LEAGUE OF NATIONS

Health Organisation

INTERGOVERNMENTAL CONFERENCE OF FAR-EASTERN COUNTRIES ON RURAL HYGIENE

Preparatory Papers :

REPORT OF FRENCH INDO-CHINA

GENEVA, 1937.

European Conference on Rural Hygiene

(June 29th-July 7th, 1931.)

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INTRODUCTION.

With a view to preparing for the Intergovernmental Conference of Far-Eastern Countries on Rural Hygiene convened by the Council of the League of Nations at Bandoeng (Netherlands Indies) for August 3rd, 1937, the various countries invited to attend have been asked to draft National Reports dealing with the various questions on the agenda of the Conference.

Attached herewith is the report of French Indo-China, drawn up by Dr. P. M. DOROLLE on the instructions of the Inspector-General of Medical and Public Health Services, with the assistance of members of the delegation in matters of which they have special knowledge.

The delegation of French Indo-China will be composed as follows :

His Excellency HOANG TRONG PHY, Tong-Doc of Hadong Province, *President of the Delegation* ;

Dr. P. M. DOROLLE, Senior Medical Officer, *Secretary of the Delegation* ;

M. AUTRET, Pharmacist, Head of Laboratory at the Pasteur Institute (Nutrition ; chemical and bacteriological control of drinking-water) ;

M. F. M. BRACHET, University Professor ;

Dr. P. L. CHESNEAU, Senior Medical Officer ;

M. G. KALESKI, Chief Engineer, Public Works Department ;

Dr. H. MORIN, Director of the Indo-China Anti-Malaria Service ;

M. G. L. OUDOT, Agricultural Adviser ;

M. F. X. VINAY, Officer of the Civil Administration Service ;

M. TRAN VAN THIN, Indo-Chinese physician.

INTERGOVERNMENTAL CONFERENCE OF FAR-EASTERN COUNTRIES ON RURAL HYGIENE

(*Bandoeng* (*Java*), *August* 3*rd*, 1937.)

REPORT OF FRENCH INDO-CHINA

I. HEALTH AND MEDICAL SERVICES.

1. Principles governing their Organisation.

For administrative purposes, French Indo-China constitutes the Indo-Chinese Union which is under the authority of a Governor-General and consists of one colony—Cochin-China—and four protectorates—Annam, Tongking, Cambodia and Laos. To Indo-China is attached the territory of Kwang-Chau-Wan leased by China. Each of the five countries of the Union is under the authority of a Resident-General (in the protectorates) or Governor (in Cochin-China).

At the beginning of the nineteenth century, long before the arrival of the French in the country, a great emperor of Annam, Gia Long, laid the foundations of an Assistance Service, comprising provincial doctors ranking as mandarins, homes for the sick and indigent and leper villages. In the south of the territory, Jayavarman VII, the great king of Cambodia who built the Bayon at Angkor, had, as far back as the twelfth century, founded over a hundred hospitals in connection with monasteries throughout the Khmer empire, which extended from Laos to lower Cochin-China.

These enlightened attempts, however, failed to survive the upheavals, invasions and revolts to which the country was later exposed, and it was not until the French occupation,

in 1862 in Cochin-China, and in 1897 in Annam-Tongking, that the first institutions for medical care were opened to the natives of the country. After a period of organisation, all the credit of which belongs to the Colonial Army Medical Corps, the Medical Assistance Service was officially created in 1905 and took over the hospitals and field ambulances founded by the civil and military authorities and by private initiative.

In 1931, the military and civil health services which previously had been under the authority of a single Inspector-General were separated.

At the present time, the Inspector-General of Public Health, who is attached to the staff of the Governor-General and is a member of the Governing Council, is responsible for all matters relating to health and medical care. He is responsible for superintending the activities of the frontier, seaport and airport health services, hospitals and similar establishments and health, medical care and social services, and for initiating and maintaining co-operation with private organisations. He advises with regard to the medical and public health estimates of the various countries of the Union, which the local authorities are required to submit to him, and on all schemes for the erection of public health establishments, hospitals, special institutes, etc. On the technical side he controls the Local Health Directors who, in each of the five countries of the Union, direct the activities of the health service under the instructions of the heads of the local administrations.

Each country is subdivided into areas called provinces (of which there are eighty-eight in the whole of Indo-China) of varying size, some—*e.g.*, Thanh-Hoa in Annam—having populations of over a million. Each province is under the authority of an administrator, or Resident as he is called in the protectorates, the native administration being in the hands of a mandarin or other official of high rank. The health service is represented by a provincial health officer, who is attached, for technical purposes, to the Local Health Director and, for administrative purposes, to the Head of the province.

The staff of the Medical Service provide medical attention and at the same time are responsible for general health work. This combination of the two classes of work in a single service,

which has come down to us from the period of organisation, has had to be retained. In 1930, it was thought that advantage might be taken of the prevailing prosperity to set up—gradually and with all due circumspection—a separate service to take charge of public health work and preventive medicine. Circumstances compelled the health administration to abandon this project, which would have entailed expenditure out of proportion to the funds available during the years of depression.

It is, no doubt, fortunate that the old form of organisation has been maintained. It would, indeed, appear that the rural populations are not sufficiently advanced to be able to grasp the purpose of a public health service, in which they would see nothing more than a coercive organisation whose duty it was to apply, with no immediate benefit to themselves, health rules the value of which they would not always realise.

The doctor who provides medical attention and at the same time is responsible for the application of public health measures is, on the contrary, a familiar figure, and they trust him. By his ministrations he is gradually able to gain the support of the mass of the people. But, in any case, even if it had been possible to carry out the project of organising a special staff of doctors to undertake public health work, there can be no doubt that, in the course of their rounds, such officers could not have avoided giving advice and attention to any sick persons who applied for it, as the latter would never have understood that a doctor could refuse to help them.

It is admitted in Indo-China that, to secure the full efficiency of these services, the ideal would be the separation of medical treatment proper from public health work ; this has, moreover, actually been achieved in the larger centres through the organisation of public health services which are quite independent of the hospital services. It is thought, however, that, having regard to the comparatively backward state of the country, the time is not yet ripe for the application of this principle to the organisation of provincial and rural services.

The decentralisation of these services is necessitated by the extent of the territory and by the administrative organisation which, in its turn, is the inevitable consequence of differences

of race and interests as well as of the pre-existing administrative divisions. Improved communications have done little to change the administrative structure, the basic unit of which is still the province. The organisation of health services under five local directorates corresponding to the five countries is still inevitable ; an attempt which was made, for reasons of economy, to group the Cochin-China and Cambodian services under a single directorate very soon resulted in the deputing of powers of sub-director to the senior Cambodian medical officer, and, shortly afterwards, the reconstitution of the two independent directorates.

Unity is adequately ensured by the Inspector-General, who is attached to the central administration of the Union, co-ordinates the work and is empowered to make the necessary technical suggestions to the heads of the local administrations. Similarly, it is the Inspector-General who is, in the main, responsible for the co-ordination of the activities of the health services proper with those of the scientific services (Pasteur Institutes) and the other services concerned with the welfare of the native population (agriculture, public works, public instruction). There is no permanent machinery for practical co-operation between these various departments, and one of the fortunate results of the Conference initiated by the League Health Committee will have been the emphasis it has laid upon the value of such co-operation by bringing together the members of the various national delegations and thus leading to exchanges of views between the representatives of services that are working on parallel lines and have much to gain from concerted action.

It is scarcely to be expected that there will be any substantial increase in the appropriations made for the health services, which, in certain budgets, account for 10% of the total expenditure (see below, *Budgets*). The regular increase in the population at the rate of approximately one million every five years necessitates ever greater efforts as regards both the organisation of medical care and the application of preventive measures. A plan of action based upon a clear conception of what is and is not practicable within the limits of the available funds had therefore perforce to be drawn up.

The activities of the public health services in Indo-China are governed by two factors of vital importance : in the first place, the increase in the number of Indo-Chinese native doctors, with qualifications equal to those of doctors from the home country, whom experience has shown to be fit for posts of great responsibility—a subject to which we shall revert when dealing with Staff—and, in the second place, the existence of a traditional pharmacopœia, of considerable value and influence.

The development of medical teaching and the training of large numbers of doctors of Indo-Chinese origin make it desirable to readapt staff organisation on the lines of gradually substituting native for European doctors in the majority of posts—a change which will lead to substantial savings, as is explained below.

Traditional medicine is a factor which cannot be neglected in any programme of medical care. It derives from two sources, which, though differing in importance, are by no means unrelated : the Cambodian system of traditional medicine and the Sino-Annamite system. Cambodian medicine combines a jumble of magic incantations and witchcraft practices with a large number of formulæ making use of local plants. The Kruv or Cambodian doctors, for example, have for centuries handed down by oral tradition knowledge of the action of chaulmoogra in the treatment of leprosy and even use the Krabao variety (*Hydnocarpus anthelminthica*) with which we are familiar to-day. Sino-Annamite medicine, which is practised among a much larger population (sixteen to seventeen millions), derives from Chinese medicine, whose forms, modes of preparation and drugs and remedies it has adopted with local modifications due to the incorporation of old peasant remedies and the use of certain plants peculiar to Annam. Side by side with this traditional medicine as practised by the Annamite doctors, there is also Chinese medicine proper, frequently modernised in its externals. In one or other of these forms, traditional medicine retains the confidence of the vast majority of the population in spite of the inefficiency and blunders of certain more or less amateurish medicasters. There exist in the country thousands of modest booths of old-style practitioners and noisy shops of the patent-medicine sellers, who

have no qualms about adding to their own products Western remedies more or less transformed and adapted to the tastes and purses of their customers. The latter, in spite of their attachment to the traditional medicine, are not unaware of its shortcomings and resort to Western methods when local forms of treatment fail. Even so, the medicaments imported from China and cleared through the Customs represent an annual value of several millions of francs. Those obtained and prepared locally may be estimated at a much higher figure.

