38
	Marked improvement.			
	<i>Lower Kwilu Territory.</i>			
9,384	97	11	108	1.2
	No improvement. Small centres of infection to be watched.			
	<i>Niadi Territory.</i>			
19,029	71	11	82	0.45
	Position remains satisfactory.			
	<i>Kamtsha Lubue Territory.</i>			
67,384	308	75	383	0.65
	Position very satisfactory.			

Bapende Territory.

Persons examined	Cases	Comatose	Total	Annual index
20,835	389	III	500	2.6
Satisfactory in the north-east, but centre of infection towards the south.				
<i>Totals:</i> 288,134	3,312	461	3,773	

To sum up :

1. *Congo District.* — The maximum infection was 31 per cent, minimum 0.4 per cent, the mean 1.6 per cent.

2. *Kasaï District.* — The maximum infection was 25 per cent, the minimum 0.3 per cent, the mean 2.6 per cent.

The A.M.I.B. co-operated in examining 36,752 persons, 191 of whom were found to be suffering from sleeping-sickness ; 3,500 examinations are carried out monthly by members of the medical mission.

The future programme will be a very full one if the satisfactory results hitherto achieved are to be maintained and existing foci of infection stamped out. As Dr. DAVID says in his report :

“ Seven years of prophylaxy and of enormous sacrifice have produced the most satisfactory results and have completely transformed the villages and their population. Those who have been longest in residence—and I myself have been there since 1912—can confirm this.

“ Nevertheless, after and in spite of a long struggle, there still exist foci calling for hard work and patience where the slightest relaxation of effort would be followed by a recrudescence of the disease. Ten years of prophylaxy will not suffice to eradicate sleeping-sickness in these unfortunate but interesting regions. The services of a well-equipped medical mission will obviously be absolutely necessary for some time to come, nor can any time-limit at present be fixed.”

The results obtained by this mission should be considered in connection with the work carried out by the medical officer of the Kwango district at Bandundu, who has examined in the neighbourhood of the chief town 1,380 natives, of whom 244, or 17.6 per cent, were found to be suffering from the disease. His assistant sanitary officer examined in the territory of Bagata, between Kwilu and Kasaï, 27,073 natives, of whom 1,098, or 4.05 per cent, were found to be suffering from the disease. A health officer will be sent to the Lower Kwilu. To the figures for this district should be added the cases discovered and treated by the H.C.B. at Lusanga, where the percentage would appear to be 0.8 per cent.

DIBAYA MEDICAL MISSION.

The mission resumed its work at the end of June on the arrival of a medical officer and a sanitary assistant. There were 39,985 natives from 126 villages examined, and 2,098 cases treated ; 14,912 gland punctures were made and 559 new cases discovered. This gives an annual average infection index of 1.5 per cent, while, in 1926, when the mission first started, the index was 3.5. A high percentage of infection—8.5—persists in the northern region of the Dibaya territory, particularly in the chieftaincies of *Matari*, *Mpatu* and *Kamunanzapo*.

	%
Maximum	8.5
Minimum	1.3
Mean	1.5

The highest percentage was 12 in 1926, the lowest 3.5, and the mean 3.5.

The staff of this mission has recently been increased, and in 1928 it will be possible to resume the prophylactic campaign against sleeping-sickness with the utmost energy (report by the provincial medical officer).

DR. FOURCHE'S MISSION IN THE KASAI DISTRICT.

This mission, under Dr. FOURCHE, has worked in the *Batshoks*, *Batshila Lunga*, *Lulua* and *Dibaya* territories.

The method of examination adopted was the study of clinical symptoms (somnolence), palpation followed by punctures and microscopic examinations of the glandular lymph.

In addition to definite cases, cases classified as "suspects", after microscopic examination had given negative results, were also treated.

There were 235,795 examinations made, among which were 4,819 old and new cases. The number of cases in the mission's zone varies considerably and oscillates between less than 1 and more than 10 per cent. *G. palpalis* is to be found everywhere. As a result of the prophylactic campaign carried on since 1923 among the Batshoks between the Lowa and the Kasai, the disease is tending to become more and more circumscribed.

There still exist some small permanent foci which require watching.

The increase in the health personnel has enabled a census to be taken between the Kasai and the Lulua in the territories of the Babinji and Bashila Lungu, and it has been found that the percentage of cases varies between 0 and 1.28. A very extensive campaign has been carried on from Luluabourg as far as Dibaya, where epidemic centres exist, with a percentage of cases varying between 1 and 10.

In order to repeat on a large scale the important experiments carried out previously by Dr. VAN DEN BRANDEN, Dr. FOURCHE in 1926 gave to 3,101 healthy subjects, belonging to centres with an infection rate of about 10 per cent, preventive injections of Bayer 205. One or two injections were given. Of these subjects, 1,681 were re-examined after seven or ten months and 772 of them were re-examined after fifteen months.

The protection afforded by Bayer 205 was shown to be complete up to seven months, and quite appreciable up to ten months; after that period the immunity did not persist.

Dr. FOURCHE recommends the application of Bayer 205 as a preventive measure for whites and natives living in highly infected regions, for persons moving from one district to another and for small colonies where infection is rife.

I am of the opinion that prophylactic treatment with Bayer 205 has not yet been sufficiently tested and that there can be no question of generalising this very costly method.

The percentages established by this mission are as follows :

	%
Maximum	11.4
Minimum	0.14
Mean	2.04

for patients under treatment. In addition, this mission has treated 9,657 suspects.

In the Kasai, in the neighbourhood of the head village of Luebo, out of 18,962 natives examined, 355 old and new cases—*i.e.*, 1.8 per cent of the population—are under treatment; the percentage of new cases is from 1.08 to 1.5. The population varies and most of the patients come from the highly infected territories of Luluabourg and Dibaya.

The religious missions in the district give very little information. At Mutoto, 1,459 cases were treated by Dr. KING; at Hemptinne St. Benoit, 23 cases were treated; at Mwilianbongo, 1,600 injections were given. From Luluabourg and Merode, in spite of the presence of the medical officer attached to the National Missions, no information has been received.

Sankuru District.

This is the first time that it has been possible to make a careful inspection and the results obtained are encouraging. Government staff examined 67,605 natives and 808 cases were discovered.

The percentages by regions are :

	%
Maximum	2.3
Minimum	0.1
Mean	1.2

Only one mission deals with sleeping-sickness—that of Tshume St. Marie, which examined 485 natives and discovered 62 cases. It is impossible to establish a percentage; it would be necessary to send a Government health officer to take a census.

The territories of *Katako Kombe*, *Port Franqui*, *Lomela*, *Loja* and *Kole* are almost free from infection. Care must be taken to prevent the endemic from spreading in this region.

Urban District of Leopoldville.

The Laboratory at Leopoldville has examined 15,131 natives, including members of ships' crews, travellers and residents, and has diagnosed 93 cases, *i.e.*, 0.6 per cent. There were 147 new cases admitted to the quarantine hospital; 145 were already there at the beginning of the year, and 128 were discharged apparently cured. Out of 789 examined from among the native population of Leopoldville, 10, *i.e.*, 1.2 per cent, were found to be infected. This percentage fell last year to 0.7.

In the Leopoldville hospital, 14,407 persons were examined, and 40 new cases—*i.e.*, 0.26 per cent—were discovered.

Chenal District.

Out of 14,346 natives, 650 new cases, *i.e.*, 4.5 per cent, were discovered.

The maximum was 11.4 per cent in the Chenal.

The minimum was 3 per cent in the interior.

Mean : 4.5 per cent.

The average number of cases under treatment, including old cases, was 12.8 per cent. This figure is very high, but the previous maximum in the Chenal was 29.2 and the minimum 11.9.

The medical officer attached to the Labour Office at Leopoldville diagnosed 30 cases among discharged workers from the Safricas and Gobertange shipyards. These companies should supervise their workers better.

THE EQUATOR PROVINCE.

The Sleeping-Sickness Mission in the Bangalas territory has been reduced to its simplest form through lack of staff. Systematic work in this province has been impossible, but 180,523 natives were examined and 3,306 cases, *i.e.*, 1.08 per cent, have been treated. It has only been possible, however, to deal with a small proportion of the cases existing in this province ; it is to be hoped that an increase in staff will enable us to intensify the campaign throughout the province, and in particular in the Bangalas, Ubangui and Lake Leopold II. territories.

Bangalas District.

On the basis of the figures for 1926, the position in the Bangalas district would seem to be as follows :

	%
Bomana	7.3
Bomboma	3.3
Busu Melo	0.5
Mojamboli	0.28
New Antwerp	4.5
Bujala	1.2

That is to say :

Maximum	7.3
Minimum	0.28
Mean	2.3

The Catholic Mission at Mbaya.

This mission discovered a percentage of 10.7 cases, and the mission at Boyange discovered 6.1 per cent. It should be noted that these missions only examine patients coming to the dispensaries for treatment ; they do not organise systematic "round-ups".

Lisala.

The medical officer at Lisala discovered 0.31 per cent among the floating population of the station.

Ubangui District.

The medical officer at *Libenge* has always devoted his attention to sleeping-sickness among the population in the neighbourhood of the station. He found, at the station itself, 1.25 per cent ; among the Sango, 11.2 per cent, and at Mojombi, 7.3 per cent. It should be noted that many natives from the French Congo come for treatment to Belgian dispensaries.

The medical officer in charge of the Sleeping-Sickness Mission in the region of *Banzyville-Yakoma* finds a maximum of 3.3 per cent, a minimum of 0.5 per cent, and a mean of 0.6 per cent.

In 1926, the mean was 0.5 per cent ; the general situation therefore has hardly changed. This region borders on the Monga and Bondo regions in the Lower Uele, where cases have been notified.

Lake Leopold II Territory.

	%
Maximum	4.9
Minimum	0.16
Mean	3.3

The situation is most serious at *Bolobo*. This observation post is directed by a doctor of the Protestant mission.

Equator District.

Coquilhatville only examines a floating population ; in 1926, the percentage of cases was 6.6 ; at Bokuma, the missionary found 2.2 per cent ; at Lotumba, 1.04 per cent, and at Bikoro, 0.7 per cent ; these two latter posts are directed by two Protestant mission medical officers.

The only information available for the Lulonga district concerns Ikoli, where there are 0.2 per cent of cases.

EASTERN PROVINCE.

There are three main foci in the Eastern Province : one in the north, in the Uele territory ; one in the east, in the Ituri territory ; one in the centre at the mouth of the Lomami.

There is another small focus along Lake Tanganyika.

Uele Territory.

A medical mission has been dealing with this focus since 1920. The general summary for the last five years is as follows :

Year	Natives examined	Cases treated	%
1923.	157,575	3,208	2.03
1924.	189,262	4,871	2.5
1925.	155,928	4,226	2.07
1926.	199,061	4,114	2.06
1927.	200,642	4,429	2.2

The general position, therefore, would appear to have changed only slightly during this period.

* * *

On examining the situation in detail, we observe that, since the mission was founded, 16.7 per cent of the population has been found to be suffering from sleeping-sickness in the *Upper Uele zone, Bangaro* sector ; the number of new cases is, however, progressively falling.

Year	Cases	%
1925.	470	2.35
1926.	223	1.1
1927.	177	0.88

There are 1,718 cases, *i.e.*, 8.6 per cent of the population, under treatment.

Doruma. — The percentage of new cases has more than doubled during the year ; from 0.2 per cent in 1926, it has risen to 0.4 per cent in 1927. There are 114 cases, *i.e.*, 0.9 per cent of the population, still under treatment.

Doruma (South). — There were 81 new cases, as compared with 71 in 1926, *i.e.*, 1.5 per cent of the population. Two cases are still under treatment.

Niangara. — There were 362 cases, *i.e.*, 0.6 per cent of the population, under treatment, as against 276 in 1926 ; the percentage of new cases is 0.04, as compared with 0.5 in 1926.

Dungu. — No census has been taken in this district. The percentage of cases discovered by partial inspections can be estimated at 0.06. In 1924, no case was discovered among 6,335 persons examined. Four old cases were under treatment ; some cases have been recently discovered in the *Demu* chieftaincy.

Amadi. — There were 11 cases under treatment ; a partial inspection gave 0.7 per cent of cases.

It would be interesting to examine the position to the south of the Uele territory towards the Bomokandi district. In 1924, no new cases were discovered among 19,125 examined. Seven old cases were under treatment.

Aba Faraje. — In 1923-24, an old focus, nearly extinct, was discovered in the neighbourhood of Aba. This Congo focus, which comprised some 50 patients at the end of 1923, was itself situated at the limit of the infected border zone, the focus of which had its centre at Yei, in the Anglo-Egyptian Sudan. In 1924, out of 30,637 natives examined, no case was discovered. During 1927, natives of Faraje passing through Yei were examined and 2 cases of sleeping-sickness were discovered. The alarm was raised, and an inspection carried out in the country of origin led to the discovery of 9 new cases and subsequently 5 new cases. In all, there were 18 cases under treatment.

To sum up, 112,289 natives were examined in the Upper Uele ; among these, 333 new cases, *i.e.*, 0.3 per cent of the population, were discovered. There are 2,555 old and new cases, *i.e.*, 2.27 per cent of the population, under treatment. The maximum is 8.6 per cent, the minimum 0.5 per cent and the mean 2.2 per cent.

Lower Uele Zone. — Here the position is not so clear ; the data are less concise and it is impossible to establish the percentages. There are 1,874 cases under treatment (150 of which were discovered in 1927) out of a population of 88,353, *i.e.*, 0.17 per cent new cases and 2.1 per cent cases under treatment.

At *Monga*, 12 cases have been notified.

At *Bondo*, 4 cases were diagnosed.

At *Dakwa*, 72 cases were discovered in 1927. In 1924, the percentage was 1.1. It should be pointed out that in 1924, out of 23,400 persons examined at Bondo, there were no cases. From 1913 to 1924, only 60 cases were discovered, of which 12 remained under treatment.

At *Bambili*, 8 new cases were discovered.

At *Bili*, there are 150 cases, 11 of which are new cases, as compared with 2 in 1926.

The *Gwane* sector records 1,180 cases under treatment, or 6.9 per cent of the population, as compared with 7.2 per cent in 1924. New cases in 1927 number only 32, *i.e.*, 0.18 per cent. The number of new cases is progressively decreasing.

Year	Cases
1924.	119
1925.	85
1926.	39
1927.	32

In the *South-West Zone* of the Lower Uele, the particulars are incomplete. At *Ibembo*, out of 13,746 persons inspected, 27 new cases were discovered; 156 cases, *i.e.*, 1.1 per cent, remained under treatment.

Each of the three zones served by the mission possesses a quarantine station, at Doruma, Ango and *Ibembo* respectively.

	Doruma	Ango	Ibembo
Present on January 1st	27	81	51
Admitted during the year	87	257	363
Discharged	58	254	290
Deaths	18	15	322
Remained on December 31st.	48	69	93

East Ituri (Report by Dr. TAVERNARI, Provincial Medical Officer).

In the *Ituri* territory, there are still three foci of trypanosomiasis, namely, *Abock*, *Kasseny* and the Valley of the *Semliki*. These three foci are intimately connected¹.

Trypanosomiasis originates on the shores of Lake Edward, follows the course of the *Semliki* through the valley and debouches in Lake Albert; it spreads over the shores of this lake and stops at the foot of the *Mitumbe* Mountains, the ridge of which it has never crossed.

There are to-day 130 cases in the *Abock* sector; the centre of infection tends to die out.

Only 3 cases are under treatment in the *Kassenyi* sector; this focus also seems to be dying out.

The *Beni* sector deserves special mention. To trace the origin of what may now be termed the Sleeping-Sickness Mission of the *Semliki*, we must go back to 1906. The mission as at present constituted was only formed in July and consists of a medical officer and two sanitary assistants. The methods employed in the past were useful, but lacked continuity and uniformity.

The first work the mission had to accomplish was to take a census of all existing cases and classify them according to sectors; a sanitary assistant was placed at the head of each sector.

Regular inspections were then begun, Dr. JUNGANO commenced spinal puncture, a method which allows a great number of patients to be sent home. This measure was well received by the natives, who had begun to complain that the series of injections were never coming to an end.

At the end of 1927, 12,910 persons had been examined, 934 of which were gland cases; 174 new cases were discovered.

¹ See page 20.

The position at Beni may be summed up as follows :

Old cases	639
New cases	174
Deaths	<u>48</u>
Total	861

The ratio of new cases to the population examined is 1.4 per cent ; but the percentage rises to 6.4 if we include all the cases at the end of 1927.

Treatment is based on the use of tryponarsyl, which, as elsewhere, proved very effective. Unfortunately, cases of blindness occurred, and in this connection Dr. JUNGANO points out that the ocular trouble occurred among old patients who had previously been treated with atoxyl, probably in excessive doses.

There were given 6,730 intravenous injections with tryponarsyl and 67 with Bayer 205.

The most important prophylactic measures adopted were the abandonment of the Old Beni medical post and the transfer of the district headquarters to New Beni. This transfer was followed by the removal of the riparian populations from the Semliki and their settlement along the Irumu-Beni motor-road. The transfer of Old Beni to New Beni was followed by the removal of the Catholic mission and the quarantine hospital.

This motor-road is of great prophylactic value. To confine sleeping-sickness within the limits of the old focus and wage an effective campaign against it will be easier now than was the case in the past, when trypanosomiasis used to travel with the caravans and inevitably spread step by step as far as the Irumu territory.

The seasonal migrations of the populations of the Semliki to the salt-works at Katwe have been responsible for the spread of trypanosomiasis. Several measures have been recommended. On the advice of Dr. VAN HOOFF, a market was organised at Kasindi under Government supervision for the purchase of Katwe salt. Dr. JUNGANO reports that the natives are not enthusiastic about the plan and that they still prefer to go to Katwe, where they can pay for the salt by labour.

The quarantine hospital at Beni has to-day four mud-built wards, store-rooms, kitchen, etc. There are, in all, 68 beds available.

Lomami Centre.

The trypanosomiasis centre on the river Lomami in the Aruwimi district is comparatively less important than those previously reported.

The Lomami river was inspected in 1924 by a Government medical officer. Since then, the cases in this region have been placed under the supervision partly of a health service affiliated to the A.M.I.B. and partly of the Basoko medical officer.

Since the end of 1927, a resident medical officer has been assigned to the Lomami district to carry out prophylactic measures against sleeping-sickness.

The Aruwimi district records 168 cases. This figure is an argument for the institution of a Government service to carry on the campaign against trypanosomiasis.

* * *

The particulars supplied by the other districts are not very concise, as a methodical examination has not been made.

There has been some criticism of the prophylactic methods employed by the Government of the Belgian Congo in these frontier regions. According to the critics,

we should have adopted the same measures as our neighbours—removal of villages, settlement of the latter along main roads, creation of an uninhabited strip of land along the frontier, etc. In point of fact, great efforts have been made in this direction, but coercive methods are not always possible. It should, in addition, be noted that we are obliged to spread our efforts over vast regions—in fact, over the whole Colony. Motor-roads are not made for prophylactic but for economic reasons; they pass through regions where the settlement of the population would hardly be possible. However, the northern zone of the Uele territory has been evacuated; villages are already settled in healthy districts which are easily supervised; and the clearing of bush in the neighbourhood of fords is kept up. In the Semliki district, the population has also been removed and settled along the motor-road. But here our work is hampered by the fact that the natives flee into Uganda territory. The same thing happens in Tanganyika, in the Urundi territories.

KATANGA PROVINCE.

UPPER LUAPULA DISTRICT.

Bukama Sector. — Out of 81,329 persons examined, 253 new cases were discovered; these, together with the 224 old cases, make up a total of 477 cases, *i.e.*, 0.57 per cent under treatment. In the Bukama territory the percentage is 0.57; in the *Kisale* territory 0.38; in the *Kibara* territory a rough estimate gives 1.1 per cent.

Lukafu Territory. — The missionary directing the A.M.I.B. medical post in this region reported in March that cases of trypanosomiasis had been discovered in the Lufira valley. The Mining Union actively assisted in the campaign in this region; a medical officer was sent and reported 72 cases, *i.e.*, 1.92 per cent, out of 3,749 natives examined. A mission should therefore be despatched to this district. It should be noted that in 1926, on the northern reaches of this river from Lupa, 5.82 per cent of cases were found; to the south of Lupa, 0.53 per cent; on the southern reaches of the Lufira in the Sampwe territory, 0.65 to 1.15 per cent; in the riparian Kibara villages along the Lufira, as much as 10.55 per cent.

The *Sakania* territory is free from the disease.

TANGANYIKA-MOERO DISTRICT.

A great effort has been made this year: 47,225 natives have been examined, and 1,339, or an average percentage of 2.5, treated (833 new cases). In the *Baudouinville* district the percentage was 0.95; in the *Biemba*, *Lukuma* and *Niuzu* districts 1.6, *Albertville* 1.6, *Ankoro* 2.5, *Kabalo* 2.2 and in the districts of *Kongolo* and *Southern Niuzu* the percentage varied from 6 to 7.

In the *Kiambi* district, which formerly suffered severely, only 1 per cent was found.

The district medical service has, in addition, treated 150 cases from the Bukama territory. These cases were discovered among a population of 25,000 natives, thus giving a percentage of 0.6.

LOMAMI DISTRICT.

Throughout the district 3,845 cases have been treated; but, as it was not possible to proceed methodically, the treatment of these few cases must remain ineffectual.

Dr. KELLEBERGER at *Bibanga* reports that 40,000 natives were examined twice during the year; 2,688 cases, *i.e.*, 6.07 per cent, were treated.

A Government medical officer made a partial inspection and reported the following particulars :

	%		%
West Babinda territory . . .	3.4	Kanda Kanda territory . . .	0.84
Pania Mutombo.	3.8	Mutambo Mukulu territory . . .	0.44
General average. 1 per cent			

In the Kambaie stock-breeding centre, 9 per cent of cases were discovered among the workers.

LULUA DISTRICT.

As I reported before in 1912, the cases found in this district are limited to the Kapanga territory. The position has not changed since then, although *G. palpalis* is found along all the rivers as far as their source.

RUANDA-URUNDI TERRITORY.

Here the position is not particularly good. The medical service has done its best and the population in the infected region is thoroughly examined twice a year ; the patients are treated and carefully examined at regular intervals.

I need only say that, at the first inspection, 519 new cases out of 44,728 natives, *i.e.*, 1.15 per cent, were discovered, and at the second inspection 747 out of 38,064 natives, *i.e.*, 1.9 per cent ; hence, among 44,000 examined, there were 1,266 new cases, *i.e.*, 2.87 per cent.

Since 1924, 4,630 cases in all have been discovered :

Sector	%	Sector	%
Ruzizi	0.45	Magara	4.5
Usumbura	1.3	Rumonge	5.8
Nyanza	2.3		

In this last sector, examination was rendered more difficult by the flight of the natives into the Tanganyika-Moero territory.

TRYPANOSOMIASIS AMONG EUROPEANS.

The Government medical officers reported 14 cases among Europeans, 6 in the Katanga region, all in the Tanganyika-Moero district, and 8 in the Congo Kasai province, 6 of which were discovered at Leopoldville, 1 in the Lower Congo and 1 in the Kwango province. In addition, 2 cases have been reported among the missionaries of the Swedish Mission at the Northern Cataracts. There were no deaths.

TREATMENT.

All the medical officers agree that the former method of treatment should be replaced by tryparsamide.

There is no doubt that, for the moment, no other treatment is more effective and that the natives themselves realise this ; the treatment cannot, however, be generalised, for financial reasons. The problem also arises of opening old quarantine hospitals. The examination of the cerebro-spinal fluid and the institutional treatment of all cases presenting modifications of this fluid is becoming necessary. This will call for adjustment and additional study.

MEMORANDUM SUBMITTED
BY THE BRITISH COLONIAL OFFICE

I. PROGRESS OF INVESTIGATION IN RECENT YEARS.

The preparation of a memorandum on the " progress of work on sleeping-sickness during the last few years " is a matter of considerable difficulty. Apart from official reports from various colonies and committees at work, there are numerous isolated papers, running into hundreds, written rather as personal accounts by the many who are working on the subject in its various aspects, in different stations and in different languages — English, German, French, Spanish, Portuguese, Italian. A considerable proportion of these has been read in the original, but some have been published in periodicals or records difficult of access and have been available merely as abstracts in publications which reach a larger circle of readers.

I. TSETSE-FLY INVESTIGATIONS.

The headquarters of tsetse-fly investigation in Nigeria are at Sherifuri. The chief species of fly encountered are *Glossina tachinoides*, *G. morsitans*, *G. palpalis* and *G. longipalpis*, the two former being met with in the drier northern part of the country, the two latter in the southern part, where the rainfall is heavier. In the intermediate zone all four occur together. Most of the experimental work has been concentrated on the two first-named.

G. tachinoides has been found infected in nature and experimental transmission has been carried out at Sherifuri with *Trypanosoma brucei*, *T. gambiense*, *T. vivax* and *T. congolense*. This fly has been found to be mainly responsible for epidemic sleeping-sickness in the northern provinces, and the heavy infection found in *G. morsitans* with trypanosomes pathogenic to domesticated cattle renders the areas infested by this fly uninhabitable by stock, an exceptionally unfortunate circumstance seeing that these areas are among the most fertile in Northern Nigeria.

Statistics have been drawn up based on an examination of some 80,000 flies. Records have been kept of the percentage of females caught, the nature of the imbibed blood (when this could be determined), the rate of breeding, the trypanosome infection and other points. In addition to estimating the proportion of food taken up by different species of tsetse from mammals, birds, and reptiles, the precipitin test was employed for determining the nature of the imbibed bloods.

Information concerning the range of flight of glossinæ has been obtained by experiments with marked flies. By compilation of statistics the investigators have been able to estimate the effects of local measures of fly control, such as clearing of forest, delayed grass-burning and exclusion of game from a fenced tsetse focus.

In the clearings only the fringing forest and heavy woodland savannah in the neighbourhood of primary and secondary foci of the fly have been destroyed, that is, areas in which the fly is concentrated during the comparatively shadeless period towards the end of the dry season. From this it appears likely that large areas of the country may be reclaimed from fly infestation by removal of only from two to eight per cent of the total forest ; this question, however, needs to be further tested.

The general conclusions drawn from these experiments are :

(1) That one or other of the riverine species—*G. tachinoides* and *G. palpalis*—is always present with *G. morsitans* in Nigeria, and these are dangerous to man, particularly when scantiness of game limits their food supply, because colonies of the flies then become established at the watering pools. Hence embarkation on a policy of organised destruction of game is considered unwise.

(2) Deferred grass-burning is regarded as impracticable, first because the country is full of cattle-grazers and nomads all eager for early burning, and secondly because erosion and impoverishment of the soil would ensue.

(3) In the wetter southern parts, where the fly is almost universal, clearings should be limited to protective measures for safeguarding stations, ferries and the like. At the same time, active treatment of sleeping-sickness patients should be carried out to limit the rate of infection of the fly with *T. gambiense*.

(4) In the drier northern parts there is hope of being able to reclaim areas at present infested and they are still a relatively small part of the country. Clearing, it must be borne in mind, is only a preliminary to reclamation of infested lands; if settling is not also undertaken, they will revert to tsetse-haunted bush.

Reclamation on these lines is now being carried out in the northern and eastern districts under the supervision of officers of the Political Service seconded to the investigation. Further, sleeping-sickness cases in natives are being treated in steadily increasing numbers. The present rate of treatment is some 1,000 per annum, and the value of the treatment is becoming more and more fully appreciated by the native population.

In addition to the work done by the tsetse-fly investigation staff, the problem of trypanosomiasis is also being attacked by officers of the veterinary department. Again, at Vom, in Nigeria, is an agricultural institute with two entomologists on the staff. Mr. A. W. POMEROY, formerly one of these, is now engaged on tsetse-fly work on the Gold Coast as medical entomologist in the Research Institute at Accra.

Mr. SWYNNERTON, in Tanganyika, for dealing with this disease and the tsetse-fly menace, formulated a policy comprising three main lines of attack. First, segregation and treatment of cases with a view to sterilising the blood of infected persons and thereby cutting off one source of supply or reservoir of the parasite; second, removal of natives from areas heavily infected and establishing them in cleared fly-free country, at the same time controlling the movements of natives by the issue of permits, thus abolishing contact between man and fly; third, clearing of bush along lines of communication and extending agricultural operations. This work and its results are dealt with in more detail later (pp. 46 *et seq.*).

A large tsetse-fly control scheme, based on the lines followed by Mr. SWYNNERTON in Tanganyika, has been carried out in the Dowa and Fort Manning districts of Nyasaland under the supervision of Dr. W. A. LAMBORN. This scheme consists in intensive settlements at the outskirts of the fly area and in rapid deforestation to a depth of about 1,000 yards into the fly-infested country. Dr. LAMBORN considers that shortage of game causes the flies to disperse in search of food, with consequent increase in the area infested. His opinion that carriers other than glossinæ exist is not shared by members of the International Commission at Entebbe.

Apart from the work of the International Commission, many isolated investigations, carried out as opportunities presented themselves to medical officers of various mission-stations and others, have been reported in the literature. The wisdom of appointing the Commission as an international body was, as Dr. DUKE states, manifested

herein, as their outlook was not limited by local conditions, while spasmodic efforts by isolated workers were likely to prove abortive. Again, different points may often be best studied in different centres, and the exchange of information and the critical correlation of results are best effected by a central and unbiased commission. Examples of this are the possibilities of studying with greater facility clinical conditions and therapeutic measures in the French and Belgian Congo, the behaviour of the parasite in the insect-vector in Uganda, various measures of control and eradication in yet other centres, and so forth. When these have been impartially and critically considered and definite conclusions arrived at, a combination of them can be judiciously applied, *mutatis mutandis*, in the various areas of infestation.

We can now speak of some of those more restricted efforts and thereafter of reports from workers in isolated districts, who are brought into contact with sleeping-sickness as part of their daily work.

A separate branch of the Tanganyika Medical Department was inaugurated in 1926 for dealing with trypanosomiasis. Six medical officers were seconded for the work and the policy they have adopted is to concentrate the population in fly-free clearings, where their tribal organisations are maintained. By the end of the year seven clearings had been completed, extending in all over an area of more than 60 square miles. Fly-infested forest of 7,500 square miles had been evacuated and some 15,000 inhabitants transferred to the clearings.

Dr. W. H. DYE, who has also been working in Tanganyika, is much impressed by the ease with which the disease can be controlled by removing the human source of infection. He maintains that it is almost impossible to reduce the numbers of the flies and that fly campaigns should be limited to annual clearing of bush in the immediate neighbourhood of villages, and he relies on the prompt removal of infected persons and the employment of a staff of trained native inspectors to patrol the villages and find out those that are sick.

From the veterinary aspect, Captain G. N. HALL, pathologist in the Veterinary Department, Uganda, has been searching for vectors other than *Glossina*. Outbreaks of trypanosomiasis were found to occur in cattle far from any known fly-infested areas. Captain HALL placed healthy animals in contact with infected beasts in a field where *Stomoxys* and *Hæmatopota* were found, but not *Glossina*; infection took place in 17 days. Further experiments, however, failed to incriminate *Stomoxys*.

Field-work in Uganda is organised by Dr. G. W. Hale CARPENTER. He considers that hunting in the bush is mainly responsible for infection among the natives and that the important means to adopt is energetic search for infected persons and the treatment of them.

2. TREATMENT.

The majority of drugs employed in the treatment of sleeping-sickness patients consist of compounds and preparations of arsenic. Reports on their efficacy largely emanate from individual medical officers working in more or less isolated districts, and the opinions expressed are usually based on a limited number of cases. Taken as a whole, however, they furnish sufficient evidence for giving a verdict as to their value under certain circumstances.

A considerable number of the papers have been consulted in the original, but where this could not be done, the abstracts in the *Tropical Diseases Bulletin* have been taken as authoritative, since these have been made by those who are recognised as experts and thoroughly cognisant with the subjects with which they deal.

The preparations which have been most widely employed are Bayer 205 (Germanin) and tryparsamide, and these will be first mentioned.

Dr. LLOYD reported in 1925 on 131 cases treated with Bayer 205 at Sherifuri. He grouped them together without division according to the stage of the disease; hence we can only deduce the general results. His method was to give five injections, each of 1 gramme, the first three on alternate days, the last two at weekly intervals. The first injection was followed by such improvement in the general sensation of well-being that some patients did not continue treatment. Fifteen died; 11 of these failed to complete the course, and 3 were in an advanced stage when first seen.

Five cases occurred among the staff of the tsetse-fly investigation; all remain well, one 22 months, the others 12 months after cessation of treatment.

TANON AND JAMOT report (*Rev. Méd. et Hyg. Trop.*, 1925) on 39 cases in the Cameroons that this drug proved itself a useful trypanocide, but that its use was attended by signs of renal mischief which might be of serious import and not merely transient. They did not regard it as superior to atoxyl; the latter was equally good, perhaps better for patients in the early stages; they considered it as more valuable for infection by *T. rhodesiense* than by *T. gambiense*.

MACLEAN, when writing of the disease in Tanganyika Territory during 1926, mentions that he too found Bayer 205 disappointing in all his early cases. These latter usually recovered with doses of from 1 to 1.2 gramme for four or five weeks, but in the more advanced cases "dramatic improvement and apparent recovery" were succeeded, after periods varying in length up to a year or even longer, by relapse and death. In the "ambulant" cases with a high natural resistance to the disease he considered the drug might be very valuable.

KELLERSBERGER'S experience (*Trans. Roy. Soc. Trop. Med. and Hyg.*, June 1926) differed somewhat from that of TANON AND JAMOT as regards the use of Bayer 205 in *T. gambiense* infections. He treated patients in *palpalis* areas of the Belgian Congo and found that 100 per cent of early cases in the acute stage with unaffected cerebro-spinal fluid were cured, and that this result could be brought about by small doses. In the presence, however, of concurrent affection—malaria or ankylostomiasis, for example—the drug was badly tolerated.

STRADA AND LOPES (*Ann. Soc. Belge de Méd. Trop.*, July 1927, Vol. 7, No. 1), to mention but one further instance of the many papers published, agree with the general consensus that in cases of *chronic* trypanosomiasis with changes in the cerebro-spinal fluid, though Bayer 205 reduces the lymphocytic content, the improvement is but transient, and, moreover, it is rare for the signs in the cerebro-spinal fluid not to progress to a fatal issue if this drug be relied upon at such a stage.

In the succeeding issue of the same publication (Vol. 7, No. 2) VAN DEN BRANDEN places on record results apparently good from the use of Bayer 205 prophylactically. He examined the inhabitants of a village in the Belgian Congo and found 17 cases of sleeping-sickness. He inoculated all with the following doses: healthy adults, 1 gramme; adolescents 0.5 gramme; children 0.25 gramme; infants 0.1 gramme. Two injections were given in each case. At a subsequent visit, six months or more later, only one of those whom he had injected had developed the disease and there was reason to believe that this individual was already infected at the time of the first injection.

Two other references to the use of Bayer 205 may be mentioned, the first as to its mode of action, the second in respect of the possible application of the uses of the drug in animal trypanosomiasis to the human disease. As regards the former, KLIGLER (I. J.) AND WEITZMAN (I.) (*Ann. Trop. Med. and Parasit.*, July 1925) tested the effects of Bayer 205 *in vivo* and *in vitro*, using *T. evansi*. They showed that the drug acted by directly affecting the parasite, rendering it non-virulent to the host, which is then able

to destroy and eliminate it. Differences are observed in different hosts and these are ascribed to varying rates of elimination, that is, to the residual concentration of the drug in the circulation.

Finally, the remarks of EDWARDS (J. T.) (*Trans. Roy. Soc. Trop. Med. and Hyg.*, 1926), though dealing with *T. evansi* infection, may be applicable to the treatment of sleeping-sickness in man :

“ Although prolonged sterilisation of the circulatory system may be effected by administration of a single intravenous dose, in well-established cases of infection the trypanosomes multiply in the cerebro-spinal canal. This may be counteracted by introduction of Bayer 205 intrathecally in very dilute solution simultaneously with intravenous injection, having regard to the relative weights (about 1 : 500) of the tissues affected by the introduction of the drug into the two channels.”

Up to that time the dose for intrathecal administration had always been calculated on the total weight or on the blood-volume, not on the relative proportion of the spinal fluid to the blood.

The foregoing remarks will suffice to give an idea of the general trend of opinion as to the use of Bayer 205. The question of tryparsamide will next be considered.

CHESTERMAN (C. C.) AND TODD (K. W.) (*Trans. Roy. Soc. Trop. Med. and Hyg.*, Vol. 21, No. 3, 1927) tried giving this preparation as a base orally. They found that doses up to 0.15 gramme, starting with smaller amounts, were tolerated fairly well, there being no other signs of toxic effect than nausea, perhaps vomiting and a little diarrhoea. Marked clinical improvement was obtained, and this was confirmed by the results of lumbar puncture, but progress was so slow that they returned to injections of the sodium salt in place of the base by mouth. Dr. CHESTERMAN had previously reported (*Lancet*, November 1925) :

“ There are a variety of drugs capable of effecting and maintaining sterilisation of the peripheral circulation for varying periods. Sterilisation is effected most quickly by tartar emetic, less so by atoxyl, least quickly by Bayer 205, but the reverse order holds good for the maintenance of sterilisation when once effected. This brings out the real value of Bayer to the sanitarian concerned with the removal of infectivity. None of these drugs can, however, be relied upon to cure a case which has shown definite nervous involvement.”

He mentions that he had treated with tryparsamide five patients in whom the cerebro-spinal fluid was unaltered and they had remained well for 3½ to 12 months afterwards.

VAN DEN BRANDEN (*Bull. Soc. Path. Exot.*, 1925), in October of the same year, stated that to obtain real and permanent results in chronic trypanosomiasis it is necessary to give from 70 to 80 grammes of tryparsamide. His record is based on 115 cases, which he classified according to the cellular content of the spinal fluid, and his results were 57 per cent apparent cures in the mildest cases with a total amount varying from 20 to 62 grammes, but 17.6 per cent only in patients with trypanosomes in the spinal fluid.

LAIGRET, of the Pasteur Institute, Brazzaville, speaks highly of tryparsamide and thinks it should supersede other drugs ; he records 27 deaths among 356 patients (7.5 per cent) in whom it was *not* used, and only 12 among 678 (1.8 per cent) in whom it *was* used. It has, he states, the additional advantage of benefiting also yaws and syphilis.

KING (J. C.) notes that, from its employment in an American mission hospital in the Belgian Congo, it appears to be specific for *T. gambiense* infections and efficacious in all stages except for such patients as have been previously treated with arsenic and antimony.

KELLERSBERGER, of the Bitunga Hospital, Presbyterian Mission, supports this favourable opinion. He reports having treated 100 cases, which he divided into four groups : (1) early cases, without marked clinical symptoms and without any recognizable change in the central nervous system ; (2) those with slight changes in the cerebrospinal fluid and mild symptoms pointing to invasion of the central nervous system ; (3) those with grave clinical symptoms and important changes in the spinal fluid ; (4) very advanced cases which had relapsed after treatment with other drugs.