These figures are the measure of the people's attachment to the traditional medicine. Furthermore, all attempts at control, even though made with the sole and declared object of punishing the improper use and preventing the imitation of European medicaments, have met with the keenest opposition in the Press and on the part of the native members of the representative bodies.

Every allowance must be made for this state of affairs and here, as in the other Far-Eastern countries in which Chinese medicine is established, there can be no question of its prohibition.

The study of the traditional pharmacopœia, for which the ground has now been largely cleared by patient research, should be developed through the institution at the School of Medicine of a laboratory of native pharmacology which would select, from the mass of traditional medicaments, the remedies worthy of retention, on the lines of the work done at the Haffkine Institute, Bombay. Official training for native herbalists, with a proficiency certificate, would also be valuable as a means of familiarising drug sellers with the properties of their wares and the posology of the simples which form the basis of native therapeutics and, in this way, of avoiding many mistakes and over-dosing. Such a measure would be welcomed by the natives, who have twice urged the opening of a school of Sino-Annamite pharmacy.

Subject to these reservations, the traditional pharmacopœia and medicine must be respected in so far as they are conducive to the maintenance of public health. Through their unquestionable prestige among the people and the cheapness of their remedies, they enable the vast majority of those suffering

from the milder complaints to obtain treatment which we should be unable to give them and which we could never provide without increasing the cost of medical provision to a figure out of keeping with the country's budgetary resources.

The lightening of the task of the public services through the intelligent use of traditional medical systems makes it possible to equip the country with the hospitals and dispensaries capable of providing the complicated treatment required by the serious illnesses for which the natives have recourse to us. Such is the *raison d'être* of the hospitals, the equipment of which is being constantly improved with a view to the highest possible degree of technical efficiency. By thus limiting their curative activities to forms of treatment which are beyond the resources of the traditional systems of medicine, the health services are able to devote a greater part of their attention and funds to prophylaxis and preventive medicine.

2. Staff.

(a) *Doctors.*

The medical and public health services are staffed by European and native doctors differing in both origin and training.

The European doctors, of whom there are in all 110 (actually at their posts), belong, in the main, to the civilian staff of the Medical Service and are recruited by competitive examination. Some twenty posts are held by doctors of the Colonial Army Medical Corps, who are seconded for service under the civil authorities. In the less densely populated frontier districts, certain Army doctors take charge of the Medical Service for the native population in addition to their military duties. There are a few civilian doctors, mostly specialists, who are put in charge of services in certain central hospitals, under contract or on a fixed allowance. The figure of 110 European doctors given above does not include the members of the teaching staff of the Higher School of Medicine, consisting of full professors and lecturers whose hospital classes at Hanoi are given in the hospitals of the Medical Service, in the running of which they thus play a preponderant part.

The native doctors, of whom there are 240 in all, belong to the Indo-Chinese staff of the Medical Service. The great majority of them are Annamites, doctors from Cambodia and Laos being rare.

The first Indo-Chinese students to graduate at the Hanoi Medical School were passed out in 1906. In 1909, three of the most brilliant of the school's pupils were sent to France to complete their studies at the Paris Faculty of Medicine.

From that time onwards and until last year the Hanoi School continued to train students for a local diploma. At the same time, an increasing number of young Annamites went to Europe to study, or to complete their studies, for the French State Diploma of Doctor of Medicine. Some of them entered the administrative services on the native side, or even, after taking the competitive examinations in France, on the European side of the Medical Service.

Down to 1934, the Hanoi School only awarded a local diploma, which was obtained after a four years' course of theoretical and practical studies. The pupils, all of whom received scholarships from the administration, were only required to have received a higher elementary education, as evidence of which they had either to produce a certificate or to pass a general entrance examination. The school was staffed by French teachers not belonging to the teaching staff of the medical faculties in the home country.

Twenty-five years' experience of this system showed its practical results to be excellent.

The number of Annamite students studying in France for the State diploma rapidly increased, however, some doing brilliant work and even succeeding in becoming "internes" of the hospitals in Paris or other faculty towns. The native doctors thus fell into two categories : doctors of medicine, and simple Indo-Chinese doctors ; the latter, whatever their ability, were in danger of finding themselves in a position of inferiority as compared with their more fortunate compatriots who had been able to study, or complete their studies, in France. The extension of secondary education, whether of the pure French type or of the mixed Franco-colonial type, adapted, particularly as regards the humanities, to traditional Indo-

Chinese culture, made it possible to discontinue the training of local doctors and to convert the School of Medicine into a Higher School of Medicine, giving exactly the same courses of instruction as the French faculties and requiring its students to possess the same certificates for secondary and higher studies (Baccalauréat and certificates for physics, chemistry and biology).

The new school is directed by a full professor of the Paris Faculty of Medicine. The teaching staff is recruited by means of the highest of all French university competitive examinations, the " Agrégation " of the faculties of medicine.

During a transitional period, the school performed the functions both of a local school and also of a State school of the highest grade, at which students could take the first four years of the course for the State diploma. The result was that, in the very first year after the foundation of the Higher School of Medicine—*i.e.*, 1935—the first diplomas of doctor of medicine were awarded after examinations and the submission of theses presided over by a professor sent out each year by the Paris Faculty of Medicine.

It is difficult to compare the two types of training successively adopted for young Indo-Chinese doctors. The second, that of the Higher School of Medicine awarding State diplomas, was the result of the country's general progress, the development of secondary education, and the growth of the hospital services in the capital, affording students the necessary facilities on the clinical side. The earlier system, that of a Medical School awarding a local diploma, was in keeping with the country's requirements and possibilities at the time of its adoption. It also did very valuable service in turning out trained practitioners and thus facilitating the creation and development of the Medical Service. The transition to the second system of training was effected gradually as part of the general advance that is reflected in the foundation, at Hanoi, of a University already comprising higher schools of medicine and law and to be completed in due course by the addition of faculties of arts and sciences.

From the point of view of the medical and health services, the local training of doctors holding the State diploma represents a considerable step forward, the significance of which deserves special emphasis. It means that, as locally trained doctors

come forward who qualify—by passing the competitive examinations or by producing the adequate diplomas—the Government will appoint them to posts at present held by European doctors. This policy has been boldly followed in French Indo-China for a number of years. In 1936, forty-one out of eighty-eight vacancies in the provincial Medical Assistance Services went to Annamite doctors holding the State or local diploma, and certain of these posts were in the more important provinces—*e.g.*, twelve in Tongking, seven in Annam, six in Cochin-China, nine in Cambodia and seven in Laos. Experience has shown that these appointments were justified and that the same policy can be gradually and cautiously extended, as several Annamite doctors with the necessary professional experience and personality have shown themselves worthy of permanent appointment to positions of authority which they had previously occupied in a temporary capacity with conspicuous success. This tendency will inevitably become more and more pronounced as the young doctors trained in the faculties in France or at Hanoi apply for admission to the service, especially as some of them possess, or will possess, first-class university or hospital qualifications. Already there are in Indo-China at least six Annamite surgeons capable of successfully performing the most difficult general surgical operations and some ten highly qualified nose, throat and ear and eye specialists. The same is true in other special branches of medicine : the largest lunatic asylum in Indo-China, which receives patients of all races, is directed by a Cambodian doctor holding the rank of Chief Medical Officer in the French State Asylums Service. Other Annamites are in charge of important services for the treatment of skin and venereal diseases and tuberculosis and are acquitting themselves most creditably.

In short, as their professional qualifications and standing improve, the doctors of Indo-Chinese origin are gradually coming to occupy their rightful place in their own country. This policy naturally presupposes the gradual reduction of the European staff ; but, although the French population is becoming increasingly inclined to discard its prejudices and have recourse to the services of Annamite doctors, a sufficient number of European practitioners must nevertheless be

maintained in the larger centres to ensure freedom of choice. Everywhere else, however, the French Administration could not, without appearing to confess the failure of its own methods of education, refuse to Annamite doctors the place occupied in their respective countries by their immediate or more distant neighbours, the doctors of Siam, China or Japan. Experience would not even seem to point to the necessity of creating medical areas in which a European doctor would be appointed to superintend the Indo-Chinese doctors in charge of the provincial medical services. The supervision of the local Director under the present organisation would appear to be sufficient.

The gradual displacement of European doctors by their Indo-Chinese colleagues, inevitably less highly paid, as they serve in their own country without the risks and expense attendant on expatriation, will make it possible to employ a more numerous staff without increasing expenditure.

Indo-Chinese doctors who do not belong to the administrative services or who have retired or resigned from them are attracted by the prospects of practice in the larger towns. In 1936, there were eighty-seven such doctors registered as being in practice in the various countries of the Union (forty-four doctors of medicine and forty-three with local qualifications). Fifty of these, including thirty-two fully qualified doctors, are in practice in the big cities (Saigon, Cholon, Hanoi, Haiphong etc.) ; thirty-two, including twelve fully qualified, in the provincial capitals (particularly Cochin-China) and only five, none of whom possess the State diploma, in the rural centres. This distaste for country practice is due to the liking for town life they develop during their student days and also to the difficulty of earning a sufficient income in the country districts, where patients able to pay for Western medical attention are rare. The difference between the standard of life of the masses and that expected by the young doctor just setting up in practice is undoubtedly considerable. He aspires to an income quite out of proportion to the average earnings of manual workers and peasants. In consequence, the efforts made to induce doctors to settle in the country districts have so far met with little success. The best method is to place doctors willing to settle

in rural centres in charge of small subsidiary health services (medical stations) with a monthly allowance to supplement their earnings. A model contract has been drawn up and is in use in Annam.