His results were very encouraging. Some cases which appeared to be almost *in extremis*, and others who were violent, irresponsible or degenerate, had vastly improved and many were maintaining the improvement 9 to 12 months later, while others were to all appearances completely cured. Untoward sequelæ were rare ; he had only one case of blindness, the result of an overdose, but some exhibited temporary derangements of vision.

JAMOT AND VERNON (*Bull. Soc. Path. Exot.*, 1927, Vol. 21, No. 7) treated their patients with ten weekly injections of doses of about 4 centigrammes per kilo, the initial doses depending on the general state, but rarely exceeding 3 grammes for a strong adult. A strength of 10 per cent they found to be most suitable. They administered it subcutaneously and experienced no trouble. They concluded that it had a powerful and lasting action in advanced cases with meningeal involvement and that its use was not incompatible, as some believe, with previous administration of atoxyl or tartar emetic.

LEDENTU (G.), in a report from the Pasteur Institute, Brazzaville (Vol. 41, No. 9, 1927, pp. 982-1001) gives somewhat more detailed information. He obtained a high percentage of cures (62.5 per cent had remained well for periods of from 9 to 24 months) among patients in the second stage, and success was attained with comparatively small doses (2.5 grammes for an adult of 50 kilos). He notes also that previous treatment with atoxyl did not interfere with tryparsamide, since the degree of resistance to arsenic created by atoxyl is but slight, though it increased the likelihood of ocular disturbances and consequently, if atoxyl had previously been administered, he found it advisable to reduce the dose of tryparsamide to 0.015 gramme per kilo. An insufficient course of tryparsamide, however, in contradistinction to atoxyl, provoked very definite arsenic resistance.

The same author, together with VAUCEL (LEDENTU AND VAUCEL, in the same journal two months later, Vol. 41, No. 11, November 1927), came to the following conclusions : (1) In the early stages in which there were no signs of involvement of the central nervous system, treatment by tryparsamide was not satisfactory. Relapses followed, the parasites reappeared in the blood and invasion of the central nervous system was not prevented. In the later stages, however, when there were definite indications of central nervous affection, they were much impressed by the use of tryparsamide. In the early second stage (with lymphocytes not above 70 per cubic millimeter in the spinal fluid, and albumin 0.5 gramme per litre) 86.5 per cent successful results were obtained ; in later second stage, with profound changes in the spinal fluid, but with the general condition good, 73 per cent were "successful" ; in the advanced second stage showing clinical symptoms, 53 per cent were successful, and 15.62 per cent were ameliorated. Benefit was obtained even in the terminal stages of advanced cases. It was noticed, however, that only such as showed considerable improvement from the

first series of injections continued to benefit ; in other words, if the early injections did no good, little if anything was to be gained by continuing the administration.

One or two writers have recorded comparative results of the two drugs, Bayer 205 and tryparsamide.

Thus, MACLEAN (*Tanganyika Report*, 1926), who dealt very largely with infection by *T. rhodesiense*, reports that " tryparsamide gave good results in a few cases, but more often failed, even in large doses ". The use of the two combined had to be spread over a long period (4 to 6 months), and was very irksome to the patient ; " the results were good, but hardly better than might have been expected from Bayer alone ". He found no conclusive evidence that a previous course of Bayer rendered tryparsamide more likely to produce optic atrophy. " Gambiense cases," he states, " are best treated with tryparsamide."

DYE (W. H.) (*Trans. Roy. Soc. Trop. Med. and Hyg.*, 1926) also tried both drugs. He gave Bayer 205 intravenously in doses of 1 gramme on the first, third and fifth days, then at intervals of 5 to 7 days till 6 to 7 grammes had been given. Tryparsamide was administered, also intravenously, 10 doses each of 3 grammes at 5-day to 7-day intervals. He found that the former preparation cleared the peripheral blood of trypanosomes in 24 hours, and, generally speaking, they did not reappear over a period of 2 to 6 months, but it proved useless in *rhodesiense* infections.

To a third series of cases he gave Bayer 205 first and followed this up with five weekly 3-gramme doses of tryparsamide. The results were so " spectacular " that this method is now employed by him as a routine. If the reverse was carried out, the Bayer succeeding the tryparsamide, though the parasites disappear, the patients do not improve clinically and the disease progresses to a fatal issue.

Lastly, KEEVILL (*Trans. Roy. Soc. Trop. Med. and Hyg.*, 1926) treated 50 cases of infection by *T. rhodesiense*, also in Tanganyika Territory, and found that tryparsamide failed to sterilise the peripheral blood or the cerebro-spinal fluid, and produced little immediate physical improvement ; such, however, usually followed the use of Bayer 205, both as regards the parasites and the general condition of the patient. He holds that the place of tryparsamide is in the treatment of cases which have relapsed after Bayer 205 ; or, ideally, in the subsequent treatment of all those in whom the spinal fluid fails to return to normal. As regards the question of treatment with tryparsamide consequent on that with Bayer 205, he appears to differ from DYE and agree with MACLEAN, in that he states that previous treatment with Bayer greatly increased the risk of visual disturbance and blindness, and that, if this drug has been used, tryparsamide treatment should be postponed for at least 10 weeks. In respect of immediate results Fourneau 309 was as good as Bayer 205.

A few remarks may be added on the experiences of workers with other preparations.

(1) *Acetylarsen.* — LEDENTU AND VAUCEL (*Bull. Soc. Path. Exot.*, 1927, Vol. 20, No. 6) find that the action of this drug on the trypanosomes is prompt, a dose of 0.7 gramme causing them to disappear from the peripheral circulation in 7 hours and from the glands in 8 to 24 hours. Its action is, however, transient and relapses occur in 18 to 20 days. On the parasites in the cerebro-spinal fluid its effect is uncertain and only temporary. It is well tolerated and does not cause any ocular disturbances.

(2) *Fourneau 270.* — One of the phenylarsenic acid series. LEDENTU AND DAUDE (*Ann. Inst. Pasteur*, 1926, Vol. 40, No. 10) used a 20-per-cent solution freshly prepared, and injected it subcutaneously ; the injection was painless and absorption rapid.

In the final stage of the disease, injections of 0.001 gramme per kilo caused disappearance of trypanosomes from the glands in 48 hours and the sterilisation lasted 11

days ; 0.005 gramme brought about the disappearance in 21 hours and reappearance occurred, not in the glands but in the peripheral blood, in 4 to 15 days. With a dose of twice this amount, 0.01 gramme per kilo, the glands diminished in size and trypanosomes disappeared after the 3rd day, to reappear in the blood between the 20th and 29th days.

They recommend gradually increasing doses of 1.5, 2, 2.5 and 3 grammes, working up to 5 or 6 centigrammes per kilo at weekly intervals.

In the second stage the drug exerted a profound influence on the meningeal reaction ; a single injection of 1 to 1.5 centigramme per kilo in some instances led to disappearance of trypanosomes and decrease in albumen and in the number of lymphocytes.

In the third stage only very small doses could be used. They concluded that Fournau 270 was a powerful trypanocide, that its action in the first stage of the disease was a little uncertain and that it was too early as yet for definite inferences to be drawn. In the second stage they considered its action to be superior to that of atoxyl and comparable with tryparsamide.

LEDENTU AND VAUCEL later reported that, when injected in a prolonged series, it gave very good results, as good as and perhaps even better than those with tryparsamide, and, since it can be given subcutaneously, it is in some ways preferable.

Fournau 309, regarded as possibly identical with Bayer 205, gave, in the hands of TRÉFOUEL AND VALLÉE, results similar to this in its prophylactic effects and in producing peripheral sterilisation. This last is, however, of short duration.

(3) *Moranyl* (Fournau 309 or Bayer 205), tested by oral administration by LEVADITI AND KLARENBECK (*C. R. Acad. Sci.* 1927, Vol. 184, No. 10), was found to confer protection to a rabbit against nagana for at least 39 days and in some cases for as long as 87 days. Thirty-one animals were used and there were only two failures ; these had had the drug 24 and 48 hours respectively before the inoculation.

It appears, therefore, that intestinal absorption of the drug is slow, but when once this has taken place the active principle persists for a long time. Repeated small doses proved efficient prophylactically.

No record is available as to its employment in human cases.

(4) *Tryponarsyl* has been tried by LEDENTU AND VAUCEL. They found that the results are analogous to those with tryparsamide, but that its toxicity is less.

(5) *Hoechst 2574*—a pentavalent arsenical—has been proved to be definitely trypanocidal, but the duration of sterilisation is at present undetermined and it has not yet been sufficiently tested to warrant any conclusions as to its efficacy.

(6) *Clyclosan*, another pentavalent arsenical, was tried by CHESTERMAN AND TODD ; they found it very toxic and used it for two patients only ; its trypanocidal power was of no high order.

(7) *Stovarsol* (Acetyloxyamino-phenylarsenic acid), even in large doses, 3 grammes daily for several days, proved slow in action and its effects were only transient. It was found of little if any use, therefore, in sleeping-sickness.

(8) *B.R. 68*. — In the arsenical preparations previously employed the arsenic has been bound to the benzol nucleus. In *B.R. 68* (GIEMSA (G.) AND MAYEDA (S.), *Inst. f. Schiffs- u. TROPEN-HYG., Hamburg*) the arsenic is "introduced into heterocyclic ring systems with cyclically bound nitrogen (pyridin, chinolin)". These investigators found it very effective for nagana-infected mice and, as compared with other arsenical compounds, its chemotherapeutic index was 1 : 25, while that of tryparsamide is 1 : 2, and atoxyl 1 : 1. (The "chemo-therapeutic index" is the rate between the curative dose and the maximum well-tolerated dose.)

This drug has not yet been tried for human sleeping-sickness patients, and it cannot be assumed that it will prove equally serviceable for trypanosomiasis in man; arsenophenylglycin, for example, is very active for mice, but cannot be used for man.

(g) *Antimony Compounds*. — Experiments carried out by BOCK (*Zeitschr. f. Hyg. u. Infektionskr.*, 1927, Vol. 107, No. 2) lead to the conclusion that differences in the toxicity and therapeutic activity of the antimony compounds is dependent, as with arsenicals, on the action of the oxidation and reduction processes which occur in the living organism. The method of their administration is not of negligible significance; not only is absorption to be considered, but also the biological activity of the tissue into which the drug is introduced.

(a) *Antimosan*, or Heyden 668—Contains trivalent antimony. VAN DEN BRANDEN found that injections, whether intramuscular or subcutaneous, gave but poor results and these were transient.

(b) *Stibosan*, or Heyden 471 (Sodium 3-chloro-4 acetylamino-phenyl stibinate; Cl. $(\text{CH}_3\text{CO.NH}) \text{C}_6\text{H}_3\text{.SbO(OH)ONa}$). — VAN DEN BRANDEN tried this by the intravenous route and stated that he found it effective, but its trypanocidal action was less rapid than that of tartar emetic, to which, moreover, it did not seem superior for chronic cases.

(c) *Stibenyl* (Sodium 4-acetylamino-phenyl stibinate). — Closely allied to the last by replacement of a hydrogen atom in position 3 by chlorine, the formula being $\text{CH}_3\text{CO.NH. C}_6\text{H}_4\text{.SbO (OH)ONa}$. This appears to be quite ineffective in human trypanosomiasis.

3. DIAGNOSIS.

On the question of diagnosis, there have been some further recent developments to which attention should be called.

LEDENTU AND VAUCEL, of the Pasteur Institute, Brazzaville, have studied the formol-gel reaction in cases of human trypanosomiasis. The upshot of their investigations is that, since the test may yield positive results in syphilis and other diseases as well as in trypanosomiasis, it is not of much value from a *qualitative* point of view, but that, when the *reaction rate* is taken into consideration, interesting results are obtained.

In non-treated cases of trypanosomiasis in the first stage of the disease the reaction is rapid—7 minutes. In the second stage it is slower—25 minutes in those where spinal fluid contains trypanosomes; 2 hours in those where spinal fluid shows changes but no trypanosomes.

They find that the effect of treatment is to retard the reaction in a vast majority of cases and sometimes even to make it negative, but nevertheless the test has no prognostic significance.

The same authors (*Bull. Soc. Path. Exot.*, Vol. 20, No. 8, pp. 737-741) in reviewing the question of diagnosis, state that the only certain criterion is the discovery of the trypanosome, but this is frequently difficult. Other tests of value are the auto-agglutination of red corpuscles and the formol-gel reaction. They tested these last two in two series of cases: first, of untreated trypanosomiasis, and secondly of patients apparently healthy, but exhibiting enlargement of glands. They concluded that, in all cases of sleeping-sickness in which trypanosomes are found, the auto-agglutination and the formol-gel tests were positive and parallel, that is, when auto-agglutination is marked, the formol-gel reaction is rapid, and vice versa. Absence of auto-agglutination coincided with a negative formol-gel reaction and thus excluded trypanosomiasis. In cases

where trypanosomes had not been found (and therefore the diagnosis was uncertain), a rapid formol-gel reaction was much less frequent than a positive auto-agglutination; they inferred therefrom that the formol-gel test is of the greater diagnostic value. (Such an inference is, of course, not warranted until confirmation is obtained in the cases in which the formol-gel test is negative but auto-agglutination positive.)

Lastly, the "adhesion phenomenon" described by DAVIS AND BROWN (*Trans. Roy. Soc. Trop. Med. and Hyg.*, 1927, Vol. 21, No. 2, pp. 113-124) is one which has a wide scope in application. The substance in the serum, whatever it may be (the authors suggest it may be "opsonin-like"), is thermostable, withstanding a temperature of 65°C. for 2 hours. They have tested the reaction in a considerable number of infections and have found it to be absolutely specific with the sera of animals immunised against leptospiral infection and also against *T. equiperdum*, *T. lewisi*, *T. evansi*, *T. rhodesiense*. The test, therefore, is one of wide applicability, and may prove very serviceable in the diagnosis of trypanosome infections.

4. MISCELLANEOUS.

There remain one or two items recorded recently by individual workers on the subject of trypanosomiasis which could not find a fitting place in the foregoing pages, but to which attention should be directed as they may open up avenues for future investigation.

(a) *Congenital Infection.*

In connection with the case recorded by KELLERSBERGER (*Trans. Roy. Soc. Trop. Med. and Hyg.*, Vol. 19, No. 1/2; *Trop. Diseases Bull.*, Vol. 23, p. 51) of a child 3 weeks old, ill with rise of temperature and enlargement of spleen and in whom numerous trypanosomes were found in blood films, the following by NAMIKAWA (in the *Journal of the Medical Association*, Formosa) may be mentioned. He inoculated three pregnant mice with a strain of *T. gambiense* which had been maintained in mice. Three days later the animals were killed and the uterus, placenta, and embryos were examined in smears and in sections for trypanosomes. They were found to be present in all, and the author concludes that congenital infection can take place.

(b) *The Mechanism of the Crisis in the Trypanosome-infected Guinea-pig*

As the result of experimental work, MUTERMILCH AND SALOMON (Pasteur Institute, Paris) (*C.R. Soc. Biol.* 1928, Vol. 98, No. 5), showed that, after a septicæmia lasting 4 to 6 days, specific antibodies secreted by the hæmopoietic organs appear suddenly in the general circulation. The amount is at first very small, but suffices to destroy the most sensitive parasites. The fresh quantities of lytic antibody which continue to be poured into the circulation destroy progressively those parasites of graded resistance till in the end only those naturally resistant survive. These later multiply and give rise to the relapses.

The internal organs do *not* serve as a place of refuge for the trypanosomes, nor do there appear to exist filtrable forms as MANAGLIA and others have postulated (original paper abstracted by Professor Warrington Yorke, *Trop. Diseases Bull.*, Vol. 25, No. 5, p. 352).

II. SUMMARY OF THE CONDITION OF SLEEPING-SICKNESS QUESTIONS IN VARIOUS BRITISH COLONIES AND PROTECTORATES IN 1925 AND THE PROGRESS MADE IN THAT AND THE FOLLOWING YEARS.

I. UGANDA.

In the annual report of Uganda, 1925, it was stated that the policy of extirpation of the tsetse-fly on Lake Victoria had been attempted, but "the carrying of it into effect is fraught with great difficulties". No further active measures of reclamation were undertaken, as those parts previously reclaimed had not been consolidated.

Dr. G. W. Hale CARPENTER, the Senior Medical Officer (later designated Specialist Officer) in charge of sleeping-sickness, sent in a detailed report of the position in each infected area so far as he was able to do from personal visits. He acknowledged that the information was of necessity meagre, owing to shortage of staff and his consequent inability to inspect many of the districts. It was shown that there was probably a more or less continuous belt of infection through the southern part of Budama district and extending as far northwards as the Namabala branch of the Mpologoma swamp.

Another problem to be dealt with was the Bwamba area, where it joins the Belgian Congo, since it was practically certain that there were many cases of the disease lying hidden there. In the west Madi district there were more deaths at Moyo than in any other locality, and he considered that this state of affairs was likely to continue until the central river Ebikwa had been cleared.

The prophylactic value of injections of tryparsamide for members of any prospective hunting party was stressed because sterilisation of the blood was found to persist for a considerable period so that mechanical transmission from one individual to another and also the cyclical infection of the fly would be obviated.

An account is also given in the 1925 report of a statistical enquiry into the records of fishing permits on Lake Victoria. For this purpose the lake was divided into four "blocks", a fisherman being licensed for one block only, in order that infection, should it occur, might be limited.

In the following year, the Specialist Officer reported that the medical staff was still inadequate and that, in consequence, progress had not been as great as it might have been. He states :

"There is still great need for an increased administrative staff, and satisfactory examination of population will never be possible until every man, woman and child in areas where the disease exists is registered and under supervision, which is at present impossible."

The conditions in parts of Uganda have already been mentioned in some detail in the account given above of the report of the Sleeping-Sickness Commission, whose headquarters were at Entebbe.

Dr. CARPENTER found, as a result of his investigations in the Victoria Nyanza infected area, that encroachment in a large scale had taken place, uncleared watering

and landing places were in use and plantations were being opened up in the forest belt on the coast. A notice was inserted in the *Gazette* that occupation of such parts was not allowed and would be made punishable. Re-examination of fishermen, mentioned in the previous year's report, showed that, except in the Nyanji area, none had been found infected.

Infection had, however, been introduced on the Kyadondo coast near Kampala. Another centre from which infection might spread was Jinja, where there were extensive encroachments.

Considerable correspondence took place with the Belgian Government concerning the movements of natives in the Katwe area and the conditions under which the salt traffic was carried on. Administrative measures were planned by which it was hoped that the risk would be materially reduced. These measures included enlargement of the proclaimed areas, increasing clearings on the rivers, and posting an inspector on the frontier at the crossing over the Lubilia river, whose duty it would be to examine persons entering the Congo and to issue permits without which salt could not be purchased.

2. TANGANYIKA TERRITORY.

Certain measures of a general character were proposed for adoption in 1925, of which the chief were: segregation and treatment of cases; removal of natives from area heavily infested with glossinæ and settlement of them in open fly-free or cleared country; the clearing of bush and scrub along lines of communication, and extension of agriculture. The hope was expressed that these would result in a "definite change for the better being evident within the next two years".

Increase in personnel, six medical officers being exclusively employed on sleeping-sickness work, made it possible to extend investigations into the incidence of human trypanosomiasis throughout the Territory. It was estimated that approximately 15,000 square miles of country were infected. It was found also that the disease was endemic in villages widely separated, though only a small proportion of the inhabitants were attacked. The endemicity, however, took on an epidemic character when shortage of food necessitated more frequent prolonged excursions into the forest for hunting, fishing, etc., the individual vitality being at the same time lowered by the conditions of partial starvation.

Treatment by Bayer 205 proved very effective in early cases, but tryparsamide was more satisfactory for those in advanced stages in whom the nervous system was clearly involved.

During the succeeding year investigations failed to discover any new foci, and efforts were chiefly concentrated on the infected parts of the Tabora and Ufipa districts. These comprise some 10,000 square miles (see p. 37). The policy adopted was to concentrate the population in fly-free clearings while maintaining their tribal organisation. During 1926, seven clearings, extending over a total area of more than 60 square miles, were completed and two others were in progress. On the completion of these, another 4,000 square miles of fly-forest will be evacuated. To prevent the population straying back and to keep them contented, they are given facilities for cultivating their own crops.

Some of the points referred to merit a little more detail. As regards the symptomatology of the disease, the incubation in a European case was shown to be not longer than 27 days and possibly as short as 18 days; the parasite was *T. rhodesiense* and the vector *G. swynnertoni*. Secondly, as regards reservoirs of the virus, Dr. MACLEAN stated that there was no evidence of any vertebrate host of the parasite other than man, in Liwale and Northern Ufipa at least.

The policy for prevention which is followed may be summed up in the three measures :

(a) Sterilisation of the peripheral blood of infected persons by drug treatment. This is a point needing careful observation, seeing that after apparent cure the parasite may again invade the blood before any clinical signs of relapse arise.

(b) Reduction of contact between man and fly, by establishing settlements on the edge of the forest. It is, however, a difficult task to control or reduce, and still harder to prevent, excursions into the forest for hunting, for fishing in parties and living in temporary camps, taking stock into the forest for grazing, and so on. To induce the natives to settle and cultivate the cleared areas, seeds are distributed to them free, and beehives are being introduced, while some of the more important fishing sites and the paths leading to them have been cleared.

(c) Control of the movements by the issue of permits. This, though excellent in theory, is found difficult in practice.

The following records briefly the conditions prevailing in the respective areas :

I. *Maswa-Ikoma.*

Infection here, first discovered to be extensive in 1922, is mainly by *T. rhodesiense* and the chief vector *G. swynnertoni*. After evacuation of forest villages, measures were largely confined to treating accessible cases and maintaining bush-clearings along the main roads. In 1926, the banks of a section of the Simiyu river and the paths leading to some of the main fishing places on this river and on the Duma were cleared. Other measures, projected or in process, were supervision of the clearings north of the Duma and a survey of the banks to ascertain whether agriculture could be carried on after clearing ; lastly, a survey of the fishing places in the Duma and Simiyu to determine the degree and extent of contact between man and tsetse during the fishing.

II. *Tanganyika Lake Shore Area.*

More than 3,000 cases were under observation on the German side of the lake in 1912-13, but the first cases since the British administration took charge were found in 1924.

Infection is mainly with *T. gambiense* and the vector *G. fuscipes*, though belts of *G. morsitans* actually reach the lake shore. One great source of danger appears to be the possibility of fishermen conveying the disease from one part of the coast to another. Clearing of the whole lake shore is under consideration, but the question of the practicability of this has not yet been decided.

Persons proceeding to and from the Belgian Congo have to present themselves for examination at the hospital. Any found infected after examination of the blood and gland-juice are detained, and all crews and passengers crossing from the Belgian Congo are examined on their arrival at Kigoma.

III. *Ufika-Tabora Area.*

Sleeping-sickness has existed here probably since 1921, though not definitely recognised till three years later. In the following year (1925), it was known to extend over an area of at least 10,000 square miles, and many villages had been abandoned on account of its ravages.

The type of trypanosome is *T. rhodesiense* and the only species of glossina found is *G. morsitans*.

Control of natives was found necessary and six large clearings were made in 1925, and the population from some 5,000 square miles removed thither. In 1926, these were enlarged and another 2,500 square miles evacuated; further extension is to be undertaken.

Incidence of disease in the cleared settlements showed a considerable fall in 1926, but there had been definite extension elsewhere, not as fresh outbreaks, but insidiously.

IV. *The Liwale Area.*

Cases were reported here in 1924 and a survey was made the following year. The type is *T. rhodesiense* and the vector almost exclusively *G. morsitans*. It is believed that some of the villages most heavily infested with fly have for a considerable time constituted endemic centres, whence the disease has been spread by movements of the inhabitants.

As regards preventive measures, reliance has been placed largely in sterilisation of the peripheral blood by Bayer 205, on evacuation of the more heavily infested villages in the endemic area and building new ones in more favourable sites, together with gradually increasing areas of bush-clearing until the fly disappears from the vicinity of those villages which are not evacuated.

Mr. C. F. M. SWYNNERTON, in his report on tsetse work in Tanganyika Territory during 1927, gives a summary of the points which may be regarded as proved from his undertakings and also enumerates those questions which he next proposes to take in hand. The former are of special interest in view of the opinions of those carrying on similar work in Nigeria.

Mr. SWYNNERTON, in speaking of grass fires, states that the firing can be delayed and that this firing destroys certain types of thicket, drives the fly before it and kills a proportion (larger or smaller) of the pupæ. He found also that the fires will drive out *G. swynnertoni*, except, of course, from swamp-land, which cannot be properly fired. Other glossinæ, as *morsitans* and *tachinoides* (in Nigeria), would react similarly.

Where thickets are very serried, or of the evergreen type, fires cannot be relied on for clearing, though repeated firing will greatly reduce the number of flies. To get any rapid result, clearing of residual thicket is necessary. Thicket destruction is being attempted with machinery, rollers and chemicals. The first trials with a tractor and rollers are said to be promising, but hand labour may prove best.

In places where there is too little grass to burn and too many thickets to clear, agricultural settlement is among the measures suggested.

Fly concentration may be reduced either by direct attack, or indirectly by exclusion of game animals as tried in Nigeria, and by clearing the land and establishing settlements.

As regards the formation of barriers, except for joining up of open spaces already existing, the clearing of barriers is impracticable from the points of view of both labour and expense. The important discovery has, however, been made that very dense forest constitutes a natural barrier to *G. morsitans*, and it is proposed that such should be reproduced in conjunction with a "live-pole" palisade to keep back the game. *Euphorbia tirucalli* is one plant which rapidly forms a dense thicket, but others are also to be tested.

Again, it has been found in Tanganyika that where a bush area from which the fly has been cleared is bounded by a broad strip—a "buffer-strip"—in which the

density of the fly has been reduced, by fire for instance, the freed area does not easily become re-infested. If the area is bounded by a strip in which fly is plentiful, re-invasion is rapid.

Briefly stated, the objects of investigation to be undertaken are :

(i) The best means of direct attack on the concentrated fly areas other than hand-catching, such as spraying, dipping of cattle, etc.

(ii) The cheapest, most labour-saving and most permanent methods of clearing.

(iii) More accurate determination as to the range of conditions under which each fly can make good and persist. When it can be stated definitely that certain areas will not be invaded or that infestation will for a certainty ultimately disappear, much time, labour and cost of unnecessary campaigns may be saved.

(iv) Planting of thickets as barriers against game on the one hand and fly on the other. Trained forest officers will pay special attention to these questions and to the closely associated one of natural or artificial barriers in controlling movements of the fly.

(v) Watching the progress of reclamation measures as regards the effects on the fly density, sex proportion, breeding generally and parasitisation, nature of food, and so on.

3. KENYA COLONY AND PROTECTORATE.

In 1925, the arrival of an entomologist, Dr. C. B. SYMES, enabled the campaign against trypanosomiasis in the South Kavirondo to be started, and, from information obtained, a policy was formulated with the following recommendations :

(i) One aim in view was to be the total extermination of the tsetse-fly by clearing of fly-infested bush.

(ii) Immediate provision of safe watering-places for those living in infested areas, where total clearing could not as yet be carried out.

(iii) Priority of bush-clearing was to be guided by two factors : (a) the degree of contact between the population and the fly and (b) the area which could be kept clear.

(iv) To obtain this information, it was necessary to draw up a fly survey and a population survey.

(v) Infected individuals were to be treated.

(vi) Movement of the people was to be under control, to prevent migration of the infected and to restrict traffic to safe routes.

Tsetse-fly surveys were carried out in three districts. *G. palpalis* was the vector incriminated in all. A special Sleeping-Sickness officer was appointed to take charge of the area and bush-clearing operations were started ; the lower reaches of the Miriu were cleared, and an area of $1\frac{1}{2}$ square miles made available for cultivation. Local natives were invited to settle and cultivate this area.

The main hospital at Kisii being difficult of access, a site for a new hospital for investigation and treatment of cases was chosen at Homa Point ; building was begun in December.

A meeting of administrative and other officers from Uganda and Kenya took place at Mjanji to discuss problems as they affect the districts adjoining the Kenya-Uganda border.

The investigations of the entomologist demonstrated that in South Kavirondo the infested area consisted of a stretch of river bush, where the breeding of *G. palpalis* was very light, but contact with human beings broad, and a higher hilly portion of very dense bush providing the main breeding grounds, on which human contact was narrow. By means of clearing, the fly was confined to the hilly portion, so that no fly was present over a mile stretch of river previously dangerously infested, while fords, watering-places and traffic routes were rendered safe. It is essential that any work of clearing to be of use must be made permanent by occupation and development. The general plan, where an area is mapped out for fly-elimination, is to aim first at the immediate safety of the population and secondly the destruction of the breeding centres of the fly.

The following is an extract from a summary given in the report for the year :

“ Considerable advances have been made in our knowledge of the distribution of trypanosomiasis and of the tsetse-fly in Kenya and . . . the problem presented in Kenya is one much easier of solution than in the adjoining territories. The complete elimination of the fly is a matter of practical politics. Successful bush-clearing depends upon extensive investigations of each individual fly-belt. ”

In the following year investigations at Kavirondo were mainly carried out by Professor KLEINE, a member of the Sleeping-Sickness Commission.

Early in 1926, bush-clearing operations were taken in hand along the shore at Homa Point and extended to an area on the Oloach river. This work, however, unfortunately could not be continued as the medical officer in charge could not spare the time to supervise it.

The experimental clearing of the Miriu river banks and settlement of the cleared land were not followed up, and natural reversion to heavy scrub resulted. Tsetse-flies were numerous and bit freely ; no outbreak, however, took place owing to the fact, as Professor KLEINE determined, that there was no infection to be conveyed.

Precipitin tests were carried out with a view to determining the nature of the food of the glossinæ and 24.6 per cent of the first batch of 154 were found to give a positive for human blood.

Dr. J. ENZER carried out a survey of the shore-dwellers of the Victoria Nyanza between July 1926 and November 1927, in the course of which he examined approximately 92 per cent of the population. The disease was found to be confined to Central and Southern Kavirondo. The most highly infested locality in the former was Uyoma, where 113 cases, mostly recent infections, were found and 100 deaths were said to occur there annually from the disease.

Kaniakela, a subdivision of the Kaniadoto locality, was the worst in Southern Kavirondo, 109 cases being found among 845 persons examined (12.89 per cent) ; moreover, this was evidently a dangerous focus, as Dr. ENZER states that nearly all the other cases in Southern Kavirondo had contracted their infection here.

As regards his recommendations for prophylaxis, the recognised methods—clearing of bush, cutting waterways, evacuation of infested areas—are not generally applicable or practicable, because the disease is very scattered and it would mean clearing the whole coast-line from Uganda to the Tanganyika border ; the percentage infection being so small, such measures would entail great waste of both time and money. Exceptions to this general statement are : Seme, in Central Kavirondo, where bush-clearing would be effectual ; Uyoma, where cutting of waterways would

materially lessen the chances of infection ; and Kaniadoto, in Southern Kavirondo, where evacuation of the area would suffice to stamp out the disease.

Dr. ENZER concludes by stating that " sleeping-sickness in Kenya does not merit the full work of a medical officer. Two or three months in every eighteen would be ample to devote to this disease." He suggests that a rapid census of the infected locality should be carried out at these intervals, while the treatment of the few cases could be performed by a trained dresser. Such a measure would diminish the risk of infection by eliminating human carriers of the trypanosome and prevent recurrence of epidemics by giving timely warning.

4. NIGERIA.

A conference was held at Kaduna, in September 1925, to consider means of dealing with trypanosomiasis ; problems were discussed and co-operation by heads of departments and local residents was promised. At that time, clearings were being made in Gerbi valley and the medical officer was pursuing his investigations in the Jemaa valley.

Experimental field work in three main directions was undertaken :

I. *Fencing of a Tsetse Focus to exclude Game.*

The object of this was to test the question of the advisability of game destruction in connection with control of *G. morsitans*—a much-debated subject for some time. It was thought that removal, by exclusion, of game-animals might show itself in : (a) reduction in the number of flies ; (b) alteration in quantity or type of blood taken, or a state of fly-malnutrition ; (c) changes in the female percentages in the catch of *G. morsitans*, an increase indicating hunger.

G. tachinoides appeared to be but little affected thereby ; there was no evidence of their malnutrition, the number imbibing reptilian blood remained about the same. Though there was an increase, in fact a doubling, of human-blood imbibition (from 1.3 to 2.8 per cent), the total percentage was small.

G. morsitans showed considerable differences : the numbers were much reduced, the daily catch being half that in the control areas ; many of those caught were badly nourished, human blood was more often found in the gut-contents ; the female percentage was considerably raised.

It would appear that *G. morsitans* could be rapidly reduced by starvation through exclusion of game, but since *G. tachinoides* or *G. palpalis*, which are always present, showed no reduction, game destruction would not help much in solving the larger problem.

II. *Controlled Grass-burning.*

The results of this projected measure were not very satisfactory ; the orders proved almost impossible to enforce. Moreover, such areas where the burning was delayed served as sanctuary for game, and tsetses were found very well fed up to the time of the burning.

III. *Large Clearings.*

By means of large clearings, it was attempted to make a wide fly-belt to link up important cattle areas by a safe road. The prospects of settlement in the cleared areas was good, the land being excellent for farming.

Further measures of control by treatment of cases were also undertaken; trypanamide gave better results in advanced cases than Bayer 205. This point has already been sufficiently detailed.

Touring through the districts and looking for cases is a necessity, and bases ought to be established for this purpose. By this means, patients who improved after a few injections could be kept under observation and control, whereas, under the prevailing conditions, they were liable to return to their homes, improved but not cured, and therefore not only liable to relapse and thereby bring discredit on the treatment, but dangerous to others as constituting foci for further infection.

There is no doubt that in the absence of the tsetse there would be no limit to expansion of the cattle industry in Nigeria. There are horses, sheep, pigs, cattle and goats present in large numbers in Southern Nigeria, but they are of extraordinarily small size. They appear, however, to thrive in these fly-infested areas and trypanosomes are said to be present in their blood.

Important questions arise from these facts, scientific and economic. Such, for example, as: (a) whether cattle are immune (non-infectible) or resistant and tolerant; (b) whether the resistance is transmissible or merely due to repeated exposure; (c) if it is inherited, could it be passed on to other breeds?

Dr. Buchanan SMITH has sketched an outline of research which he proposes, in order to decide some of these questions, by cross-breeding and other means. As he states:

“ If the resistance is inherited in a *dominant* manner, the economic application will be comparatively easy. If, on the other hand, it is inherited in a *recessive* manner, the economic application will be considerably retarded, as the native cannot be expected to understand results which are delayed by a full generation.”

It is suggested that the work should be done at Sherifuri.

In place, however, of embarking upon research work along genetic lines, sanction has been obtained for Dr. JOHNSON at Sherifuri: (a) to test immunity by serological means; and (b) to infect dwarf cattle with *G. morsitans* and compare their resistance with that of the northern cattle. For this work, a veterinary research officer is to be seconded from the Veterinary Department.

In the report of the following year is given an interesting account in more detail of the results of the measures proposed in 1925.

The effect of exclusion of game by fencing-in a tsetse-focus has been mentioned, and more prolonged trial merely confirmed those findings, namely, that the effect was not equal in the cases of *G. morsitans* and *G. tachinoides*; the former were reduced to a greater degree, because the latter feed also on reptiles, which cannot be excluded. Since, however, one or other of the riverine species is always to be found, and these are dangerous to man on account of their establishing colonies at watering-places when short of other food, game destruction is inadvisable.

Delay of grass-burning yielded disappointing results when compared with those of SWYNNERTON. The difference is attributed to the fact that the thicket of Northern Nigeria is much more massive, while the uneven nature of the grass is also a contributory factor, because large patches of short grass interdigitate with the longer growth and burn off like fluff, and on the arid ground are numerous tamarind-trees which are only just scorched by the fire and in the shade of these the fly is unharmed. Even where large numbers of adults and pupæ were destroyed, an increase soon followed from fresh immigration.

As regards the clearings: the fringing bush of foci in which the flies breed was cleared, not the general forest, and every inducement offered to the natives to settle

and occupy the land to prevent its reversion. The distribution of tsetse is found to change as an area becomes settled and townships form, as clearing of land and increase of traffic drive away the game.

5. NYASALAND.

During 1925, attempts were made to control *G. morsitans* by the agency of a parasite, *Syntomosphyrum glossinae*, attacking the puparia, but those were unsuccessful, because, after a certain reduction, nature seemed to restore the balance again.

Dipping of animals in a solution of arsenic containing 0.08 per cent of arsenious acid to protect against tsetses and other biting insects proved quite ineffectual.

Next, a scheme along SWYNNERTON'S lines was proposed, consisting of four points: (a) clearing of a wide strip of country across the line of advance of the fly; (b) intensive native settlement along the strip so cleared; (c) agricultural development of the land and its gradual extension; (d) organised bush-firing in the late dry season.

In the report for the following year, Dr. W. A. LAMBORN notes, as regards the scheme for tsetse control which was started in the Dowa and Fort Manning districts, the strange fact of occasional restriction of *G. morsitans* to certain areas in spite of the apparent similarity of woodland, of geological formation, of fauna and of water supply. He formulates the hypothesis that the male has certain feeding habits, possibly the ingestion of sap or other natural juices of a plant growing in particular localities, which thus become tsetse foci. This is purely hypothetical and he has been unable to find confirmation of it. The factors concerned in expansion of other areas are another undetermined question. It is not due to migration of game, because it occurs in parts where game is scarce, even absent. It may perhaps result from dispersal in search of prey owing to the elimination of game.

Another point of importance upon which Dr. LAMBORN lays stress is that "certain outbreaks of animal trypanosomiasis seem to be explicable only on the hypothesis that there must be other indirect carriers of the infection than glossina." He therefore tested the problem of direct transmission of trypanosomes of the *brucei* type by the agency of ornithodoros, cimex, larva of auchmeromyia, and indirect transmission with the two first-named; also all the possible vectors for indirect transmission of *T. pecorum* and the larva of auchmeromyia for indirect transmission of *T. vivax*. The results, however, were negative in all. *Rhipicephalus appendiculatus* also proved negative, as did also certain midges, in particular *Ceratopogon*.

He found that a goat could be rapidly infected with trypanosomes from the ox; the animal became very ill, its blood contained the trypanosomes in large numbers, there was marked leucocytosis; when the goat was apparently almost at the point of death, gradual recovery set in and it became a carrier. It is thought that these animals may be responsible for outbreaks of trypanosomiasis in Nyasaland which are often difficult of explanation.

Tsetse control was taken in hand on lines based on those of SWYNNERTON in Tanganyika, that is, intensive settlement at the outskirts of the fly area and rapid deforestation to a depth of about 1,000 yards in the direction of the fly-infected country and over a length of some eight miles.

Villages were moved to these clearings and huts built having a uniform diameter of 12 feet, and the huts were erected at 50-yard intervals and in three rows 50 yards apart, the individual buildings alternating in the rows. There was no opposition on the part of the natives; on the contrary, they clamoured for plots.