The overcrowding of the medical profession in the large cities and even in the chief provincial capitals (one such town, Cantho in Cochin-China, has five registered practitioners) will undoubtedly lead doctors to seek a livelihood elsewhere and will induce them to take up rural practice, for which they are at present disinclined.

(b) *Auxiliary Staff.*

Until the last few years, the only *midwives* were those in possession of the local diplomas conferred by the midwifery schools at Hanoi and Cholon (for Annamites) and PnomPenh and Vien-tian (for Cambodians and Laotians). This purely local diploma was awarded after a two years' course of theoretical and practical studies, and the teaching was sometimes given in the language of the country. The standard of general education required for admittance to the schools was quite elementary. As planned, this system turned out native midwives who did, and, indeed, are still doing, excellent work, but whose standard of general education and technical training was below that which is now possible. The considerable development of women's education and the taste for study shown by the Annamite girls have made it possible to introduce a system of university training leading up to the State midwifery diploma. Girls wishing to take up such studies are required to have passed through a higher elementary school. Their general education enables them to follow and profit by the full course of training given at the Higher School of Medicine by the Professor of Clinical Obstetrics. These " State-certificated " midwives will gradually take the place of the local midwives, the recruiting of whom has already been discontinued in Tongking and will soon be discontinued in Cochin-China.

In all, the Medical Services employ 330 Indo-Chinese midwives, of whom approximately 200 are in Cochin-China, where most of them are employed as rural native-trained midwives. (In

1935, such women attended 15,000 births in Cochin-China.) In Tongking, Annam, and more recently in Cambodia, the provincial maternity centres have been turning out rural native-trained midwives (or "ba mu" as they are called). These women are sent for training by their villages, and while at the centres learn how to deal with normal confinement cases and are taught the rudiments of asepsis and mothercraft. On their return to their villages, provided with stocks of the more usual antiseptics and simple dressings, they attend women in childbirth in their own homes or in small rural maternity centres. They must be able to anticipate cases of difficult parturition and send the patients to hospitals. They are gradually displacing the old-fashioned "handy women" and in Tongking, where they number 700, they attend more than half the known births. They are remunerated by the villages or by their patients, frequently in kind.

Sick Attendants.

The staff of sick attendants is approximately 1,600 strong, not including the service staff, which numbers about 2,000.

European sick attendants of whom there are about fifty, both women and men, are only employed in the hospitals in the large towns. In certain provincial hospitals, the nursing is done by some fifty women belonging to religious orders.

From the point of view of the medical service in rural districts, the native staff is alone of any importance. It is variously trained and the standard of efficiency is uneven. In Cochin-China, training is given at a nursing school attached to the hospital at Cholon. In the other countries, this personnel is trained in the principal hospitals, to which it is attached for periods of varying length, undergoing a proficiency examination. Apart from those attached to the health service staff at provincial centres, native sick attendants are placed in charge of rural infirmaries and dispensaries, of which there are 339, and go on vaccination rounds.

The present tendency is to organise and train this staff on special lines. Its members will be recruited in the villages in which they will later be called upon to serve and by which they will be remunerated, partly in kind (house, garden, strip of rice

field) and partly in cash, though naturally at a lower rate than sick attendants in the Government service proper. The training of the rural staff must be designed to fit them to act as auxiliaries who will not seek to usurp the doctor's functions but will be able to recognise cases requiring hospital treatment or the attention of the doctor on his next round. A special handbook has been compiled for the use of rural sick attendants. Thus organised, the rural nurses will meet with the people's approval, whereas the sick attendant sent out from the provincial capital, a stranger to the village and too frequently inclined to make improper use of the modicum of authority with which he is invested, frequently arouses the distrust of the notables and other inhabitants.

Hitherto, sick attendants have been mainly recruited among men, the number of women nurses representing only about one-tenth of the total. It has, however, been found that the recruiting of fully qualified State midwives, and in certain countries rural native-trained midwives, is now ensured. It would appear that the improved education of girls and the rapid progress of the emancipation of women will make it possible to recruit well-educated women nurses from the more reliable sections of the community. The courses given under the auspices of the Red Cross Societies are followed, not only by young French women, but also by young Annamite women of the highest social standing.

3. Curative and Preventive Action and Health Promotion.

Within the framework of the general organisation described above and the plan of action governed by the two fundamental factors—maximum utilisation of the services of Indo-Chinese doctors and respect for traditional medicine, in so far as it can contribute towards the maintenance of public health—the unit through which the health service functions in Indo-China is the province. Here a description of the manner of its operation in a typical province should prove helpful. The type of province considered would be an one important in a poor, densely

populated district (North Annam, for instance, where one province has as many as a million inhabitants).

The province, of which the most densely populated centre is the capital and headquarters of the provincial administration and various departments, is divided into administrative districts, varying in size as regards both area and population.

The medical service is modelled on this administrative organisation. It consists of :

Hospital at the chief town of the province.

Field ambulances or infirmary-maternity hospitals at the headquarters of the important administrative districts.

Rural infirmaries or first-aid stations throughout the province, usually at the headquarters of the less important districts ; but other factors such as the insanitary condition of a district, communications and over-population may also be taken into account in deciding where these rural infirmaries are to be established.

(a) *Curative Action.*

The hospital of the chief town of the province is well organised and has a trained staff and adequate equipment to meet all contingencies. It admits and treats patients suffering from medical or surgical complaints, not only from the town, but from the whole province. Patients are sent there from the ambulances and rural hospitals. The hospital plays a prominent part in popularising Western methods of treatment, and is thus of the greatest benefit to public health.

In view of the comprehensive treatment given there, the principal provincial hospitals are provided with modern equipment—surgical and radiological appliances, bacteriological and biochemical laboratories, and special wards, particularly ophthalmological.

These hospitals also act as centres for the training of young doctors who have just completed their courses of study and for the instruction of sick attendants, who are required to serve a period of probation there before passing on to the rural

stations, and to take the necessary theoretical courses and practical training.

The hospitals have to be reserved for patients who will benefit from treatment, and must not be crowded with the infirm and incurables. These have to be left to the welfare societies, whose activities are now developing daily, with the support of the authorities.

Within the provinces, the chief towns of important districts and the densely populated areas have a small health centre with maternity and operating services.

They are in charge of an Indo-Chinese doctor, who is assisted by a staff (midwife and sick attendants) commensurate with the size of the centre.

The competence of the staff, the arrangement of the buildings, and the equipment available must be such as to permit of all obstetrical procedures and all minor surgical operations. These services are highly valued by the population, because no risk is incurred, and they also provide the best training for the emergency operations which have to be performed in secondary centres.

The limited in-patient accommodation is reserved for surgical or serious medical cases, or patients not in a fit state to be moved.

Arrangements for removals to the hospital of the chief town are made with the administrative authorities, and patients are taken by motor ambulance or, if necessary, by water or by palanquin, if the distance is short.

Each of the administrative areas of the province has also one or more rural infirmaries or first-aid stations, according to its importance, provided, of course, that the financial resources of the province permit.

Except where insanitary conditions, communications and over-population suggest some other location, it is highly important that these infirmaries should be established at the chief town of the district itself, as close co-operation with the native administrative authorities is essential if they are to function satisfactorily.

It is essential to secure the co-operation of the district chief if the vaccination campaign is to be thorough and comprehensive,

if the visits of the medical officer are to yield their full value, if all the measures ordered by the medical service in connection with the health and cleanliness of the villages are to be carried out, and, lastly, if the removal of patients to the ambulances or the hospital of the chief town is to be carried out without difficulty. Such co-operation is more likely to be secured if the rural hospital is at the chief town of the district.

While the villages concerned can often be asked to contribute towards the construction of these rural hospitals, they must be maintained out of the provincial budget if adequate continuity is to be secured. Indeed, in some areas, the villages have agreed to pay a special tax to enable the infirmaries to function.

The rural sick attendant, who is taken preferably from the area in which the infirmary is situated, is required to possess professional and moral qualities which make him a valuable assistant.

Every effort has to be made, therefore, to train a body of rural sick attendants conscious of the important part they have to play, because they are in permanent touch with the rural population. The example set by the heads, the repeated instructions, and the publication of very satisfactory text-books, which appeal to the Annamite's natural eagerness to acquire knowledge of all kinds, contribute to this end.

The medical and health activities of a rural infirmary, the extent to which it spreads its influence afield, depend on the tours made by the sick attendant in the district within the area of the hospital.

A programme of monthly tours is carefully prepared by the chief medical officer, by arrangement with the native administrative authorities ; all the villages have to be visited periodically by the sick attendant.

The programme of tours, taking account of the different factors which vary with the district visited—density of population, insanitary condition of the district, means of communication, etc.—is communicated to the people, who are notified through the chief of the district of the exact date of the sick attendant's visit.

The object of these tours is not to give treatment to every sick person, but to *detect* and direct to treatment centres—that is to say, the rural infirmaries, the ambulances and the central

hospital—a whole class of patients who would benefit from treatment at one of these health centres. The sick attendant receives definite instructions as to the category of cases, for the most part surgical.

During these tours, the sick attendant may, of course, be called upon to give first aid. He is therefore supplied with a medicine chest containing carefully selected drugs and dressings.