The effects were stated to be a general withdrawal of the larger game-animals, followed by a diminution in the numbers of the fly; but it was acknowledged that the

time had been too short to warrant any definite pronouncement as to the chances of final success.

Later reports were to the effect that the scheme had not proved so satisfactory as had been expected and, in fact, it was about to be abandoned.

Dr. LAMBORN made a detailed survey in February 1928 of the districts concerned, and his report, a very detailed one, was to the effect that conditions were not so serious as had been reported. The possibility of work being undertaken along the Likinie river is now to be examined (telegram from the Governor of Nyasaland, June 28th, 1928).

6. GOLD COAST.

Investigations carried out in this colony showed that the north-western side was, in 1925, undoubtedly the home of several species of tsetse—*G. palpalis*, *G. longipalpis*, *G. pallicera*, *G. fusca* and *G. nigrofusca*. The intensity of prevalence of the fly was found to vary greatly throughout the year and appeared to depend, in part at least, on the rise and fall of the Volta. They were found also to be moderately highly infected with *T. congolense* and *T. vivax*, but infection with human trypanosomes was rare.

Three well-marked fly-belts were observed: one in dense forest with swampy ground, 18 to 30 miles from Sumbi. The chief species here was *G. longipalpis*, and less commonly *G. fusca* and *G. palpalis*. The second belt was the densely vegetated lower slopes of the Kpeve pass, with *G. palpalis* and *G. longipalpis*. The third was the savannah with localised dense bush on the Ho-Kpeve road; the same two species prevailed here.

During the following year, further research was carried out, with special reference to the infection of cattle with trypanosomes and the bionomics of the glossinæ found. It was demonstrated that actual infection of cattle decreased from 16 to 4 per cent in the dry season.

In 1925, 37 cases of human trypanosomiasis occurred, with 5 deaths; in 1926, there were 67, with 11 deaths. The larger number is ascribed to the natives presenting themselves for treatment and not to actual increase in prevalence of the disease.

Preventive measures included the clearing of bush round villages, water supplies and fords, the removal of certain varieties of palm-trees from the vicinity of houses and the thorough treatment of patients.

SLEEPING-SICKNESS IN THE SUDAN.

BRIEF SUMMARY OF THE EPIDEMICS AND OF THE MEASURES ADOPTED BY THE SUDAN GOVERNMENT TO COMBAT THE DISEASE.

THE SLEEPING-SICKNESS AREA OF THE SUDAN.

The *palpalis* area of the Sudan lies along the southern frontier from the junction of Bahr-el-Ghazal province with Darfur about latitude 9° 30' N. to a point in Mongalla province east of the Nile on the Uganda frontier about latitude 4° 30' N. This belt of country is a thousand miles long and *palpalis* is found along its whole length, but at no greater distance than two hundred miles north of the frontier.

THE HISTORY OF SLEEPING-SICKNESS IN THE SUDAN.

The first steps to meet the sleeping-sickness menace were taken by the Sudan Government in 1905, when a Commission was formed to investigate the steps necessary to meet the spread of the disease northward from Uganda and from French Equatorial Africa. For the next four years (1906-1910), medical officers toured the southern part of the Sudan, mapping out fly belts and establishing inspection posts on the trade routes from adjoining countries.

THE FIRST CASES.

In 1909, the chief danger seemed to lie in western Bahr-el-Ghazal, and quarantine stations were already established before the first two cases were detected among some immigrants from French Equatorial Africa. Regulations were drawn up making it legal to examine any native and to detain suspects, and although in the following seventeen years sixty-eight cases were discovered among natives entering western Bahr-el-Ghazal, no infection of the local fly was ever detected and the west has always remained free from infection.

In 1910, the Sudan Government took over from Belgium the Lado enclave, now part of Mongalla province. This district was known to be infected with sleeping-sickness, and a medical staff, consisting of three Syrian and two British medical officers, was detailed to combat the disease and to take steps to prevent its extension.

A segregation camp was formed at Yei, which was made fly-free by clearing the banks of the river of all vegetation except high trees. By September 1911, 208 cases had been found in the course of tours of inspection and were segregated in the camp. In 1912, 140 cases were found in the Yei district, and, in 1913, 139, but in 1914 the admissions fell to twenty-four and ten years later (in 1924) no new cases could be discovered and the district remained free from infection thereafter. Of the 547 cases admitted up to September 1913, 398 were still living in camp on that date. The remainder had mostly died and a few had deserted.

In 1914, the adjoining district of Kajo-Kaji was found to be infected, but owing to the war there was a shortage of medical staff and the disease spread east of the Nile. This outbreak, although numerically little different from the Yei outbreak, was not eradicated until 1924, although it had been brought under control as early as 1916.

THE SOUTHERN BAHR-EL-GHAZAL EPIDEMIC.

Early in 1917, a medical officer, touring the southern district of Bahr-el-Ghazal, found it to be quite free from sleeping-sickness. In 1917 and 1918, there was a considerable immigration of natives from French Equatorial Africa to the Sudan, and in 1917 an expedition was sent to French Equatorial Africa from the Sudan to cooperate with the French in quelling a rising. The local Sudan soldiery, after the rising was suppressed, were dismissed to their homes, and there is no doubt that they contributed to the beginning of the epidemic, but not so much as the French immigrants. The first cases in this district were found in March 1918. Between March and September 1918 one Syrian medical officer had detected 255 cases, 195 of whom were found to have emigrated from, or to have recently returned from, French Equatorial Africa. Partly owing to the shortage of medical staff due to the aftermath of the war, and partly owing to incomplete understanding by the administrative authorities of the requirements of the situation, the southern Bahr-el-Ghazal epidemic was not brought under control for five years. The following table shows the number of new cases detected in this district and the medical staff then available :

Dates	Numbers of cases detected	Medical Staff
1918	255	One Syrian medical officer unable to leave the station.
1919	621	One British and one Syrian medical officer touring the district alternately.
1920	192	One Syrian medical officer unable to leave the station.
1921	656	One British and one Syrian medical officer touring the district alternately.
1922	434	One British and one Syrian medical officer touring the district alternately.
1923	839	One British and six Syrian medical officers touring and concentrating natives into villages.
1924	276	One British and four Syrian medical officers ; concentration into villages completed.
1925	203	One British and four Syrian medical officers ; some villages remaining infected had to be moved.
1926	79	One British and three Syrian medical officers.
1927	33	
1928 (to June)	8	

It will be seen from these figures that, with a scattered population living near infected watering-places, the efforts of an inadequate medical staff were unsuccessful in preventing the spread of sleeping-sickness, and the epidemic had assumed menacing proportions. In the fifth year, a more serious attempt was made to gain control of the outbreak. The district was brought under the jurisdiction of a

separate District Commissioner, a larger medical staff was provided, and the population was concentrated into villages round cleared watering-places. The natives ceased to hide the sick, the admissions rose to 839, following by a spectacular fall to eight after five years.

This result has been achieved by three means :

1. The detection of cases by frequent inspection (early cases are found by gland puncture) ;
2. Segregation of the infected ;
3. Concentration of the population to allow :
 - (a) Frequent inspection.
 - (b) Cleared drinking-places.

SEGREGATION OF THE INFECTED.

In the Yei epidemic, natives infected with sleeping-sickness were placed in a concentration camp, occupying a few hundred acres, with communal cultivations. This camp could not be made self-supporting for many years, and the expense and trouble of feeding a large number of patients, such as there were in the Bahr-el-Ghazal epidemic, made such a system impossible to maintain.

Accordingly, the infected natives of Bahr-el-Ghazal were removed to a segregation settlement at Source Yubo, occupying some twenty square miles, and accommodating at one time two thousand sleeping-sickness cases, and some three thousand relatives living with them. About ten miles of stream had to be cleared of undergrowth and maintained in a fly-free condition, and hired labour was used for this purpose. In other respects the settlement became self-supporting in two years, and to a great extent had become so within a year of its foundation. The people live their normal lives, each family having its own land to cultivate. Half-a-day a week the people worked for the Government on stream clearing or on a communal cultivation, which was required to feed the new admissions. By planting manioc extensively, a large food reserve was built up with little trouble. The only ration issued at Government expense from April 1922 to the present date has been a weekly ration of salt.

CONCENTRATION OF THE POPULATION.

Up to 1923, the people lived in isolation in the forest, each household having its own watering-place. Infection was found in the greater part of the Tembura district, some ten thousand square miles in extent. The concentration into villages presented fewer difficulties than had been anticipated. In 1923 and 1924, the people were ordered through their chiefs to move on to existing roads, or on to roads out for the purpose of accommodating them. Watering-places were selected, and the chiefs ordered to have them cleared. To facilitate maintenance, the clearings have been planted with couch-grass, which inhibits to a great extent the growth of other vegetation and which does not harbour fly.

For two years, wherever infection was found to continue on roads running parallel and near to streams, adjustments in the direction of roads had to be made. It became easy to detect the source of infection and after two years no further alterations were found necessary. The people live happily along the roads on both sides, and draw their water from chosen and cleared watering-places. Where the road crosses a stream, the latter is kept clear of vegetation for a distance of sixty yards on each side of the road.

As a preventive measure, adjoining districts of the Sudan have been similarly treated, and few difficulties have been encountered in changing the habit of life of the natives.

By means such as these, an epidemic of sleeping-sickness, which, at one time, had assumed alarming proportions, has, in the space of five years, been stamped out, and it may be said with confidence that the Sudan is now free from the disease, except for sporadic cases traceable to infection from outside.

(Signed) G. H. MAURICE,
Major, R.A.M.C.,
P.M.O. Sudan Defence Force.

October 3rd, 1928.

REPORT SUBMITTED BY THE INSPECTOR-GENERAL'S OFFICE
OF THE PUBLIC HEALTH SERVICE OF THE MINISTRY OF THE
COLONIES OF THE FRENCH REPUBLIC:
CAMPAIGN AGAINST SLEEPING-SICKNESS IN FRENCH
COLONIES AND MANDATED TERRITORIES (TOGOLAND
AND THE CAMEROONS)

INTRODUCTION.

The campaign against sleeping-sickness in French colonies and mandated territories (Togoland and the Cameroons) has been intensified since the First International Conference on Sleeping-Sickness held in London in May 1925.

Although this disease occurs in the majority of the colonies in the West African group, it is only found in an endemic form in a very few districts and shows no signs of spreading; indeed, but for the systematic supervision of the small centres in which it occurs, it might escape notice altogether.

But in the greater part of French Equatorial Africa, along the Shari river as far as Fort Lamy, human trypanosomiasis is very prevalent, not only as an endemic, but from time to time as an epidemic, of varying degrees of severity.

The same applies to the Cameroons, where the basins of the Upper Nyong and the Doumé are infected to a serious extent.

In 1927, a centre of infection was discovered in Upper Togoland, small in extent, but presenting alarming features.

This paper is intended to outline in brief the measures adopted by France for combating the disease in the territories under her authority.

I. ADMINISTRATIVE MEASURES.

I. SPECIAL APPROPRIATIONS TO COMBAT SLEEPING-SICKNESS.

	1925 Francs	1926 Francs	1927 Francs
Equatorial Africa . . .	1,040,000	1,287,000	4,000,000
Cameroons	577,372	1,500,000	3,574,628

In Togoland, these expenses are provided for in the general budget for native medical relief; there are no special appropriations as the infected areas are not extensive. A special staff, consisting of a medical officer and two native assistants from the Dakar School, has, however, just been appointed to deal with the recently discovered centre of infection.

2. PRESENT ORGANISATION OF THE SERVICE.

By a decree of the Minister of the Colonies, dated July 8th, 1926, the service for the prevention of sleeping-sickness in the Cameroons has been reorganised and established on a permanent footing. It includes :

- 10 medical officers ;
- 20 European health officers ;
- 200 native assistants, of whom a certain number are qualified to make microscopic examinations for trypanosomes in the blood or lymphatic glands.

The Service is equipped with field laboratories fitted with all the apparatus necessary for the diagnosis and treatment of cases.

Each medical officer is in charge of an area and has a special staff at his disposal for tracing and treating the disease. He visits all the villages in his area in turn. The natives are assembled and examined individually. All previously identified cases—records of which are kept—are treated as well as fresh cases and suspects, so as to ensure the sterilisation of trypanosome-carriers.

For the purpose of discovering sleeping-sickness cases which have not yet been identified, the medical parties generally proceed as follows :

All natives showing symptoms of either swollen glands, tachycardia, or general ill-health are considered as suspects. They are examined one by one for trypanosomes : first the glandular lymph and then the blood by the thick-drop method, if the result of the preceding test has been negative.

Suspects in whose case this examination has given negative results but who show signs of auto-agglutination are generally considered as infected with trypanosomiasis.

As an extra check, suspects in whom no parasites have been found are submitted to a second examination by the medical officer in charge of the party.

Spinal puncture would be desirable in many cases, but experience has shown that, being sometimes painful, it is dreaded by the natives and should therefore not be included among the operations carried out by travelling parties.

Fixed laboratories established at Ayos and Doula also assist in research work concerning sleeping-sickness, its prevention and cure.

In Equatorial Africa, the campaign against sleeping-sickness with a specialised staff was begun in 1917. The war was then at its height and only a very limited number of doctors was available; consequently, the prophylactic campaign was only systematically organised in 1920, since when it has steadily developed as more effective means, increased appropriations and a greater number of doctors became available.

At the present moment, the Preventive Service in Equatorial Africa, which was reorganised under the Decree of January 18th, 1928, has at its disposal:

- 11 medical officers,
- 1 veterinary surgeon (or naturalist);
- 10 assistant health officers¹;
- 12 European health assistants;
- 105 native assistants.

The general system of medical parties operating in fixed areas, is similar to that adopted in the Cameroons.

In addition, all general practitioners employed in the native medical relief service take an active share in the campaign within a certain area around their usual place of residence.

**French Equatorial
AFRICA**

PROPHYLAXIS AND TREATMENT OF TRYPANOSOMIASIS

Decree of April 12th, 1917

Health Card.

ORIGIN	ADMINISTRATIVE VISAS	IDENTITY
Colony:		Name:
District:		Sex:
Subdivision:		Approximate age:
Medical post:		Race:
No. of Card:		Birthplace:
Date:		Occupation:
Name of Medical Officer issuing card:		Domicile:
Signature:		Subdivision:
		Village:
		Name of Local Chief:
		CHECKS ON IDENTITY
		Height:
		Distinctive marks on organs
Signature of the Administrator:		Marks derived from ethnological characteristics, racial or individual, mouth, teeth, tattooing, malformations, etc.:

¹ These include foreigners (Russians) not holding the French Government diploma, without which no one is legally authorised to practise medicine in French territories.

(Reverse of Health Card.)

MEDICAL PART

First Examination.	Place :			
	Date :			
	Patient :	Glandular hypertrophy		
		Glandular fluid		
Other brief indications :	Peripheral blood	Direct examination		
		Centrifuging		
		Hæmo-agglutination		
	Spinal puncture			
Remarks				
	Health passport :			
	First medical finding :			
	Successive operation :			

Treatment Cards. — In order to facilitate control and keep the medical officer informed as to the evolution of the disease and the treatment given, each patient receives a card similar to the model above. He carries it on his person enclosed in a metal case. In the event of death, the village head-man keeps the card and hands it over to the medical officer on the occasion of his next visit.

In addition, all the data on the card are entered in the area register. A copy of this register is sent to the administrative headquarters of the district after each tour of inspection. Thus it is always easy to obtain the necessary information should a treatment card be lost.

In certain districts where the disease is considered a disgrace (Upper Shari and Logona), the card in its metal case, which would make the patient too conspicuous, is replaced by a metal disc similar to the individual tax disc and marked with a number. This number corresponds to the page in the register giving all medical data concerning the patient.

Further, in order to follow the evolution of the disease in any given area, a table, which is reproduced on pages 64 and 65, is published after each tour of inspection showing the progress of prophylaxis from year to year.

Medical Passports. — No native may move from one place to another without a medical passport. Before his departure, he must undergo a medical examination which is recorded on the passport. If he is infected, his departure must be postponed until his blood is sterilised. These passports must be endorsed at all administrative or medical posts and the journey may be interrupted for reasons of medical necessity.

Unhappily, and in spite of the penalties imposed on offenders, it is difficult in so vast an area as Equatorial Africa to keep a strict watch on the movements of the natives.

FRENCH EQUATORIAL AFRICA.



..... *Colony.*



Medical Passport for Sleeping-Sickness.



Destination.....

Name..... *Sex*..... *Age*.....

Village.....

Area No......

Case of Sleeping-Sickness. Regularly treated No......

Free from Sleeping-Sickness. Has no Health Card.

VISAS :

(Reverse of Table annexed to Quarterly or Annual Report.)

FRENCH EQUATORIAL AFRICA.

INSPECTION OF THE HEALTH AND MEDICAL SERVICES.

INSTRUCTIONS concerning the preparation of statistics for the Sleeping-Sickness Prophylaxis Service.

In order that the results of prophylaxis may be compared year by year and area by area, it is essential that all tables should be drawn up according to a uniform model.

The above model will be adopted as from the date of the annual summary report on the work of the area in 1922.

COLUMN 1. — Description of Group. — Groups will be established by the medical officers in charge of areas at their discretion and will cover either an administrative subdivision or an itinerary for a tour of inspection or any other division. But once the list of villages forming any group has been drawn up, the composition of this group must on no account be altered.

In the quarterly reports, the villages and the figures referring to each of them must be shown.

In the annual summary report on the work of the area, group totals must be given, without detailed figures.

COLUMN 2. — Census Figures. — Lists must be obtained from the Administrators in accordance with the Decree of January 22nd, 1921.

COLUMNS 3 TO 14. — Men, Women, Children, Totals. — In order to avoid confusion, all those as yet uncircumcised or excised will be classed as *children*.

COLUMN 15. — Only to be completed in the annual tables. It will show the initial morbidity in each group: the percentage of sleeping-sickness cases in proportion to the *population examined* at the first inspection tour recorded.

All areas now in operation will find in their archives the details necessary to establish for each group and village the index of initial infection which will show whether the health conditions have improved or deteriorated at any given period.

The column will further show the percentage for the year in which the table is drawn up.

COLUMNS 16 TO 19. — Only to be completed in the annual tables.

The annual index of fresh infection is the percentage of *fresh cases of sleeping-sickness* in proportion to the numbers of the population *examined*. These figures will yield definite data for each year showing the increase or decrease of infection. But for purposes of comparison, all percentages must refer to a uniform *period of twelve months*.

Example: Group A was visited for the first time from January 1st to 15th, 1922. At that time, among a population of 2,500 persons *examined*, there were 150 cases, *i.e.*, a proportion of 6 per cent—that is the initial index of morbidity (column 15). Revisited from August 1st to 15th (seven months later), 28 *fresh* cases were found among 2,800 persons examined. Twenty-eight fresh cases in seven months is equivalent to 4 infections per month, or 48 per annum, or 1.7 per cent of the 2,800 persons examined.

The same group revisited from November 1st to 15th shows a further 20 cases among 2,700 persons examined. The total of fresh cases is thus $28 + 20 = 48$ in ten months, or 4.8 per month, 57.6 per annum, and the percentage will be calculated in proportion to the average number of persons examined in August and November, $\frac{2,700 + 2,800}{2} = 2,750$ or 2 per cent. Omit fractions of months between two visits.

COLUMNS 20 TO 22. — Only to be completed in the annual table.

Old-established areas which have already adopted a division into groups must not change the composition of the latter, as otherwise the value of the data already acquired would be lost. They must calculate the initial index and the index of annual infection, going back as far as possible.