He gives the notables and inhabitants health instructions and advice—concerning the cleanliness of the village, anti-malarial prophylaxis, personal cleanliness, the protection of the water-supply, etc. He draws up, on a special printed form, a "health record card" for each village visited, containing information for the use of the medical officer of the infirmary or ambulance.

The necessary corollary to the tours made by the rural sick attendants are the periodical tours of the chief medical officer to the infirmary or ambulance. The rural infirmaries are visited once or twice a month, according to the size of the province and the number of rural infirmaries.

The programme of tours is drawn up in advance, and is communicated, not only to the rural sick attendants (these tours are not surprise inspections, which would be valueless), but also to the chiefs of districts, and by them to the chiefs and all the inhabitants of the villages.

All the cases detected by the rural sick attendant during his monthly tour are seen by the medical officer, who takes with him one or two assistants and the necessary equipment. He gives such treatment as he considers necessary at the rural infirmary itself—for instance, treatment for entropion, ablation of pterygium, circumcision for phimosis, removal of cysts, lancing of abscesses, dental extractions, scraping of ulcers, etc.

On the occasion of the visit it is in keeping with the traditional mental outlook that the district chief or his representative and the cantonal and communal authorities should attend and that the village authorities should decorate the infirmary. These measures appeal to the imagination of the peasant and give him confidence. They should not be overlooked.

If, during his visit, the sick attendant has made observations as to the health condition of certain villages, the assembled

notables receive such health instruction and advice from the medical officer as is considered necessary.

Lastly, a decision is reached as to the removal of patients to the hospital, and this is carried out immediately either by motor-ambulance of by arrangement with the district chief.

The medical officer is able to get into touch with and increase the confidence of the rural population by means of these tours. In view of the extension year by year of the means of communication and transport, they are quite compatible with active and valuable hospital work.

(b) *Preventive Action.*

But, as we have seen, the provincial medical service is not restricted to curative medicine.

Its personnel, equipment and budget also serve for preventive action, which make it a real public health service.

Here co-operation between the various services is essential. We shall see how this can be brought about within the narrow limits of a province.

The provincial medical service is responsible for the following activities :

Anti-smallpox vaccination. The most careful preparations are made, in full agreement with the native administrative authorities, whose assistance is essential at all stages, and anti-smallpox vaccination is administered by the rural sick attendants in their respective areas under the supervision of the doctors.

Anti-cholera inoculation is restricted, when there is no epidemic, to the organised centres and to some of the most vulnerable points ; but it can be extended at once should an epidemic suddenly break out.

Anti-typhoid vaccination is confined to the centres.

BCG vaccine is now administered at all maternity hospitals.

In addition to the above, the medical service provides treatment for certain endemic diseases.

Anti-malarial prophylaxis. — Anti-larval measures and medical prophylaxis in towns, villages and centres. Information and detailed instructions are given to the health service on application to the anti-malarial service of the Pasteur Institute.

Anti-venereal prophylaxis. — Anti-venereal clinics providing for full treatment on modern lines is provided at several hospitals.

Trachoma prevention, which is indissolubly linked with popular instruction in hygiene. The schools give most valuable assistance, and the co-operation of the medical and educational services is essential.

Prevention of water-borne diseases. — This brings up the whole problem of the supply of drinking-water to both towns and villages. An example of the practical work which has been done at a low cost in this connection, through co-operation, within the provincial organisation, between the health and public works services will be found in the chapter on sanitation.

Leprosy prophylaxis. — The function of the provincial health service is to detect and classify cases.

The training of rural native-trained midwives or " ba mu ", whose duties are defined under " personnel ", also constitutes preventive action. The best of these are drafted to small rural maternity homes, some of which are attached to rural infirmaries.

(c) *Health Promotion.*

Lastly, it is the Provincial Medical Service which is responsible for spreading a knowledge of hygiene among the people. This will bring about an improvement in public health and well-being.

Wherever the medical inspection of schools is carried out on carefully planned lines (though different from those followed in Europe), the pupils render valuable services in popularising hygiene throughout the village.

Thus, the health inspection of school buildings and especially lectures for the teachers and talks for the pupils in accordance with a carefully planned programme are most valuable, as experience has shown, in spreading a knowledge of hygiene. Account should also be taken of the instructional value of the care provided for sick school-children by the medical service and of its preventive action—vaccination, dental care, correction of defective refraction, anti-malarial and anti-trachoma measures.

Outside the schools, health propaganda is conducted among the mutual education societies, the native officials of all ranks, and the centres.

The rural population is more difficult to reach. With the aid, however, of the health record-cards which are prepared by the rural sick attendants on their tours, the medical officer is able to concentrate usefully on specific problems. The chief town of the district with its administrative buildings—schools, hospitals, etc., which are bound to set an example of cleanliness and hygiene—provides what is no doubt a slow, but none the less an effective, means of propaganda.

Posters and pamphlets issued in the first place to infirmaries, schools and administrative buildings, and disseminated by degrees in rural areas, can do useful service in spreading a knowledge of hygiene.

The Provincial Medical Service cannot perform its public health duties satisfatorily, however, unless there is close co-operation with the various other departments.

In the first place, there must be co-operation between the French and the native administrations. The medical officer of health, whose work is sometimes difficult and often thankless, must feel he can count, not only on the administration's understanding, but also on its encouragement if he is to devote his public spirit, his physical strength and his moral and professional qualities for fulfilling so difficult and complex a task.

The support of the native administration is also essential if he is to acquire the necessary authority and establish contact with patients in villages.

With the co-operation of the Education Service, he can enlist the valuable support of masters and pupils in spreading a knowledge of hygiene in rural districts.

Co-operation with the Provincial Public Works Department is essential for both anti-malarial measures and local sanitation and providing a supply of drinking-water. An example will be given below.

Close touch with the Veterinary Service is also useful for the prevention of animal diseases which are transmissible to man and for the inspection of slaughterhouses and markets.

This plan of action within the unit formed by the province has been carried out satisfactorily for many years in many parts of the territory. The natural tendency shown by some to confine themselves too strictly to specialising in hospital treatment is discouraged by the responsible health authorities, but in the very large centres the calls on the clinical services are so heavy that the staff is unable to devote sufficient time to visiting the interior. The gradual introduction on a large scale of doctors trained locally, as described above, will be an essential factor if rural health work is to be done on a really comprehensive scale.

4. Budgets.

The normal expenditure on medical and health services is met from the general budget, the five local budgets, the provincial budgets and the municipal and communal budgets. Appropriations from the general budget are allocated and earmarked by the Inspector-General of Public Health, and appropriations from the other budgets by the heads of the local administrations (Governor of Cochin-China, Chief Residents of Tongking, Annam, Cambodia and Laos), on the proposal of the local Directors of Health.

The expenditure on general public health inspection, the Lanessan Hospital (European Hospital, Hanoi), the Cancer Service, and the Maritime Port Health Service, and on grants to scientific institutions (Pasteur Institute, etc.) is borne on the general budget.

All other medical and health expenditure is borne on the local, provincial and communal budgets.

Decentralisation has been introduced in recent years, and the financial autonomy of the provinces has been increased. Their budget receipts have been augmented, and in return they are responsible for a larger share of provincial expenditure. This measure, the object of which is to make the return yielded by expenditure a matter of interest to the provincial administrations and the population, has some disadvantages as regards the health services. Provincial budgets vary widely in amount ; consequently, the rich provinces are provided with all their requirements, whereas the poorer provinces, notwithstanding their needs (which, because of the very poverty

of the people, are often greater than those of the rich provinces) are reduced to a bare minimum alike of personnel, equipment and drugs.

There are exceptions. At Laos, the local budget covers all medical expenditure ; in Annam, it covers expenditure on personnel, with the exception of the remuneration of rural sick attendants ; and, in Cochin-China, it covers the remuneration of European medical officers.

To modify this state of affairs would entail considerable changes in the general plan of the budgets, particularly as regards the allocation of receipts. It is to be hoped, however, that, after the inevitable period of trial and error, the ideal solution may be adopted—to make the provincial and communal budgets responsible only for expenditure on rural infirmaries, maternity homes and dispensaries and for the maintenance of patients in the provincial hospitals ; and to make the local budgets responsible for all other expenditure, particularly expenditure on health services, the cost of sera and vaccines, expenditure on staff, equipment and medicaments for the provincial health agencies.

The following table shows the allocation of medical and health expenditure, the proportion it bears to the total of the budgets, and the *per caput* outlay.

It will be seen that this table shows only the expenditure of public bodies concerned with medical treatment and preventive medicine. The expenditure of private bodies (private, lay or religious institutions, Red Cross, etc.) could not be ascertained in the time available. Expenditure on sanitation, water-supply, and the construction and repair of hospital buildings is not shown under health expenditure when these various items are met from the ordinary budgets.

The percentage of health as compared with general expenditure increased considerably in 1935 as compared with the preceding years (4.3% in 1933 and 4.8% in 1934), as the cut made was relatively less heavy in health expenditure than in any other.

It should be noted that the differences in health expenditure per head of population in the various countries of the Union correspond to a similar difference in the general wealth of the

people and the taxation imposed on them. For instance, in Cochin-China, which has the heaviest health expenditure per head of population, the people pay twice as much personal tax alone as the natives of Tongking. It should be observed that, in the poorest countries (Tongking, Annam), the percentage of health expenditure as compared with the whole budget is higher than in Cochin-China.