Brazzaville, March 31st, 1922.

Director of the Public Health Service,
Inspector of the Sanitary Services.

BOYÉ.

— 65 —

“ Filter ” or Observation Posts. — The object of these posts is to check medical passports, to detain natives known to be suffering from trypanosomiasis and to prevent these germ-carriers from continuing their journey until they have been sterilised.

Such posts have been established along the caravan or frontier routes and are intended to set up a barrier between healthy and infected zones. They are supplied with the laboratory equipment necessary for accurate diagnosis.

The names of all travellers are entered on the post register together with the medical observations recorded.

But here again, several years' experience has shown the difficulties of establishing a barrier proof against leakage. After a few months, there is a decrease in the number of travellers passing any given post. Natives fearing detention at the post choose a more devious route, and in so vast a country it is almost impossible effectively to supervise all roads. The same applies to transit from one country to another, from the Belgian Congo to the Anglo-Egyptian Sudan or from the Cameroons to Equatorial Africa and vice versa.

Voluntary Segregation Villages. — In one prophylaxis area in Equatorial Africa, an attempt has been made to establish voluntary segregation villages on sites specially chosen near the main thoroughfares. Patients are allowed to take their families with them. They receive medical attention, land to cultivate and supplies to carry them on to the first harvest, and they are exempt from head tax.

Some of these individuals applied to be allowed to settle permanently in these villages, but, in the majority of cases, segregation has only been temporary and natives have returned to their homes after the lapse of time necessary for sterilisation.

The position of these villages close to main thoroughfares accessible to motor traffic makes it easier for the medical officers of the prophylaxis service to visit them frequently. About ten of these villages are now in existence.

Segregation Camps. — These are established in the areas and are exclusively reserved for germ-carriers who will submit to none but compulsory treatment. They are detained as long as treatment is required. Special quarters are reserved for the bedridden and delirious.

Clearing Bush. — The object of the above measures, which constitute the medico-administrative side of prophylaxis, is to destroy the virus in its most dangerous reservoir—*i.e.*, man—by the sterilisation of germ-carriers.

The aim of other measures is to extirpate the tsetse-fly, or at any rate reduce its numbers in certain infested regions, and thus decrease the probability of infection.

From this point of view, the most dangerous localities are the bush belts on either side of shallow streams, particularly near villages and fords.

These belts indeed provide the very best conditions for the propagation of glossinæ—luxuriant vegetation and dense and shady thickets. Natives, both travellers and those who come from neighbouring villages to fetch water or wash themselves, are fond of lingering in these spots to rest.

It is known that the pupæ of glossinæ rapidly die when exposed to sunshine or very strong light. The authorities take measures, therefore, to ensure that a wide space (200 meters) in the neighbourhood of fords or pools is cleared of all undergrowth in order to prevent the breeding of tsetse in these places.

This is an easy task in the proximity of villages, since local labour is available and village head-men can be instructed to maintain the clearings. The problem, however, is a very different one on certain highways across territories sparsely inhabited by a scattered population. It would be no easy matter to insist on the wholesale clearing of undergrowth.

**FRENCH EQUATORIAL
AFRICA.**

MEDICAL SHEET

Issued in conformity
with the Governor-
General's Circular
of April 18th, 1925. ¹

COLONY. _____

concerning the village of _____

DISTRICT _____

SUBDIVISION _____

INHABITANTS OF THE VILLAGE

Race: _____ Tribe: _____

Men: _____

Women: _____

Children: _____

Inspection carried out _____

by Dr.: _____

Date of last visit: _____

Number of inhabitants inspected: { Men _____
Women _____
Children _____

Number of smallpox vaccinations _____

Number of previous vaccinations (according to village records) _____

Number of patients seen: Short description of diseases noted and the sanitary condition of the village:

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¹ A sheet must be prepared for each village visited ; after inspection, two copies of this sheet must be delivered to the head of the district, who will enter his comments thereon. He will then file one copy in the health records of the village and will transmit the other to the Governor. Medical officers engaged in sleeping-sickness work must prepare this sheet for every village visited by them in the manner described above.

(Reverse of Medical Sheet.)

GENERAL OBSERVATIONS AND MEDICAL OFFICER'S PROPOSALS.

General condition of inhabitants. — Health conditions in village. — Presence or absence of glossinæ. — Ordinary diet of inhabitants. — Measures proposed for improving the sanitary condition of village.

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Sent to the District Officer (*date*)

Medical Officer.

OPINION OF THE DISTRICT OFFICER.

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.....
.....

Measures taken:

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.....
.....
.....

Sent to the Lieutenant-Governor of.....

at....., the..... 192 .

The District Officer.

When touring their areas, medical officers and administrators always see to it that a large space around all villages is well cleared of undergrowth and all dense vegetation affording a refuge for flies. Vegetables such as manioc, potatoes, yams, etc., are cultivated around the villages for this purpose.

Changing the Site of Villages. — When the medical officer of a sector comes to the conclusion that a village is, on account of its situation, over-exposed to the attacks of tsetse, he proposes to the administration of the territory a change of site. He previously inspects the new site.

Medical officers, particularly those engaged in prophylaxis work, who are constantly travelling, have instructions to keep for each village a *health file* on which they note all their observations. A copy of this file is sent to the administrative head of the district.

Extension of the Road System. — Great efforts have been made in recent years in the Equatorial African group of colonies and in the Cameroons to develop a system of roads suitable for motor traffic.

In the Oubangui-Shari colony in particular, thousands of kilometers of such roads are now in existence.

This greatly facilitates the work of trypanosomiasis prophylaxis. When medical units can motor from place to place they spend infinitely less time in travelling than those which have to rely on carriers: they can therefore deal with larger areas. Villages are gradually springing up along these motor roads, a fact which renders medical and administrative supervision easier and reduces portage, since traders come to buy produce in the village itself and then take this produce away in cars. In Oubangui, for instance, to meet this form of trade, markets are now held on fixed dates at which natives from the surrounding villages and traders meet. This, by greatly diminishing individual native travel, also reduces the chances of spreading the sleeping-sickness virus.

Difficulties encountered. — The difficulties encountered in applying these measures are numerous and often hard to overcome, both in the domain of purely administrative prophylaxis and in that of medical administrative prophylaxis. They are due to the following causes:

1. The nomadic life of some of the inhabitants. Those who live near rivers spend the whole of the day fishing and are therefore constantly exposed to the danger of infection because, as we have already pointed out, river banks are the most favourable breeding-places for tsetse-flies. Moreover, on account of these nomadic habits many natives are absent when village assemblies are called for medical inspection purposes. It often happens, indeed, in the riverside districts of Oubangui and the Congo that inhabitants pass from the French to the Belgian side of the river and vice versa.

Persuasive methods have very little effect on them; compulsion would necessitate a large administrative staff and would result in the natives migrating to some less effectively controlled region, either in French or Belgian territory. Thus the agreements between the Cameroons and French Equatorial Africa, on the one hand, and French Equatorial Africa and the Belgian Congo, on the other, for the supervision of the migrations of natives over the frontier remain far too often inoperative.

2. The apathy, indifference, intractability and, in many cases, mistrustfulness of the natives where European methods are concerned. For instance, they sometimes run away and hide in the bush on the approach of a medical officer.

With a view to gaining the confidence of the natives, therefore, medical officers of the prophylaxis service have been instructed to treat as many cases of frambœsia

as possible. The certain cure of this loathsome disease in a few days by means of one of the arseno-benzols has a very happy effect on the native mind. Thousands and thousands of these cases are treated by the medical officers engaged on sleeping-sickness work, and sleeping-sickness prophylaxis largely gains thereby.

3. The vastness of the territories which have to be supervised, and the fact that means of communication are generally very slow.

In spite of these difficulties, however, important results are registered every day and in many districts the natives now no longer evade the medical officer but come to him quite willingly.

The French Colonial Administration holds that very close co-operation between medical officers and administrators is an essential condition for the success of the campaign. In his own district, the one thing the native understands is the authority of the administrative head of that district, with whom he comes constantly into contact for the payment of taxes, levies, questions of law, etc.

Therefore, the administration has been formally instructed to give the *utmost* assistance to medical prophylaxis units. In order to ensure such co-operation, the medical officer, as soon as he has decided on his itinerary, communicates this information to the administrator, who himself issues orders to the villages for the assembling of the natives at a given time and place. The administrator is supposed, whenever possible, to accompany the medical officer, or at any rate to send one of his assistants.

In Equatorial Africa, at the beginning of 1925, the Government published a special set of instructions for the use of administrators. This booklet explains briefly the objects of the prophylactic organisation, how this organisation works and the highly important part they have to play side by side with the medical officer. It emphasises the fact that the total population must be present at the assemblies called by the administrator if preventive measures are to be successful and no germ-carrier is to escape periodical sterilisation.

II. METHODS EMPLOYED TO STAMP OUT SLEEPING-SICKNESS.

During the eleven years that have elapsed since a methodical campaign in our Equatorial colonies and in the Cameroons was first inaugurated, methods have gradually changed and developed with the growth of scientific knowledge and the appearance of new remedies.

The main weapon in the campaign against sleeping-sickness must be prophylaxis. The aim of prophylaxis is to diminish the probability of infection by sterilising germ-carriers and endeavouring at least to impede the breeding of *glossinæ* in the neighbourhood of human habitations.

The endemic areas are so vast and the sufferers so scattered that a prophylactic campaign and the treatment of the patients could not have been carried on simultaneously without a huge administrative staff and hospital establishments capable of receiving tens of thousands of patients and the hope of obtaining any but moderate results would be small, seeing how difficult it has been, and—we must admit—still is, to obtain complete cures in this disease when it has passed beyond the first stage, in spite of all the therapeutic means employed. Consequently, treatment, in the strict sense of the term, has been given only to patients (free or segregated) in villages and segregation camps or hospitals, that is to say, patients who could be kept under permanent medical supervision. But the main effort has been, and still is, concentrated on prophylaxis.

In the Cameroons, on the contrary, where the endemic areas are smaller, more attention has been paid to curative treatment than has been possible in the neighbouring colonies.

PROPHYLACTIC TREATMENT.

Atoxyl has hitherto been practically the only drug employed, since it possesses very numerous advantages.

It is easily administered by subcutaneous injection.

Very few accidents have occurred from its use, particularly in the first stage of the disease.

It rapidly produces peripheral sterilisation. Its cost price is low.

From the beginning of 1917 to 1924, atoxyl was employed in a manner described by the Société de Pathologie Exotique, in instructions prepared towards the end of 1917, as "minima" prophylactic measures. This method was: two injections of atoxyl, the dose being 0.01 to 0.015 centigram per kilo of patient's weight, with an eight-day interval between the injections. It was thought that, after such doses, peripheral sterilisation was maintained for about six months in most of the subjects so treated.

It has now, however, been ascertained, after long experience, that at the end of six months an average of 17 per cent of the patients thus treated again show trypanosomes in the circulating blood and that this proportion rises to 24.5 per cent after twelve months.

The method, therefore, has proved to be inadequate; the only remedy would have been to increase the number of sterilising injections and the number of medical inspection tours. This, however, would have entailed the employment of a large number of medical officers, a number far greater than could have been procured in view of the general post-war dearth of doctors in the belligerent countries.

As soon as the inadequacy of so-called " minima " prophylactic measures had been demonstrated, the Pasteur Institute at Brazzaville endeavoured to discover a more lasting method of sterilisation with atoxyl which would be easy to employ and necessitate as small a medical staff as possible.

The research into this subject was protracted, since results had to be watched over a sufficiently long period ; it was therefore only at the end of 1923 that BLANCHARD AND LAIGRET communicated their conclusions.

Patients who had been given *six strong injections of atoxyl*, with an interval of ten days between the injections, the dose being 0.02 centigramme per kilo (without ever exceeding the dose 1 gm. 10 per injection), showed at the end of the year only about 6 per cent blood infections.

This method was immediately adopted everywhere (1924), the instructions issued to medical officers of the prophylaxis service being as follows :

" After each village assembly the patients must receive their first injection of atoxyl; they are then to be told the date on which they must come to a given centre to receive the second injection. On that date they are to be informed where and when they will receive the third injection, and so on up to the sixth injection. "

The centres were established in such a way as to entail as little travelling as possible for patients in order to encourage the latter to come regularly for their injections.

Though this method makes it necessary for the medical officer and his staff to travel for about sixty days throughout an area so arranged that they can come back to the starting-point in ten days, it at least possesses this advantage : only one series of six injections is necessary in the course of the year and it produces at the end of this period sterilisation in about 94 per cent of the patients, according to the first series of observations.

After the method had been applied for one year (at the end of 1925), the Director of the Health Service for Equatorial Africa issued instructions that control tests should be carried out. This was done in two areas, one in the Middle Congo and the other in the Oubangui.

In the first area (Middle Congo) :

Sleeping-sickness cases which had been given twelve months previously six injections of atoxyl :

Examined : 192.

Trypanosomes present in the blood or lymph : 0.

In the second area (Oubangui) :

Sleeping-sickness cases which had been given fourteen months previously six injections of atoxyl (being at that time in the first stage) :

Examined : 60.

Trypanosomes present in the blood or lymph : 3.3 per cent.

Sleeping-sickness cases which had been given fourteen months previously six injections of atoxyl when they were already in the second stage :

Examined : 40.

Trypanosomes present in the blood or lymph : 7.5 per cent.

In communicating these encouraging results to the medical officers of the prophylaxis service, the Director of the Health Service added :

" From this moment we can feel sure that we are on the right track in the matter of prophylaxis. The problem will be entirely solved as soon as science has

placed in our hands an efficient trypanocide for sterilisation in the second stage of the disease. For patients of this category we are obliged, on account of their intolerance of atoxyl, to lessen the doses ; thus, among these patients, there are 7.5 per cent relapses, as against 3.3 per cent among those injected during the first stage.

“ Second-stage cases are always a danger as germ-carriers. We should therefore endeavour to establish for them segregation villages in which they can be sterilised repeatedly and undergo a complete treatment with atoxyl, emetic, and tryparsamide controlled by lumbar puncture.

“ Consequently, we must not be over-optimistic as regards this method of six injections of atoxyl, both in respect of *sterilisation* and *cure* in most cases injected during the first stage.

“ There are certainly a large number of permanent cures, but experiments carried out by the Pasteur Institute at Brazzaville show that, *in certain cases, patients thus treated, gradually and without any outward symptoms, pass into the second stage, although peripheral sterilisation is maintained.*

“ The future will show in what proportion this evolution occurs.

“ But—and I cannot insist too strongly on this point—in the problem with which we are dealing : *the elimination of sleeping-sickness in Equatorial Africa*, the most important factor by far is the sterilisation of germ-carriers. If such sterilisation is carried out by means of a reliable method such as we now seem to possess, the disease will become increasingly rare and finally disappear.

“ Obviously it would have been preferable if we could have saved several thousand sufferers throughout the whole of French Equatorial Africa who are destined to die in the near future, but in the present state of our knowledge regarding the treatment of sleeping-sickness any attempt to attain this result would involve a considerable effort, while success would be most uncertain.

“ The saving of these sufferers can only be aimed at as a *secondary objective*. Our most important task is to *secure* prophylaxis through the sterilisation of germ-carriers. As soon as the human reservoirs of virus have been destroyed, the disease will die out naturally or will become so rare that it will no longer constitute any appreciable obstacle to the development of our native population.”

Since this time (the beginning of 1926), new evidence has been forthcoming as to the efficacy of this method of prophylaxis *wherever it has been possible to enable the medical officer to inspect the vast majority of the population and atoxylise all the patients* and then to carry out a fresh annual series of injections. In areas where it has been possible to approach anywhere near ideal conditions for the application of this method, the results obtained have been very encouraging, regarded from the point of view of prophylaxis alone. If the method is rigorously applied over a long period, there is reason to hope that sooner or later this disease will disappear. Here are some of the results :

Sector IV.

Territories :	Annual Index of Fresh Infections	
	1926 Per cent	1927 Per cent
Boko-Sango	7.22	1.88
Bamba N'Gouala	9.82	2.88
Gorna Mobingou	5.49	1.70

Sector IX.

Territories :	Annual Index of Fresh Infections	
	1926 Per cent	1927 Per cent [†]
Mindili	14.60	2.77
Xexe	18.04	2.80
Babia	16.00	7.16
Bedira	12.01	5.40
Menai	18.31	9.49
Mouroundoussa	20.31	3.00

Sector I.

Sub-Divisions :	1924 Per cent	1925 Per cent	1926 Per cent
Mouroubas	3.16	2.28	1.39
Grimari	2.83	2.47	1.83
Bambari	4.96	2.50	1.85

* * *

However, from the point of view of the duration of peripheral sterilisation produced by six injections of atoxyl, further experiments carried out in the Pasteur Institute at Brazzaville have given slightly less favourable results than those previously indicated. They have shown in certain cases that blood relapses between the sixth and tenth month after the last of the six injections may attain 10 per cent instead of 3 per cent after the sixth month, and 6 per cent after the twelfth month, as BLANCHARD AND LAIGRET had noted. But even in these circumstances to have succeeded in eliminating in one year 90 per cent of the circulating virus is a considerable result which must, if the efforts are methodically continued, lead to the fairly rapid disappearance of the disease or, at any rate, to so great a diminution that it will no longer be a social danger.

* * *

The prophylactic organisation in the Cameroons is, in the matter of procedure and general outline, similar to that in Equatorial Africa. As, however, in the Cameroons the endemic zones are smaller, it has been possible to make more concentrated efforts than in Equatorial Africa, inspect the infected regions more often, and increase the series of injections which are given, in principle, every six months, particularly in the centres where the infection index is high. When this index exceeds 15 per cent, injections of tryparsamide are employed concurrently with injections of atoxyl.

* * *

A medicament recently introduced in therapeutics, Fourneau 309, which has been put on sale by POULENC & Co. under the name *Moranyl*, opens out new prospects in the matter of sleeping-sickness prophylaxis. As a sterilising or curative agent this drug may be no better than atoxyl, and it is dearer and more complicated to use, but it possesses very distinct immunising properties.

Experiments were made with this product in eight villages in the region of Bambari (Upper Oubangui) which had shown in the previous year an average percentage of new infections of 11.35 per cent.

There were injected, some with doses of 0.02 gramme and others with 0.04 gramme per kilo, 500 persons not suffering from sleeping-sickness and free from organic defects. The injection in 2-10 solution was intravenous. Alongside these, 500 controls were kept under observation.

These injections caused no serious immediate accidents. Several individuals were attacked by giddiness and had to lie down; in some cases there were vomiting and salivation. These symptoms lasted for only a few minutes. When an inspection was carried out, the injected persons all stated that they had not felt any ill-effects after the injection. The urine of a number of these persons was tested for albumin, but in all cases the result was negative.

The following table shows the results of the experiments :

Injections carried out in October 1925 :

500 persons injected, 503 controls.

Seen in April 1926 :

Sleeping-sickness cases :

267 persons injected	0
313 controls	8

Seen in July 1926 :

708 persons injected (not seen at the April inspection)	0
Controls	2

After ten months, therefore, the immunising action of Fourneau 309 appeared to persist.

Similar experiments have also been made in the Belgian Congo by VAN DEN BRANDEN with Bayer 205, which appears to be identical with Fourneau 309. The period of immunity is said to have been as much as nineteen months.

This would suggest a new direction for prophylaxis, use being made of the *sterilising* properties of atoxyl in conjunction with the *immunising* properties of Fourneau 309. After each visit of inspection, the sleeping-sickness cases would receive an atoxyl injection, while those of the inhabitants who were free from the disease would be given an immunising injection of Fourneau 309.