Table showing Medical and Health Expenditure of all Indo-Chinese Budgets (General, Local, Provincial and Communal Budgets).[1]

	Total budget [2]	Medical and health expenditure [2]	Percentage of health expenditure	Native population [3]	Health expenditure per head of population
General budget	55,916,000	384,500	0.64	—	—
Cochin-China	33,395,000	3,167,800	9.49	4,424,000	0.716
Tongking	16,708,000	1,698,900	10.16	8,632,000	0.197
Annam	10,856,000	1,271,500	11.70	5,659,000	0.214
Cambodia	6,750,000	442,600	6.55	2,935,000	0.151
Laos	2,868,000	343,500	11.95	1,007,000	0.341
Total	126,493,000	7,308,000	5.77	22,657,000	0.322

[1] In Indo-Chinese piastres — 1 Indo-Chinese piastre = 10 French francs.

[2] General and health expenditure relates to the budget for the financial year 1935, the latest year for which the accounts have been closed.

[3] The population figures are as at July 1st, 1936. They are obtained from information supplied by the native authorities and checked as far as possible. They cover only the native population in the strict sense, exclusive of Europeans and foreign Asiatics and the army. The total population (natives, Europeans and foreigners) is about 23,300,000.

To the above health expenditure out of the ordinary budgets should be added, from 1931 on, the sums obtained from a loan fund. At the desire of Parliament and of the French Government, 10% of the sums obtained from the loan for important works in the colonies must be devoted to health expenditure. The share imputed to Indo-China for health purposes amounts to about 105 million francs, of which 100 millions (10,100,000 piastres) is earmarked for the five countries

of the Union. The expenditure, divided over several financial years, is set out below :

TABLE SHOWING ALLOCATION OF HEALTH EXPENDITURE FROM LOAN FUND.
(In Indo-Chinese piastres.)

	Anti-malarial measures	Water-supply	Hygiene and preventive medicine	Hospitals	Total programme	Expenditure from 1931 to 1936 inclusive
General Govern..	1,000,000	—	1,086,000	300,000	2,386,000	1,921,000
Cochin-China . .	495,000	1,210,000	67,000	655,000	2,427,000	1,483,000
Tongking . . .	320,000	630,000	157,000	1,265,000	2,372,000	1,712,000
Annam	295,000	561,000	220,000	180,000	1,256,000	847,000
Cambodia . . .	480,000	414,000	150,000	160,000	1,204,000	932,000
Laos	70,000	210,000	107,000	58,000	455,000	372,000
Total . . .	2,660,000	3,025,000	1,787,000	2,628,000	10,100,000	7,267,000

Average expenditure per annum since 1931 : 1,211,000 piastres.
Annual expenditure per head of population : 0.053 piastres.

In interpreting the data given in this table, it must be borne in mind that, since the works were begun, the ordinary budgets of the colony, both local and provincial, have contributed very nearly the same amount as the loan budget towards the item " water-supply ", which represents one-third of the whole scheme. Expenditure on this item may therefore be estimated at 0.017 per head of population per annum.

The average total health expenditure in French Indo-China per head per annum for past and future financial years must therefore be reckoned at 0.322 + 0.053 + 0.017 piastre = 0.391 piastre.

The significance of this figure will be appreciated when it is borne in mind that the native pays a personal tax varying, according to the country, from 2.25 piastres to about 5.50 piastres per annum, and that this tax is paid by about one-fifth or one-sixth of the population. From one-third to two-thirds of the Indo-Chinese taxpayer's personal tax is therefore returned to him in the form of treatment, health work and sanitation, from which he or his family benefit.

II. RURAL RECONSTRUCTION AND CO-OPERATION OF THE POPULATION.

As the report presented by the Astor Committee to the last Assembly of the League of Nations so judiciously observes, the problem of rural reconstruction is in essence the problem of rural poverty and its corollary, ignorance.

From this point of view, certain important development works, such as irrigation canals, roads and railways, which open up new land for cultivation, are fundamentally rural reconstruction works.

But this is not the only aspect of the problem. These measures may be highly effective, but they are external to the native in the sense that they come to him from outside. More may be expected from measures in which he himself participates, measures which appeal directly to the individual ; for, by reason of the numerical strength of the rural populations, direct action will produce a mass effect which will prove irresistible.

Moreover, when improvements have thus been made, there is no need for constant external assistance and supervision ; they become part of the life of the rural population and have a deeper and more lasting effect.

The main object of direct action on the individual will be to give him greater stamina and to make him more vigorous and better equipped, both physically and mentally, for the struggle for life.

From this standpoint, the problem of rural reconstruction may be divided under four heads—nutrition, health, environment and education—which fall within the scope of the agricultural, medical, rural engineering and education services respectively. The work of these services often overlaps, and there is frequently a need for co-operation.

The rural reconstruction programme may be divided under two heads—education and propaganda and practical schemes.

1. Education and Propaganda.

Practically the whole of the educational work and propaganda falls, of course, within the competence of the education authorities.

Rural education may be divided into two stages, elementary and primary, together with the training of native teachers.

Considerable time is devoted to hygiene in the programmes of the various types of education. It falls under three heads —ethical instruction, physical training and object-lessons (or natural science).

These are really three different points of view, three converging lines. This threefold division shows how much attention the Education Service has devoted to health instruction.

Perhaps it might be possible to co-ordinate them still further, to combine them into a single subject-matter in each class, and to follow it up as the pupils pass from class to class. In the general revision of school syllabuses now in progress, the Education Department is endeavouring, on these lines, to adapt them more closely to rural needs.

Provision is also made in the present programmes for agricultural training. It was introduced extensively in 1924, particularly in the training of native teachers. A good many rural schools have school gardens, and each teachers' training school has its garden for practical work.

The advisability of intensifying educational propaganda on agricultural work might also be considered. There certainly cannot be said to be any shortage of labour in the rice-fields ; in some overcrowded districts there is perhaps too much. On the other hand, vast areas of cultivable land are at present neglected (in the middle region, tablelands of Laos). Agricultural instruction on definite lines laid down by the competent services might be directed towards the development of these regions.

Among the many cheap elementary school textbooks in the native tongue issued by the Education Department, mention may be made of a textbook on hygiene, a handbook on physical training and a handbook on agriculture. Essentially Indo-Chinese wall charts concerning the village, rice-fields and forest, etc., are also issued.

Considerable attention is devoted, in girls' schools, to hygiene, mothercraft and domestic work, particularly from the rural standpoint. These subjects have formed an integral part of educational programmes since 1924. Below will be found short extracts from them :

Mothercraft : Weaning. — Foods to be avoided. Combating the mother's practice of feeding the child with balls of chewed rice. Danger of spice and alcoholised treacle.

Domestic economy. — Use and destruction of household refuse. The Annamite pond ; its dangers ; its possible uses. The garden ; rudiments of the use of fertilisers. Precautions to be taken in using human manure. Animal manure.

These extracts are taken from the syllabus for higher primary education ; in primary education for girls, more attention might perhaps be given to domestic training. Plans could doubtless be made for a rural domestic training school which, being more in keeping with the needs of the population, would perhaps be better attended than the present girls' schools. Most of the time available at these schools is devoted to general education, too little attention being devoted to special training for girls —hygiene and the domestic arts.

From the more general standpoint, mention should be made of the care taken by the Education Service to adapt its programme to and provide for the welfare of racial minorities (special educational agencies, special syllabus). This must not be lost sight of in dealing with the problem of rural reconstruction, the details of which may differ according to race, customs or environment (mountain or plain).

Propaganda is carried on first and foremost by the schools. Such propaganda affects children and adolescents most closely ; it works for the future. National educational problems have, however, become so important and so urgent, they are bound up with such vital interests and such imperative needs, especially in the East and Far East, that this propaganda can no longer be restricted to the training of young people. The Directorate of Education therefore intends to institute

courses for adults which will be a most useful and satisfatory complement to the present educational work.

These courses for adults, which will be given throughout Indo-Chinese rural areas and will be attached as it were to every rural school, will form admirable centres for propaganda on rural reconstruction.

As soon as the competent services (agricultural, health, etc.) have informed the Education Service, in a simple, clear and suitable form, of the ideas and practices to be inculcated among the rural populations, the 10,800 Indo-Chinese men and women teachers, in their adult courses or in lectures specially arranged for the purpose, will immediately put them before the rural populations with the necessary explanations.

This direct approach to adults through a teacher who is known and respected and whose prestige stands high in the tradition-bound rural areas, cannot but have a more direct effect and penetrate more deeply among the peasantry.

Direct propaganda is also carried on by the medical services. On the one hand, the medical inspection of schools offers an opportunity for conversations and for individual or collective advice ; this mainly takes the form of talks to teachers and pupils, either in French or in the languages of the country, by European and Indo-Chinese doctors, according to a pre-arranged plan. It is undoubtedly effective. Further, the health service in the provinces always co-operates in lectures given to the mutual education societies, of which there are very many in Indo-China. They are attended by many members of the middle-class and by native officials.

Posters and pamphlets have been specially used in connection with anti-malaria measures, and will be referred to elsewhere. They are most effective in the schools.

Direct propaganda is also carried on by the agricultural services. The results of the work undertaken in research and experimental institutions are made known through periodical publications in French and in the native languages, which are sent regularly to all the villages of the producing areas concerned; by notices and information in the native languages, disseminated in the villages concerned and widely published in native newspapers and reviews ; by means of demonstration fields

and experimental stations in the agricultural areas ; by the direct advice and propaganda tours of the local agricultural services ; and, lastly, at regional agricultural competitions, by means of lectures, films, demonstrations of appliances and machinery, exhibitions of seeds and of products obtained from special noteworthy varieties selected or recently introduced, which are recommended to the population.

By means of this co-ordinated propaganda through the various agricultural services, and also by reason of the interest which the Annamite peasant takes in anything calculated to improve the yield from his crops and thus to increase his profits, the results of the work done by research and experimental institutions are very rapidly disseminated, even in the most remote parts of the areas under cultivation.

2. Practical Achievements.

Thanks to instructional and propagandist efforts, the practical schemes launched by the competent services are bearing fruit. The schemes in question fall under three main heads —agricultural hydraulic engineering works, improvement of crops and sanitation. No further reference will be made at this point to the part played by the Health Services, as the subject has already received attention in the opening chapter or will be dealt with in connection with the principal diseases to be considered below.

(a) *Agricultural Hydraulic Engineering Works.*

Agricultural hydraulic engineering is a factor of the first importance in a country where water is indispensable for the regular cultivation of rice, and is consequently an essential condition for prosperity and peace. In the past, the populations have always used primitive devices to raise the water from the rivers and lower levels to the high ground, the methods employed varying from basket-work scoops handled by one to four men

to bucket conveyers worked by wheels fitted with pedals or operated directly by the force of the river currents. To obtain the benefit of plant of this kind, the cultivators surrender as much as one-third of the harvest to those who erect the wheels. Groups of natives have also had recourse to more modern methods, such as small motor-pumps, fixed or on barges. In this case, also, the cultivators hand over one-third of the harvest. Extensive dyke-building has also been done by the natives from time immemorial, especially in Tongking.

These continuous and general efforts on the part of the populations made it certain that all the work proposed in connection with the water supply would be unanimously supported. The works carried out fall under three heads—flood protection for the delta lands, drainage and drying of low water-logged ground and irrigation of high ground when the soil is too dry.

The agricultural hydraulic engineering work undertaken between 1925 and 1930 involved an average annual expenditure of 4,500,000 piastres out of budgets totalling altogether from 70 to 100 millions. Since 1930, the special budget for large-scale works has made it possible to draw up a programme for agricultural hydraulic engineering works costing over 42 million piastres. Nearly 27 million piastres had been expended by the end of 1935 ; some 15 millions remained to be expended.

Only a brief summary of the principal work completed, or in course of completion, at the present time can be given.

Flood protection has been developed for more than thirty years past by means of the repair, extension, raising and strengthening of the dykes maintained by the Annamites in this country for over a thousand years. In the last five financial years, nearly 10 million piastres had been expended out of the Loan Fund for the execution of the programme, which brings the total length of the dykes in Tongking up to nearly 1,000 kilometres. Five hundred kilometres of these dykes have a watertight facing of puddled earth. As a dam-burst (such as occurred in 1926) can cause damage amounting to over 20 million piastres, it will be seen that these works are of capital importance to agriculture as affording security which, if not absolute—absolute

security is impossible—is at any rate sufficient to eliminate the formerly ever-present menace of periodic widespread devastation.

The development of low-lying ground in the coastal areas has called both for protection from the infiltration of brackish water and for the draining-off of the fresh-water overflow. The works carried out (dykes, locks, irrigation canals) have brought some 25,000 hectares under cultivation.

In the enclosures formed by the dykes of the Red River and its affluents, the problem is to provided for as rapid drainage as possible of the rainwater in ground which, for nine months of the year, is at a lower level—sometimes as much as six to eight metres lower—than that of the river. The problem is solved by the cutting, widening and cleaning of drainage canals, the isolation of secondary enclosed areas, the construction of works provided with locks to drain away the rainwater into outlet channels, the surface level of which can be lowered without dangerously increasing the maximum flood-water level of the Red River. In the Hadong-Phuly sector, comprising some 94,000 hectares now in process of development, 50,000 hectares of rice-fields, which at present only yield one harvest, will be capable of yielding a second when the Day dam, the largest bear-trap dam in the world, is completed. The South Thai-Binh area has been regulated since 1933 (47,000 hectares). The North Thai-Binh area is in process of development (87,000 hectares). Part of the Kesat-Hungyên area (the total area of which is 129,000 hectares) is being developed, while the development of the rest is under study.

Great efforts have been made in Tongking to provide for the irrigation of high ground. The work done at Kep between 1902 and 1913 has brought 7,500 hectares under cultivation, 5,000 of which yield two harvests. The Vinh-Yên system, which was brought into operation between 1914 and 1923, affects 20,000 hectares. The Song-Cau system, which was put in hand in 1922 and brought partially into operation in 1929, covers 30,000 hectares. The Sontay system, which was begun in 1929, irrigates 10,000 hectares of highlying rice-fields by pumping. In a part of the sectors Hadong-Phuly, Thai-Binh and Kesat-Hungyên, the drainage of the

low-lying land in the rainy season has had to be accompanied by irrigation of the high-lying land in the dry season so as to allow of a second harvest.

Including the North-East Bac-Ninh area (25,000 hectares, work on which is proceeding) and the North-West Bac-Ninh (42,000 hectares, work on which is under consideration), the total area of rice-fields brought under the irrigation scheme in Tongking is 500,000 hectares.

In Annam, high ground has been irrigated in the area of the Thanh-Hoa system (50,000 hectares) for some years past. For the last ten years, 19,000 hectares of good soil have been irrigated by the Phu-Yen system. The North Vinh (38,000 hectares), South Vinh (18,000 hectares), Quang-Nam (8,000 hectares) and Phan-Rang systems (8,000 hectares) are under construction. The irrigation of 180,000 further hectares is under consideration. This will complete the programme and bring the total area up to 350,000 hectares.

One feature peculiar to Annam is worthy of note in connection with new work on these lines. The Annamite hills rise almost perpendicularly from the irrigable strip of land on the coast, making it possible to plan a system of irrigation based on the accumulation of rainwater in a series of small basins on the slope of the decline, with the outlet dammed by earth dykes which can be constructed at a very low cost. This allows of a second rice harvest at the height of the dry season.

Generally speaking, the cost of large-scale works for the irrigation of high ground varies according to the site and the system adopted (*i.e.*, gravity or pumping) from about 80 to 120 piastres per hectare, and falls to less than 30 piastres a hectare for works of the type described above in the case of Annam. Annual increases in the yield per hectare of 50 piastres are not exceptional. In certain cases, the value of land has increased ten fold in twenty years, as a result of irrigation. In various systems, the main canals are used for rafting and shipping. The main canal of the Song-Cau system, which is navigable over 53 kilometres for 300-ton barges, plays an important part in the economic life of the locality. It will be seen below that certain irrigation canals can also be used

for the supply of drinking-water with the aid of very simple filtering devices.

In the western (rice-growing) part of Cochin-China, the cultivation of the soil is dependent on the construction of a suitable system of canals and locks with tidal drainage of the fresh-water overflow and regulation of the water level in the rice-fields in accordance with crop requirements. The work of cutting the canals, which was begun by the admirals at the outset of the French occupation, has been continued at an increasing rate, thanks to the use of powerful dredgers. The total volume of earth dredged since 1866 may be put at 200 million cubic metres, the total expenditure for the purpose being 52 millions of piastres. This has enabled 1,425,000 hectares of land to be brought under cultivation at an average cost price per hectare of 37 piastres. The work is being continued, and new land is being brought under cultivation, partly out of the special budget and partly out of the local budget of Cochin-China. In addition to the improvement of 15,000 hectares in the Provinces of Cantho and Sadec and the extension of the cultivation of floating rice in a formerly uncultivated area of 40,000 hectares (in Chaudoc), the plan includes protection against brackish water in an area of 55,000 hectares in the coastal area ; the improvement of 550,000 hectares in the Transbassac, and of 250,000 hectares in the Plaine des Joncs is at present under study.

In Cambodia, the problem is, on the one hand, to stabilise production by the diminution of the risks arising out of variations in the rainfall, and, on the other hand, the protection of certain districts against the influx of brackish water. An irrigation system affecting 30,000 hectares in the Province of Battambang has increased production to an extent varying from 40 to 150%. The irrigation of over 100,000 hectares is under consideration.

The above general statement is necessarily summary. It may be supplemented by a concrete example showing the effects of agricultural hydraulic engineering works in the case of an already existing system—viz., that of Song-Cau in the Province of Thanh-Hoa (Northern Annam), where 50,000 hectares were brought under irrigation as from 1926.

(*i*) Effect of Irrigation on the Yield of the Rice-fields, the Area of the Fallow Land, and the Production of Rice.

(1) *Yield of the rice-fields before and after irrigation :*

	5th month	10th month	Total
Before irrigation . . .	700 Kg. per ha.	1,000 Kg. per ha.	1,700 Kg. per ha.
After irrigation . . .	1,660	1,660	3,320
Increase due to irrigation	137%	66%	95%

(2) *Area of land left fallow in percentages of the total cultivable area :*

	5th month	10th month
	%	%
Before irrigation	50	10-30
After irrigation	6	5
Increase in area under crops.	88	6-36

(3) *Total production :*

	5th month	10th month	Total
Before irrigation. . .	100	100	100
After irrigation . . .	445	196	278

(*ii*) Effect in improving the Standard of Living of the Native.

Comparison of the differences in the various factors constituting indices of the standard of living of the natives in the irrigated and non-irrigated areas of Thanh-Hoa respectively.

(1) *Exports of Paddy.*

Difference in exports in the irrigated and non-irrigated areas in question over periods of eight years before and after the introduction of irrigation :

$$1918\text{-}1925 \quad \frac{\text{Irrigated area exports}}{\text{Non-irrigated area exports}} = 100$$

$$1926\text{-}1933 \quad \text{,,} \qquad \text{,,} \qquad \text{,,} \qquad = 191$$

(2) *Increase of the Population.*

$$1921 \quad \frac{\text{Irrigated area population}}{\text{Non-irrigated area population}} = 100$$

1933 ,, ,, ,, = 131

There is therefore a definite transference of population to the irrigated areas.