Large-scale experiments on these lines are now in progress in one of the most heavily-infected areas in Equatorial Africa—the Franceville area. Before this method of prophylaxis is generally adopted, it is necessary to determine the optimum dose of Fourneau 309 and the duration of the immunity conferred.

* * *

In French Equatorial Africa the conclusion has lately been reached that the time has come to devote attention to the treatment of the patient as well as to prophylaxis proper. In recent years certain new remedies, notably tryparsamide, have been shown to be effective in the second stage of the disease, producing not merely lasting improvements in numerous cases but also permanent cures.

We have seen that, while the method of atoxylisation by six consecutive injections sterilised germ-carriers, it frequently did not prevent the disease from progressing to the second stage. *It is possible* that tryparsamide employed in large quantities from the outset would partially obviate this disadvantage.

This, however, will necessitate a complete new organisation, which is now under consideration. Numerous treatment centres would have to be established, to which the natives would come periodically for curative treatment—those in the second stage in any case, and, whenever possible without coercion, new cases still in the first stage.

Tryparsamide is a medicine requiring somewhat delicate handling, and could not conveniently be used by the itinerant services in those areas where patients cannot be kept under continuous observation.

Here again we must not be too optimistic, or entertain hopes which would later be destroyed by realities. The treatment of sleeping-sickness is a long process ; the results are *still uncertain* ; and tryparsamide—the remedy which has so far been found the most satisfactory— is expensive. In short, until we are in possession of a therapeutic agent of swift and certain efficiency, all our efforts must be devoted to *prophylaxis* by sterilising germ-carriers, and for this purpose there is as yet no satisfactory substitute for atoxyl, which has the advantages of being easily handled by the itinerant services, of being a reliable sterilising agent and of being extremely cheap.

**III: WORK OF THE PROPHYLACTIC MISSIONS
IN THE CAMEROONS AND FRENCH EQUATORIAL AFRICA
DURING RECENT YEARS.**

	1924	1925	1926	1927
<i>Cameroons</i>				
Natives examined	110,992	—	104,332	230,978
Sleeping-sickness cases (old and new) treated	33,143	32,519	32,249	40,174
<i>Equatorial Africa.</i>				
Natives examined	657,780	787,262	655,194	(1927 figures not re- ceived)
Sleeping-sickness cases (old and new) treated	29,817	28,328	33,117	

In Togoland, in the centre of infection discovered last year, 72,821 natives were examined, and 1,713 were found to be suffering from sleeping-sickness and were placed under treatment. The Administration of the territory is organising a prophylaxis area on similar lines to those in the Cameroons and Equatorial Africa, with the object of localising and extinguishing this centre of infection.

Paris, August 27th, 1928.

(Signed) BOYÉ,
Chief Medical Officer attached to the Inspector-
General of the Public Health Service.

IV. RÉSUMÉ OF THE EXPERIMENTS CARRIED OUT IN RECENT YEARS AT THE BRAZZAVILLE PASTEUR INSTITUTE.

Since 1925, the Brazzaville Pasteur Institute has been experimenting with tryparsamide and Fourneau 270 in the treatment of sleeping-sickness; a few tests have also been made with tryponarsyl (tryparsamide manufactured in Belgium).

Detailed reports on the results up to 1927 have appeared in various periodicals.¹ We shall here content ourselves with summarising them and the conclusions arrived at.

I. FIRST STAGE.

The action of these therapeutic agents in the first stage of sleeping-sickness has not been very thoroughly studied, efforts and attention having been quite naturally concentrated on the remarkable results they yield when the nervous system is attacked (second stage).

Only 37 cases in the first stage have been treated—16 with tryparsamide, 17 with Fourneau 270, and four with tryponarsyl.

It would therefore be rash to draw definite conclusions from such restricted observations, but the indications they afford are of some importance.

Of the 16 cases treated with tryparsamide, one was not adequately observed; the others, after an average period of eight months, showed 13 successes and two reappearances of the parasite in the blood.

The blood of 16 out of 17 cases treated with Fourneau 270 was free from trypanosomes after from three to twelve months.

In the four cases treated with tryponarsyl there were four successes recorded after a period of five months.

One of the patients who relapsed after tryparsamide treatment had been given a total dose of 12.70 grammes in addition to any previous arsenical treatment he might have received. Trypanosomes were found in the blood one month and a-half later.

This is not an isolated instance. JAMOT, LETONURIER AND DE MARQUEISSAC have reported a relapse in the blood nineteen days after a treatment with 13 grammes and, as we shall see, relapses in the blood are not uncommon during the treatment of the second stage, even after considerably larger doses.

These phenomena have not been observed when Fourneau 270 is administered in the same quantities. On the other hand, a blood-relapse was noted in a second-stage case treated with tryponarsyl.

¹ J. LAIGRET. — "Traitement de la Trypanosomiase humaine par la Tryparsamide", *Annales de l'Institut Pasteur*, March 1926, p. 173.

G. LEDENTU. — "Quelques Résultats éloignés du traitement de la maladie du sommeil par la Tryparsamide", *Annales de l'Institut Pasteur*, September 1927, p. 982.

G. LEDENTU AND M. VAUCEL. — "Nouveaux essais de traitement de la maladie du sommeil par la Tryparsamide", *Annales de l'Institut Pasteur*, November 1927, p. 1200.

G. LEDENTU AND J. DAUDE. — "Essai de traitement de la Trypanosomiase humaine par le Fourneau 270", *Annales de l'Institut Pasteur*, October 1926, p. 830.

G. LEDENTU AND M. VAUCEL. — "Note complémentaire sur le Fourneau 270 en Trypanosomiase humaine", *Annales de l'Institut Pasteur*, November 1927, p. 1233.

G. LEDENTU AND M. VAUCEL. — "Contribution aux essais de traitement de la Trypanosomiase humaine par le Tryponarsyl", *Bull. de la Soc. de Path. Ex.*, November 1927, p. 875.

It would therefore seem that tryparsamide, whether Belgian or American, has no certain action on the parasites in the hæmolymphatic system. Fourneau 270, on the other hand, when administered in suitable doses, has never so far proved disappointing in this respect.

If, therefore, these first reports are confirmed by the experiments now in progress, it is the French product rather than tryparsamide that would have to be used as a substitute for atoxyl in the treatment of the first stage.

It has the further advantage, for this purpose, of being constantly innocuous when subcutaneously injected.

2. SECOND STAGE.

Results. — In the second stage of the disease it is convenient, from the point of view of the efficacy of the treatment, to distinguish with LAIGRET four phases, of which the first two correspond to that stage of invasion of the nervous centres at which spinal puncture is the only method of diagnosis, while the last two correspond to the point at which the appearance of clinical symptoms places the fact of this invasion beyond doubt.

In the first or "early" phase (fewer than 70 lymphocytes per cubic millimeter and less than 0.50 gramme of albumin per litre), tryparsamide yields a considerable proportion of apparent cures. Thus in 30 cases under observation for about five months, 90 per cent favourable results are noted (86.5 per cent definite successes and 3.5 per cent improvements). In another batch of four cases treated by LAIGRET, two appeared cured thirteen and eighteen months respectively after the complete cessation of treatment, but the other two had blood relapses; although the analysis of the cerebro-spinal fluid was entirely satisfactory. We observed the same phenomenon in one of our own patients, who had received 47.20 grammes of tryparsamide.

In the second phase, which is marked by an already considerable alteration of the cerebro-spinal fluid, but without clinical symptoms, the results are again most striking. Thirty-eight cases under observation for several months yielded 78 per cent of favourable results, and 28 other cases under observation for from one and a-half to two years gave 82.1 per cent of successes, making an average of 80 per cent for 66 cases. Among the failures should be noted a blood relapse four months after treatment with 41.50 grammes, when the cerebro-spinal fluid showed a considerable improvement.

In the third phase (appearance of clinical symptoms) the immediate results among 64 patients were favourable in 68.62 per cent. Of 24 others, after about eighteen months, favourable results were obtained in 54.1 per cent, making 61.36 per cent of successes out of 88 cases. The failures included two reappearances of trypanosomes in the blood after doses of 25.90 grammes and 32.30 grammes, the cerebro-spinal fluid having again become absolutely normal.

Lastly, in the fourth phase, or terminal stage, the percentage of immediate successes is only 28 (out of 17 cases) but among the survivors a certain number of cures (four out of eight of LAIGRET'S patients) seem to be quite permanent—a wonderful success in view of the desperate condition of the patients when treatment was begun.

During the year 1926, treatment by Fourneau 270 was still in the tentative stage, and was only applied to a small number of cases. The results for 1927, when it was systematically employed in over a hundred cases, are not yet known. It would therefore be premature at this juncture to attempt to make a comparison by percentages between this highly important product and tryparsamide. It does not, however, seem rash to suggest, on the basis of continuous observations over nearly a year and a-half, that Fourneau 270 would not suffer by such a comparison.

Trypanarsyl treatment also has only been employed experimentally in some twenty cases. The results, after five months' observation, were found to be equal to those obtained with tryparsamide. There was one blood-relapse forty-five days after the cessation of treatment, in a case at the beginning of the second stage.

Direction for Treatment and Dosage. — Treatment undertaken with each of these products has been carried out by series of injections (generally one or two, sometimes three, rarely four), separated by intervals of rest, and graduated from 0.02 gramme to 0.055 gramme per kilo so as to administer in six or seven weekly injections a total quantity of from 0.25 gramme to 0.30 gramme per kilo, or 12 to 15 grammes for an average native weighing 50 kilos.

These doses are calculated for subjects who still retain their power of resistance ; in the case of cachectics they were appreciably reduced.

Even for patients still able to support the treatment it would seem that a dose of 0.055 gramme per kilo (2.70 to 2.80 grammes) should not be exceeded, as otherwise a needless risk of grave damage to eyesight is incurred.

In the majority of cases one series is sufficient to produce an appreciable improvement in the meningeal reaction, and often a return to normal. Experience has shown that these are the only cases in which there is any hope of a permanent cure.

In our view, therefore, extreme importance must be attached to the results yielded by the lumbar puncture, which should be carried out eight days after the last injection. If the cerebro-spinal fluid is still abnormal, particularly as regards albumin content, we think, with VAUCÉL, that the treatment should be continued without interruption until the composition of the fluid again becomes normal. If we allow any respite to trypanosomiasis which are spontaneously resistant to treatment, we enable them to become arsenic-fast and to develop unchecked.

This method has been on trial for nearly a year at the Brazzaville Pasteur Institute, and we have good hopes that it will greatly reduce the number of failures.

Failures. — These would seem to be attributable—except in a few cases where all kinds of treatment are useless—to inadequate treatment: either the initial treatment was not intensive enough for some reason (intractability of the patient, arsenic intolerance, ocular disturbances), or it was suspended after this first series when the composition of the cerebro-spinal fluid had not yet returned to normal.

When a fresh meningeal involvement has occurred, it is too late to take any effective action. Drugs, even in strong repeated doses, no longer produce more than a merely transitory improvement, and a fresh relapse sooner or later is inevitable. As we have written elsewhere, success or failure depends on the initial treatment, and the value of resummptions of treatment is illusory.

There are indeed cases, and these by no means exceptional, in which such resummptions of treatment, so far from having a favourable effect, give a fresh impulse to the disease and hasten the termination.

Lastly, it must not be forgotten that the cures in the second stage should not be determined by an examination of the cerebro-spinal fluid alone. Blood analysis is essential ; it may reveal disagreeable surprises.

Ocular Accidents. — Serious amaurotic ocular accidents are, as a general rule, found only in advanced cases and when large doses are administered. They can easily be avoided by a correct technique.

There are also cases of individual susceptibility, which cannot be foreseen. In such cases, provided that the doses have been carefully graduated, only transitory manifestations of amblyopia occur. Their frequency is from 4 to 5 per cent.

Action of a previous Arsenical Treatment. — A previous arsenical treatment has a certain predisposing influence on the appearance of these ocular complications (seven out of eight cases of amblyopia). Sensitisation appears to be of the order of 1 to 1.5 centigramme per kilo; it is therefore wise to ascertain whether the patient has formerly been treated with atoxyl or with tryparsamide.

o This influence—which is certainly unfortunate, but not peculiar to atoxyl—is only the result of a previous atoxyl treatment. Numerous observations have established that, although on first consideration one might have thought otherwise, atoxyl does not in any way interfere with the trypanocidal action of tryparsamide. The latest statistics published by the Brazzaville Pasteur Institute show, for example, 69.8 per cent favourable results in cases now treated for the first time with tryparsamide, and 74.3 per cent in cases previously treated with another arsenical remedy (statistics relating to 165 cases).

Thus there is no reason to fear that atoxyl may set up a resistance to arsenic; but, unfortunately, the same does not appear to be true of an ineffectual tryparsamide treatment, if we may judge by the inefficacy of this product in relapses in the blood or cerebro-spinal fluid.

Tolerance. — The foregoing remarks are applicable not only to tryparsamide and the similar product tryponarsyl, but also to Fourneau 270, which, like them, belongs to the phenylarsenic acid series.

From the point of view of tolerance there are degrees among these products. All of them are equally capable of causing ocular accidents or phenomena of intolerance (emaciation, diarrhoea, vomiting), but tryponarsyl seems to be the most easily tolerated. Doses of 0.07 and even 0.09 gramme have been administered without ill-effects.

On the other hand, it would seem that Fourneau 270 is somewhat more toxic, and should not be administered in doses exceeding 0.04 or 0.045 gramme per kilo. This may indicate a greater selective activity on the nervous system.

Tryparsamide comes half-way between these two substances; the doses used by us have been stated above.

Lack of Association between Clinical Symptoms and the State of the Cerebro-spinal Fluid. — Mention must also be made of a dissociation between clinical symptoms and alterations in the cerebro-spinal fluid. This may take either of two forms.

In one form, the clinical symptoms do not show an improvement corresponding with that of the cerebro-spinal fluid, and the patient dies in a state of cachexia, although the composition of his cerebro-spinal fluid is normal.

In the other, inverse, form, there are no symptoms, but the cerebro-spinal fluid shows considerable alterations; such cases are found after several series of tryparsamide injections. Some of them have been shown to be due to interruptions in the treatment. In other cases, however, the general condition has continued to be excellent, and the patient appears to be flourishing and carries on his occupations, notwithstanding a high degree of lymphocytosis; pending fuller knowledge, we are regarding these cases as arsenical reactions.

To sum up, these three arsenical remedies are powerful weapons in the treatment of sleeping-sickness, and their value is approximately equal.

If, in the present state of our knowledge, we had to issue directions for the employment of each, we should say:

During the first stage, there is no clear evidence that American tryparsamide should be used. Relapses in the blood seem fairly frequent, and there is nothing to show that the use of this remedy prevents the invasion of the nervous centres. Fourneau 270 seems preferable.

During the second stage, the value of these remedies is beyond question, and they offer approximately equal prospects of success. The principles for their use are identical : relapses attributable to insufficient treatment ; vital importance of the first period of treatment and immediate extension of intensive treatment if necessity is indicated by lumbar puncture. Trypanarsyl is admirably suited to these long periods of treatment, on account of its low degree of toxicity.

3. METHOD OF DIAGNOSIS.

It happens fairly frequently that the trypanosome cannot be actually discovered in subjects who are clinically suspect.

In centres of population, where these subjects can be kept under continuous observation, repeated examinations will sooner or later bring to light the pathogenic agent, but in the bush, during an investigation tour, such subjects are passed as free of infection. These errors of diagnosis are most unfortunate both for the patient himself and for those with whom he comes into contact. A presumptive sign might perhaps make it possible if not to avoid false diagnoses entirely, at all events to reduce their number.

Auto-agglutination of the red blood corpuscles, which is a useful sign in the European, loses its value in the native, because it is found in a large number of diseases.

The formol-gel test of GATÉ AND PAPACOSTAS seems to us to be capable of replacing auto-agglutination with advantage, owing to the rapidity of the reaction in sleeping-sickness patients.¹

Constantly negative up to a limit of 30 minutes in subjects in apparent good health, it is positive—sometimes within an extremely short time (1 or 2 minutes)—in sleeping-sickness cases. Clinically, gelification of the serum in from 20 to 25 minutes creates a very strong presumption of trypanosomiasis.

This method has already rendered us valuable service in the case of a European who came for advice, complaining of facial paralysis ; the method enabled us to detect an entirely unsuspected trypanosomiasis.

4. PROGNOSIS.

Since trypanosomiasis is less clearly divided into stages than syphilis, there is as yet no method by which the evolution of the disease can be followed and the efficacy of the treatment estimated.

Only the test of time can show the physician whether an observed improvement in the cerebro-spinal fluid will be transitory or permanent.

In the colloidal benzoin reaction, which we have attempted to use for this purpose a flocculation reaching the tenth and eleventh tubes (Guillain Laroche's paralytic zone) is of bad prognosis. On the other hand, no conclusion can be drawn from flocculation in the first five tubes (syphilitic zone), which is constantly positive in sleeping-sickness cases.

These initial indications, brief as they are, show that flocculation methods, which have hitherto been neglected in the study of sleeping-sickness, may be of importance. Research should be undertaken with more accurate methods, such as VERNE'S.

(Signed) LEDENTU,

Late Director of the Brazzaville Pasteur Institute.

¹ G. LEDENTU AND M. VAUCEL. — " La formol-gélification dans la trypanosomiase humaine ", *Bull. Soc. Path. Ex.*, July 1927 ; " Sur la valeur comparée de la réaction de Gaté et de l'autoagglutination des hématies, comme signe de présomption de la maladie du sommeil ", *Bull. Soc. Path. Ex.*, October 1927.

² G. LEDENTU AND M. VAUCEL. — " La réaction du benjoin colloïdal dans la trypanosomiase humaine ", *Bull. Soc. Path. Ex.*, November 1927.

REPORT SUBMITTED BY THE DIRECTORATE-GENERAL
FOR MOROCCO AND THE COLONIES OF SPAIN
(SPANISH GUINEA AND FERNANDO PO).

It would be well in the first place to give a short account of the organisation proposed by this Directorate about a year ago to the Directorate-General for Morocco and the Colonies for a systematic campaign against endemic diseases in our Guinea territories, and more especially against sleeping-sickness, which, at present, and by reason of its gravity, is a disease which undoubtedly calls for methodical and immediate action.

Previous personal research had revealed the fact that sleeping-sickness was widely prevalent in the island of Fernando Po and undoubtedly also, although to a lesser extent, on the Spanish continental territory, which is exposed to constant infection from agricultural labourers who are continually passing to and fro between the continent and the island. The island has been divided into five sanitary areas extending along the coast for an average distance of thirty kilometers, including the cultivated areas of the interior (the population of the island being almost exclusively agricultural) and existing villages. The infected areas cover a surface of about three thousand hectares, the population of which approximates three thousand inhabitants per area. Each of the areas is equipped with a hospital appropriate to its size, and has a sanitary station or post established at its centre, which enables the staff to exercise very rapid control over the entire area without great physical exertion.

The sanitary areas in the island, taking them in the order in which they were established, are those of Santa Isabel, San Carlos, Basakato del Este, Tuplapla and Concepción. The Santa Isabel area, which is an emigration and immigration centre, is more densely populated than the other areas and serves as a collecting-centre for documentary material, and is under the control of the Directorate itself. This is established at the capital, and its central laboratory, in turn, directs the whole organisation. There is also the Queen Christina hospital at Santa Isabel which, because of the large number of patients, has its own private laboratory.