(3) *Increase of Consumption.*

The consumption of the province of Thanh-Hoa may be compared with that of Tongking (Northern Annam) in the case of two test-commodities—*viz.*, salt and cotton tissues.

(*a*) Salt.

$$1922\text{-}1925 \quad \frac{\text{Thanh-Hoa consumption}}{\text{Tongking consumption}} = 100$$

1926-1929 ,, ,, = 156

(*b*) Cotton textile imports.

$$1922\text{-}1925 \quad \frac{\text{Thanh-Hoa imports}}{\text{Tongking imports}} = 100$$

1926-1929 ,, ,, = 109

1930-1933 ,, ,, = 112

(4) *Land Values.*

In 1930, irrigated land in the province of Thanh-Hoa was selling at prices 30 to 40% higher than non-irrigated land.

All the above indications point to a genuine and tangible improvement in the standard of living of the native as a result of the beneficial influence of irrigation.

(b) *Agriculture.*

The main lines of agricultural policy which have been followed systematically for years past are as follows :

Increase in the profits of the producer by giving him the means of reducing the cost price of his products, and reducing the margin between the prices he receives and the prices paid in the export trade.

Improvement of the quality of products as a means of increasing their sale value and opening up markets.

Development of existing—or establishment of new—dry crops as a means of limiting the risks attendant upon exclusive rice-growing, which is still the basis of the Indo-Chinese economy.

The execution of this programme has been placed in the hands of the three big organisations which control the three branches of the economic life of Indo-China—viz : the *Office indochinois du Riz* (Indo-Chinese Rice Office), the *Institut des Recherches agronomiques* (Institute of Agricultural Research), and the *Crédit Agricole* (Land Bank). They are assisted, in so far as the spread of information and propaganda are concerned, by the local agricultural services.

The *Office indochinois du Riz* is an autonomous institution with its seat at Saigon. Its activities cover the production and manufacture of and trade in rice. Its main objects are as follows :

(1) Improvement of environmental conditions for crop-growing ;

(2) Listing of varieties cultivated, weeding-out of the less suitable varieties, selection of the best varieties, growing of these for seed and distribution of the latter ;

(3) Classification of products according to their industrial and commercial qualities with a view to standardisation and determination of values, storage and marketing on sound lines.

(4) Search for new markets.

Considerable results have been achieved, in the first place, by sound regulation of water supply as described above, and, in the second place, by the improvement of methods of cultivation and the use of fertilisers (in particular, manure crops) which are within the reach of the less well-to-do cultivators.

But the chief efforts of the *Office du Riz* have been in connection with the production of seeds. The rice-grower was in the habit of using innumerable varieties of degenerated paddys, mostly hydrid varieties, which had never undergone any selection. The crops raised by this method were poor, and the manufacturers were faced with the problem of how to deal with small lots of heterogeneous varieties of rice which could not be processed without loss, or graded for marketing purposes.

Research has made it possible, by successive processes of elimination, to retain only a small number of varieties for each region, yielding a correspondingly small number of fixed commercial grades and allowing of the establishment of a limited number of standards to meet market requirements.

The *Institut des Recherches agronomiques* is a scientific institution with laboratories and testing stations in the north and south of the country, which devotes its energies to the study of the growing of dry crops—viz., colonial crops (hevea, the coffee shrub and the tea plant) and native crops in drained rice-fields, in order to minimise the effects of a bad paddy crop, as well as in ground never under rice, the object being to facilitate the settlement of the surplus population from the deltas in neighbouring regions by supplying them with the necessary means of livelihood. A fisheries section also deals with the development of pisciculture, which has not hitherto been practised to any extent by the natives.

Lastly, the laboratories of the Institut have made studies of agricultural products for export with a view to improving their quality and appearance and testing the quality of the exports of such products.

The work undertaken in connection with native crops aims primarily at determining which regions are most suitable for each, and which methods of cultivation are most effective, and evolving or improving varieties with a high yield adapted to the different regions. The studies hitherto made have been in connection with maize, the castor-oil plant and tung tree, the kapok tree and fruit trees, lac trees and tobacco. Considerable improvements have been made, or are in process of being made, in the case of all these crops ; and definite results have been achieved in the shape of very considerable increases of the areas under cultivation and the crop-yields, and improvements in the quality, and *pro tanto* sale value, of the products concerned.

The *Crédit Agricole* has been in existence in Cochin-China since 1912, where it operates as a provincial institution in the form of native mutual associations for agricultural credits.

The system of agricultural credits was made general in the rest of Indo-China in 1926 by the establishment of the *Office indochinois du Crédit Agricole mutuel* to combat usury, which is a real scourge in Indo-China, by making credits available for Indo-Chinese agriculturists, especially smallholders, such as no banking institution could offer owing to the extreme dispersion of the risks. The Office has legal personality and is financially autonomous. It provides the funds for the French and native agricultural credit branches, over which it exercises direct permanent control.

The native branches number twenty-six—viz., twelve in Tongking, seven in Annam and seven in Cambodia. They are established within the limits of the provinces in the form of civil companies, composed of farmers or farmers' associations whose property is situated in the province concerned, agricultural syndicates and co-operatives with their head-quarters in the province, communes of the province and the province itself. They derive their funds partly from advances made to them by the Office in the form of credits opened for their account, partly from deposits which they are allowed to receive. Their total funds amounted to 4,035,000 piastres on December 31st, 1935.

The organisation of these branches and their operation have been worked out in such a manner as to avoid the principal difficulty with which popular agricultural credit institutions are confronted in the Far East—namely, the difficulty of reaching the peasant, farmer or smallholder directly. As soon as the loans granted at rates that are low for the country reach a certain figure, there is often some likelihood of their going to usurers and serving only to enable the latter to extend their activities without relieving the difficulty of the small borrower in any way. Among other things, the average amount of loans has been reduced to a minimum—*i.e.*, at present about 40 piastres, which is sufficient for the requirements of the share farmer or smallholder but is too small to tempt the money-lender. The result is to ensure that the small cultivator is almost certainly reached directly by the branch and given the credit he needs at an interest rate (at present 11%), which may be regarded as low in the Far East, where rates of 36%

and 48% per annum are regularly exacted by professional moneylenders.

In addition to giving small loans of this kind, the *Crédit Agricole* finances land improvement works in which communal or provincial organisations are interested. The benefits of such works cannot fail to reach the small producer.

It would seem, however, that the chief way in which the *Office indochinois de Crédit Agricole mutuel* can rapidly and effectively raise the native standard of living is by the organisation of *co-operatives*. The co-operatives serve two purposes. In the first place, they relieve the producer of the necessity for selling his products at the moment they are harvested —generally, that is, at rates which the momentary abundance of the supply in the market necessarily renders very low— whereas on bringing his products to the co-operative, he receives, at a very low rate of interest, an advance which may be as much as two-thirds of the probable value of the crops. The co-operative stores the produce, and subsequently sells it on the most favourable terms, refunding to the producers the extra profit thus realised. In the second place, the co-operatives provide a remedy for a common defect of Indo-Chinese products : their imperfect preparation, inasmuch as the responsibility of the individual producer in this connection is taken over by the co-operative—*i.e.*, by an organisation which brings powerful resources and sound technical methods to bear under the guidance of the research institution laboratories and with the help of their engineers.

The success of the first co-operative, which was set up at Phulangthuong, showed the value of these organisations. Started on modest lines with the primary object of preparing and marketing maize, it was compelled at the end of two harvests to build large stores and to set up a rice factory and an oil plant. The first year, it was handling 2,764 tons of cereals and more than two tons of oranges and mandarines for its members. The following figures are sufficient evidence of the success and value of these societies. The members received 2.15 piastres per 100 kilogrammes of paddy and 2.32 piastres per 100 kilogrammes of maize, whereas the prices paid to local growers were 1.80 and 2 piastres respectively. The interest

on the advances made to the growers and the cost of operation and administration amounted only to 3 cents per 100 kilogrammes, whereas the extra profits realised amounted to some 30 cents.

Other co-operatives are in course of establishment for oil at Thanh-Hoa, and for sugar at Quang-Ngai ; and the mere announcement of their impending establishment put retail prices up from 15 to 20%. The total number of co-operatives will then be brought up to six for Tongking and Annam. They work most satisfactorily.

Indo-China has considerable live-stock, which is indispensable for the cultivation of the soil and the food supply of its inhabitants. It is also the object of a relatively large export trade to China and Singapore.

The main object of the Veterinary Service is the protection and improvement of this live-stock—that is to say, the epizootic disease control and prevention and the improvement of stock.

The Veterinary Service has for the purpose thirty European veterinary officers assisted by Indo-Chinese veterinary officers recruited from the pupils who have obtained degrees at the Hanoi Veterinary School and vaccinator assistants recruited and trained by the local services as required.

Sanitary police duties and epizootic disease control are in the hands of area veterinary inspectors, in the different countries of the Union. The vaccines and sera are supplied by the Pasteur Institute and, to a lesser extent, by the Tongking Veterinary Laboratory and the Thanh-Hoa Vaccine Centre. The Tongking Veterinary Laboratory and the Laboratory of Animal Microbiology of the Pasteur Institute of Saigon (which works in close touch with the Cochin-China Veterinary Service) establish bacteriological diagnoses and conduct researches in connection with the study, prevention and cure of animal diseases.

The improvement of stock is taken in hand by zootechnical institutions, which keep, and place at the disposal of native breeders, selected animals for breeding purposes which adapt themselves readily to the climate of Indo-China and to local conditions.