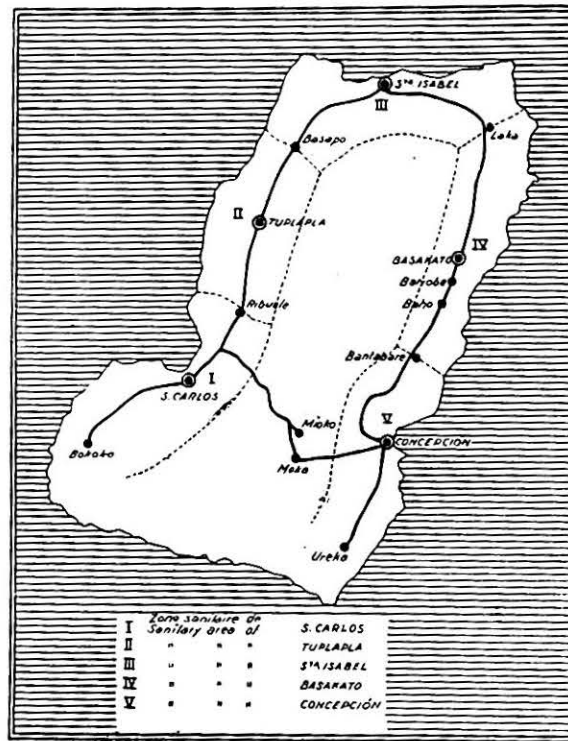
The San Carlos area, very important from the point of view of the present endemic, uses its hospital as a centre.

In the Basakato del Este and Tuplapla areas, the sanitary stations have been constructed to suit local conditions, according to the instructions laid down, with local material and upon suitable sites.

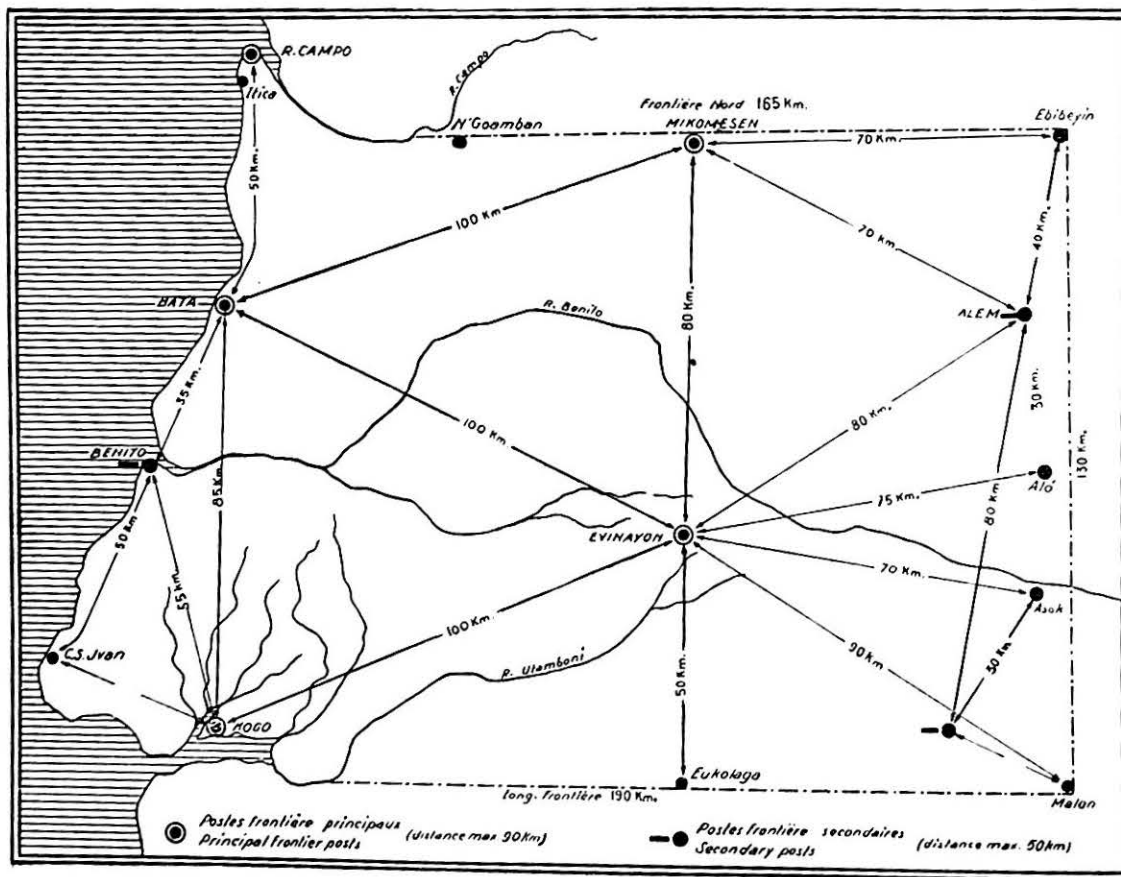
The sanitary station at Concepción, which at present operates in a building handed over by a private company, pending the construction of its own premises, will be established in the town itself in the same way as the others.

On the mainland, where the index of infection is at present low, the sanitary areas are the size of sanitary districts and their centres are distributed as follows: On the coast, at Bata, Benito and Kogo; on the northern frontier, at Mikomesen; on the eastern frontier, Alem and Enser, being close to the north-east and south-east extremities respectively are, as it were, strategic exchange points, established a

ISLAND OF FERNANDO PO.



SPANISH GUINEA — Continental Zone.



places through which the natives must pass and where they can therefore be controlled. The southern area, for the time being, has its centre at Evinayen which, although in a somewhat remote district in the interior, has the advantage of being a thickly populated area as well as a centre of official activity; its choice is further justified by the difficulties of communication still existing on the southern frontiers of the Spanish territory.

The larger districts, the boundaries of which are not yet definitely fixed, will be appropriately subdivided, if necessary, when colonisation has made the territory more accessible, but very probably there will be no necessity for this, since a comparison of the Spanish districts with those of other organisations in neighbouring colonies shows that their area will be relatively small when adequate communications have been opened up.

The larger areas on the island and the mainland were established at the outset in order to segregate and supervise cases of the disease and to avoid its spread to the continent. The index of infection in the island is known to be incomparably higher than in the continental territory, and until recently Fernando Po, in consequence of continual migrations of natives, constituted a veritable focus of infection.

Two large emigration and immigration groups comprise individuals coming from the continental territory as well as from neighbouring colonies. For purposes of investigation, these two groups are under the control of the Directorate of Health at its central laboratory.

The method employed at any given area centre, whatever its size, from the central laboratory to the most outlying post, is simple and uniform. It merely consists in making a systematic and periodical examination of all the natives living in the area, whether these present themselves of their own accord or whether they have to be summoned at an opportune moment for the examination. Blood tests may also be taken on private estates and in the villages, and an inspection is also made of general health conditions, soil, water-supply, cleanliness of dwellings, housing conditions both for the European and native inhabitants, etc. In this way the foci of infection existing in the respective areas gradually become known. It is estimated that the medical officer in each area can examine individuals and the area once a quarter in such a way that, from the results of the first examination, he may judge of the average intensity of the disease in the zone for which he is responsible, and may discover the most important foci. By treating the infected in hospital or locally, he can eliminate reservoirs of virus. He must also endeavour to check the means by which the disease is disseminated by enforcing the observance of the regulations. (*Official Bulletin of the Colony, May 15th, 1928.*)

This combined action should serve as check on the disease which, at the second inspection in the following quarter, should show a definite decrease in the percentage of infection discovered during the first visit. Special attention will still be given to persistent foci where infection remains intense, for the purpose of discovering whether the regulations are being observed, and of adopting fresh preventive measures if those compulsorily imposed have proved inadequate or have not yet been put into execution.

It has been estimated that, by the end of the year, after four quarterly inspections, the initial endemic intensity should be reduced by this means to sporadic cases: these would have to be carefully sought out and treated, since, if the campaign were abandoned at this stage, these few isolated cases might be likened to so many small cinders glowing among the ashes and capable of re-kindling the destructive fire.

As soon as the result of the daily examinations made at the area centre is known, the examination is repeated in the case of suspected individuals, and gland punctures

are made if necessary. Those who are found to be infected are then provided with a clinical record form. From time to time, all those in whom the disease has been detected in this manner are sent to the general trypanosomiasis centre by sea (in accordance with the instruction published in *Official Bulletin* No. VIII of April 15th, 1928) or, if necessary, by land, but, for preference, during the night, a general list of the evacuated patients being forwarded at the same time on a special form. After being checked by the officer in charge of the general centre on the arrival of the patients, this list is sent to the Directorate of Health for information and then returned to the centre with the clinical case records in order that the clinical history may be recorded from first to last. Those who prove to be free from infection are given the blue health card on which any other parasites and hematological findings detected by blood examination are entered. In this manner a brief account of the pathological condition of the individual is obtained. A duplicate of the card is kept in the card index.

All persons are entered on the general medical examination register, and if the area centre is provided with an establishment in which those suffering from infections other than trypanosomiasis can be accommodated, they are entered on the special registers concerned and sent there for treatment.

So long as no special cases occur to indicate the desirability of a change of method, and so long as the staff and equipment available for testing purposes remains limited, blood tests in all cases will be carried out by the thick drop method. The thick drop is then defibrinated and stained with Giemsa and Leishman. The first solution is left to act for ten minutes and without preliminary hæmolysis of the drop, since this occurs spontaneously during staining. The Giemsa is then replaced by the Leishman solution for twenty minutes, or by a second Giemsa solution for the same time. The results obtained in the way of positive reactions demonstrate the efficacy of this method, which is supplemented by other more accurate tests whenever necessary.

The standard treatment of trypanosomiasis cases for the general centre, in areas as well as in private practice, is that officially recommended. It consists in the administration of 5-10 grms. of Germanin in a solution of 10 % injected intravenously in 1 gr. doses at intervals of two and three days. This treatment is associated with the administration of 1-2 grammes of tartar emetic, in a 1 % solution and injected intravenously in doses of 10 c.c. at intervals of two and three days, either alternately with, or following, the administration of Germanin.

In exceptionally refractory cases, confirmed by microscopic examination, this treatment is given alternately with the administration of tryparsamide, tartar emetic, tryroxil, etc. Bayer 205 and tartar emetic represent, however, the standard basic treatment and usually give the best results : we shall describe these results on a subsequent occasion.

Once the course of treatment has been completed, either at the general centre or in the area, the entries on the clinical record come to an end. The patients are then provided with the red health card which contains all particulars and a photograph: a duplicate of this card is kept in the card index. They are given their discharge and indications as to the places in which they are to live, either on the island or mainland, in order that they may be handed over to the medical officers of the areas to which they are respectively proceeding.

The area medical officers must take steps to examine these patients, even if they do not come forward voluntarily, once a month, as instructed by their health card. The effect of this will be that treated patients will be kept under direct observation for at least a year and will thus be prevented from becoming fresh and dangerous germ-carriers in consequence of relapses, re-infections, etc. If, at the end of a year,

the tests do not reveal the presence of trypanosomes, they are provided with a new red card and the examinations continue, but at longer intervals. If trypanosomes are found at a subsequent examination, the patient is again subjected to systematic treatment, either at the general centre, where he will receive hospital treatment, or in his own area.

The natives of the neighbouring territories are treated, whilst on Spanish territory, like those of the colony itself so far as the action of the health authorities is concerned. They are provided with blue or red cards according to whether they are infected or non-infected or have already been treated for the disease. The parasites found in the peripheral blood are noted every quarter on the first of these cards and every month on the second. These entries enable the position in regard to the endemicity of the disease to be ascertained and may provide an indication for safeguarding measures and for the inter-colonial campaign against the most important cases of endemicity. Any native who, being the holder of a blue card, contracts trypanosomiasis has his card withdrawn and is subjected to treatment. On the completion of treatment, he is provided with a red card, which will serve as a permanent warning that special attention is required in such medical examinations as he may undergo.

Such, in general outline, is the proposed organisation. It is already working in our territories of the Gulf of Guinea and in the island of Fernando Po, on account of the present widespread infection. The scheme is being carried on with certain modifications, which have had to be made owing to shortage of labour. The effect of these modifications is to make it possible, in certain circumstances, for the patients to be treated locally by the medical officer of their area, under the immediate supervision of the Directorate of Health. Written reports of the treatment are sent in to the latter, either on a special form used when groups of agricultural labourers are concerned, or on another when influential persons are concerned. These reports are further supplemented by the summaries forwarded monthly from each area.

Natives whose financial position or personal status affords no guarantee, or who have no responsible person to vouch for them, are admitted to the general treatment centre. There the blood of the patients is chemically sterilised. A concentration camp has been provisionally established at Santa Isabel and will be transferred to the island of Elobey Chico at the mouth of the Muni—an ideal spot for the purpose; other persons may be treated locally, when this can safely be done, having regard to the patient's financial position and personal status, and if shortage of labour makes this desirable.

I.

From this description of the established organisation, it will easily be realised that everything which can be usefully contemplated in an anti-trypanosomiasis campaign has been successfully planned and carried out under our health schemes. We observe, in fact, that the first problem, that of enumeration, or, rather, the movement of natives, has been solved by the work of the Central Laboratory of the Directorate of Health, and by the medical examination of all natives, either of our territory or of neighbouring colonies, who enter and leave the island.

The census of the stable population is based upon the systematic examination carried out in the established areas and an adequate check is provided by the use of

the health card. This card combines all the features which are suitable and useful in papers for natives, as it consists of a single document containing the essential particulars of the holder's previous history, his photograph and finger prints, giving full information as to the need for periodical medical examination and used for periodical entries of the results of examinations made from time to time, so far as they relate not only to trypanosomiasis but also to other serious endemic diseases, such as malaria, filariasis, amœbiasis, helminthiasis, etc., etc. This card provides a summarised clinical and pathological record of the holder and also serves as a health passport when the last analysis made has been recorded within the prescribed period. The institution of this card thus solves the fundamental problems in regard to safeguards and the supervision and control of the natives in the territories.

Owing to the peculiarities of the native mind, recourse had to be had to certain general administrative measures instituted by authority of the Governor, whereby natives were indirectly compelled to provide themselves with a health card which must be shown for transacting all official, and even private, business which they might wish to transact. An official order published in the *Official Bulletin* of the Colony, Issue No. 7, of April 1st, 1928, directed that emigrants must produce this card in order to obtain the Governor's passport, the police visa and the travelling warrant of the shipping companies and in order to pass the inspection on the wharf and during embarkation provided for in that same order. As for the immigrants, they must produce their health card in order to obtain an identity book and the Governor's passport or permit and, if they are labourers, in order to sign on for work.

This order has been issued for the permanent native residents, who must produce their sanitary health card for the transaction of any official or even private business. Without this card, they can neither conclude a contract nor any legal selling or buying transactions, nor obtain a hunting permit, a permit to carry arms, or a building permit, nor engage in any business operations, apply for land, etc. In this manner, the measures of statutory compulsion, which are advocated in the request for an enquiry and which bring the native without fail into touch with the health authorities, have been instituted.

A number of decrees promulgated in the *Official Bulletin* of the Colony have made it clear to the natives that they must strictly observe all the sanitary regulations.

The problem of setting up observation posts at suitable spots is automatically solved by the establishment of the existing area health centres. The policy in regard to suitable medical staff and general methods of examination has also been studied and has been in operation for nearly a year, though, as in all new schemes, the organisation is still somewhat inadequate for the work.

Under this scheme, compulsory treatment of trypanosomiasis patients is stringently enforced, either by admission to hospital or in the manner explained by systematic treatment in the area, this being allowed only in consideration of the existing scarcity of labour. The Directorate of Health regards hospital treatment or the concentration of patients as absolutely essential, as it is in this manner that the most adequate, the best supervised, and consequently the most reliable treatment can be ensured.

The temporary withdrawal of trypanosomiasis patients' passports is not necessary under our scheme, as persons not coming forward for medical examination can have no passport, whilst those who are examined have either the blue card which attests their freedom from trypanosomiasis or the red card of previously treated patients. Those without cards are either persons who have not been examined or patients under treatment, whose names must appear in the report from their area, since in-patients at the general centre cannot leave the hospital.

After the treatment, a detailed account is given of all the methods employed. This account figures on the clinical record form of those admitted to hospitals and on that of the patients treated in their areas, as well as in the reports sent in by the medical officers in respect of those treated privately; the periodicity of the disease must then be entered on the health cards in the successive examinations.

II.

On our territory, the evacuation of seriously infected areas does not arise as the percentage of infection is about the same in all areas, whether of the island or of the mainland. Further, in the opinion of the author of this report, such a removal, which would have more drawbacks than advantages, is less satisfactory than the direct supervision of the foci, such as takes place in the island of Fernando Po.

III.

The health regulations published in the *Official Bulletin* of the Colony, No. VIII, dated April 15th, 1928, lay down the measures of deforestation and destruction of undergrowth, etc., which must be taken to destroy the habitat of glossinæ.

Under the proposed plan, which has been in force since the beginning of the year, the following results have been achieved:

Since November 5th, 1927, when it was created, the Central Laboratory of the Directorate of Health has made 10,547 blood examinations, both of emigrants and immigrants, and has found a total of 1,107 trypanosomiasis cases, which amounts to 10.5 per cent of the total examined.

The laboratory of the Maria Christina Hospital, which has been under Government control since October 1927, has carried out 4,700 examinations in eleven months with 500 positive results, giving a percentage of 10.64.

In the San Carlos area, in the ten months that the organisation has been established, 2,000 examinations have been made with 900 positive results, a percentage of 45.

In the Basakato del Este area, organised in January 1928, about 600 examinations have been made in seven months, resulting in the discovery of 108 trypanosomiasis cases, which gives an infection rate for the zone of 18 per cent.

In the Tuplapla area, organised in May 1928, 1,185 examinations were made in three months with 126 positive findings, a percentage to date of 10.64 for this area.

In the Concepción area, up to May 22nd, 1928, 220 examinations had been made with a percentage infected rate of 20.45 (45 positive cases discovered).

As will be seen, the total number of individuals examined in the island up to August 23rd last amounted to 19,420, with 2,779 positive findings and an average percentage of infection of 14.30 on the coast, *i.e.*, in the active and agricultural part of the island.

As regards the result of the treatment, it is yet too early to judge, and we shall not attempt to anticipate, since time must be left for the verification of the results achieved; as regards the examinations—the only point on which we can give an opinion—these results seem to have been very significant, as already shown above.

* * *

This is all we are able to say concerning the arrangements made for the campaign against trypanosomiasis in our Guinea territory. As will be seen, for more than a year past, we have made all the investigations indicated by the most competent authorities

as useful in the campaign against this great endemic. As regards the international work to be done to combat sleeping-sickness, especially in its spread from one locality to another, the present writer considers that it is essential that all the countries which have colonies suffering from this disease should, apart from the intensive work carried out in their own territories, adopt a uniform type of health card similar to the cards employed in our territories. By means of these cards, and with the help of a control stamp, a system of health control could, without great difficulty, be established, provided the greatest care was taken in carrying through whatever measures might be adopted in this connection.

The health card issued in any particular colony might be utilised as a health identity card in the same colony and, when the holder entered a neighbouring colony, the first health station would see whether the formalities of periodical examination had been complied with. If the last examination mentioned had been made within the regulation period, the card could serve as a health passport, and by means of a stamp of the nationality concerned it could be legalised for the territory of the colony, where the native would continue to be subject to periodical examination, until he went to another colony or returned to his colony of origin. When he did so, the first station would in the same way inspect his health card and make the necessary entries, and the same would be done every time and in each place visited by the native carrying this card.

The foregoing is a summary of all the information that we are able at present, to supply as a contribution to the proposed investigation, and we shall not fail to communicate later any interesting facts which may come to our knowledge in the course of our campaign, should they appear to be of general value.

Santa Isabel, September 14th, 1928.