The chief zootechnical institutions are in Tongking, the Bach-Mai and Nuoc-Hai Zootechnical Stations, which keep stallions and bulls. The Nuoc-Hai institution also breeds sheep, goats and poultry. Tongking also keeps half-breed stallions and bulls in certain provinces. In Annam, there are the cattle farms at An-Khe, Hue and Nong-Cong, which endeavour to improve local breeds by crossing with Indian breeds and the "Abondance," stock, and to improve the Thanh-Hoa native breed by selection. In Cochin-China, there is the Tan-Son-Nhut Stud Farm, which keeps stallions, bulls and boars. In Cambodia, there are the breeding-stations at Kompong-Chnang and Pnom-Penh, which keep respectively bulls and stallions.

Thanks to the propaganda tours of the veterinary staff in the stock-raising districts, as also to the notes and advice in regard to the careful selection of live-stock, the efforts of the Veterinary Service to improve the quality and quantity of the animal production of Indo-China are rapidly bearing fruit. Particularly satisfactory results have been obtained in the breeding of pigs, which occupy a primary place in the native dietary.

(c) *Co-operation of the Population.*

The co-operation of the population in the work of rural reconstruction in all its forms can be, and should be, active. Where sustained and determined efforts have been made by persons inspired by faith, remarkable results have been achieved.

A typical example is that of the Province of Hadong, a big agricultural province in the delta surrounding Hanoi, where a programme of social and economic reconstruction has been in progress for twenty years at the instance of the native authorities and with the support of the authorities of the protectorate.

In this over-populated area, which was originally dependent solely on rice-growing and exposed to the hazards of frequently unfavourable climatic conditions, a policy of patient persuasion has created new resources.

Vegetable-growing, trees, remunerative auxiliary crops (maize, starchy food crops, sugar-cane, soya, castor-oil plant,

dolic beans), rabbit and poultry breeding have been introduced, and anything, in short, which finds a ready market, does not require more than a modest initial capital and affords a possibility of rapid returns.

In addition to these agricultural innovations, advantage has been taken of the manual skill of the inhabitants and their prodigious capacity of work and patience to develop the embryonic rural handicrafts already in existence, and to create a variety of new home industries. Every village is encouraged to specialise in some small local industry—lace of the finest kind, embroidery, brocaded or plain silk weaving, spinning and dyeing of silk, weaving of napkins and mosquito-netting, basket-work of all kinds, manufacture of paper, pottery, articles of horn, tortoise-shell and mother of pearl, and so on (Figures 2 and 3). Out of a total population of over a million inhabitants, those who can be called skilled handicraft workers (men, women, children and old people) represent one-fiftieth of the population or over 20,000 persons. They are joined (according to the season, the situation, the amount of agricultural labour work in progress and the volume of orders received) by auxiliary workers who bring the numbers up to twice or three times this figure. These craftsmen are in all cases home-workers belonging to the rural population. They work along the lines of existing rural handicrafts, use the simplest tools and require only a very small working capital. A good part of the production is absorbed for local purposes ; the finer products are exported to other Eastern countries and to Europe. The value of the products sold annually amounts to millions of francs. The peasant is thus enabled, as the Annamites say, " to put more pence in his bamboo " and improve his position.

The improvement takes the form in the province under consideration of active co-operation by the population in public health works and education. Voluntary gifts and savings on the funds for ritual feasts or on the leasing of communal property have made it possible to set up ninety communal schools, fifty six maternity hospitals, three fully equipped kindergartens and a number of " village greens " for the children of the more populous villages by the unaided efforts of the villages

themselves. The total initial expenditure is over 100,000 piastres. The cost of upkeep falls on the villages, including the pay of the village teachers, the remuneration of the native midwives (who are given a share in the communal rice-fields on their appointment), salaries of the persons in charge of the kindergartens, etc.

The above example has been chosen because it is exceptionally many-sided and especially significant, since it relates to a very densely populated and very poor district with no natural variety. Achievements of the same kind, less complete, because more recent, might be cited. It is sufficient to refer to a very definite movement in favour of provincial or local fairs or exhibitions, competitions of handicraftsmen, and special " days " or " weeks " for particular branches of rural economic life, which always attract a large number of participants and visitors.

* * *

In concluding this account of the programme of rural reconstruction in progress in Indo-China, there is a psychological aspect of the question which is of vital importance, and which cannot be over-emphasised. It is this : If the rural populations are to be able effectively to co-operate in the work, it is essential to inculcate self-confidence among the natives. If he is to achieve a higher standard of living, he must begin by desiring such a higher standard, and—what is more—he must feel himself capable of achieving it. He must be shaken out of his apathy ; he has to be shown the path to follow. This psychological keying-up, which is no more than the recovery of a sense of human dignity, is the essential—if not the direct—object of national education properly understood. So regarded, rural reconstruction is essentially dependent upon the extent to which education penetrates among the masses.

Regarded from another point of view, the acquisition of elementary knowledge undoubtedly renders the rural masses more accessible to the essential conceptions which are the condition of rural reconstruction, inasmuch as it extends their range and takes them out of their daily groove. The spread of knowledge, however slight, creates an atmosphere which

is favourable to certain necessary innovations and unfavourable to certain regrettable superstitions (regrettable, because inconsistent with principles of hygiene).

One is entitled, for example, to hope that a better-educated peasant population with well-tempered bodies and minds will cease to allow themselves to be the victims of usury, that scourge of the countryside, and will become more accessible to the arguments in favour of that which is the direct antidote of usury—namely, saving.

It may be true that indigence leads to ignorance ; but the two play into each other's hands, and it is not possible to bring out the full potentialities of the native, unless there is parallel improvement of his material condition on the one hand and of his mind and understanding on the other.

The problem in this form is not purely a problem of individuals ; it is a collective problem. Rural reconstruction calls for a sense of solidarity and a spirit of co-operation on the part of the peasant masses in which they have been lacking up to now. Material interest is, it is true, a powerful educative force ; but individualism and individual egoism are two serious obstacles in the way.

School attendance on an increasingly widespread scale, and adult classes which take these necessities into account, will make it possible to give the rural masses greater cohesion and clear-sightedness.

III. SANITATION AND SANITARY ENGINEERING.

1. Housing.

A French geographer has drawn attention to the apparent illogicalities in the distribution of types of houses in Indo-China. In the damp deltas, the Annamites build their houses on the ground-level, directly on a foundation of beaten earth, where they are constantly befouled by the stagnant water, whereas in the mountains, the houses are built on piles, as they are also in Cambodia. The ultimate explanation of this anomaly is to be found in the Chinese origin of the Annamite civilisation.

Annamite houses are grouped in villages or hamlets. Seen in the middle of the countryside, they do not look like blocks of houses so much as blocks of green islands in a sea of rice-swamps. They are surrounded by hedges of bamboo, the houses being hidden behind the hedges and under trees. They are one-storey structures resting on the ground and built of vegetable material, such as wood or bamboo, and covered with straw or latania leaves (Figures 4 and 5). Brick houses with tiled roofs are a sign of social superiority and are rare.

In spite of local variations, there is a unity in the plan of these houses and in their structure. They are almost always built round a central court on the edges of the sites they occupy. They are not, therefore, open to the light on the outside, but give only on to the court (Figures 6 and 7).

The only entrance to the houses is on one side. It must never be placed on the side facing the main building. Generally it is a covered gateway of two leaves, which can be closed with catches, or merely a lattice of bamboo which is lifted up when it is desired to leave the entrance open.

The court, which may be from 35 to 50 feet square, is generally paved, so as to allow of the paddy being threshed there and the grains dried at the time of the rice harvest. The buildings form three sides of the court ; the fourth side opens on a garden or orchard. In front of the garden, jutting out slightly into the court, there is a reservoir of varying size (holding from two to ten cubic metres) which serves as a catchment for the rainwater. It is fed by areca trees, the rainwater caught in the leaves of these trees trickling down the trunk and being led into the reservoir along a leaf rolled round the trunk just above the edge of the reservoir. Behind it there is an altar on a pillar in the open air for the worship of heaven. Beyond the garden is the pond, which serves indifferently as fishpond, laundry for the household linen, wash-place for the household crockery, and bath for the occupants of the house. It is also used for washing the rice and vegetables before cooking.

The main building, which almost always faces south, is on the opposite side. It is built on a substructure of beaten earth some 20 to 50 centimetres high. It is of wood covered with thatch. The roof, which has four sides, with the ridge formed by the two larger sides, is very high pitched and comes down

to within 1 metre 80 to 2 metres of the ground. The visible frame of the roof, which has squared beams and usually carved rafters, is supported on wooden pillars with rounded shafts set simply on stone pedestals. The back of the house and the two small sides are entirely closed. The walls are of cob strengthened by bamboo lattice ; the cob is made of a mixture of mud and straw or mud and paddy balls.

The main building is 10 to 15 metres long by 6 to 8 metres wide by 4.50 to 5 metres high. A veranda 1.50 to 2 metres wide runs along the front. The house is in five bays. The three middle bays form respectively the room of honour, the reception-room and the men's room. The latter is entered from the veranda by three large openings over a threshold 40 centimetres high. The openings are closed by wooden doors held by tenons in the wooden lintels above and below and readily removed. In the very middle of the room of honour against the back wall of the house, occupying the whole of the middle bay, is the Altar of the Ancestors, before which there is a camp-bed where the descendants make ritual prostrations to the spirits of the ancestors and the head of the family receives visitors of distinction. To the left and right of the Altar in the side bays are camp-beds, one or two tables, couches and sometimes chairs. This is the common room, the men's sleeping-room.

The two bays at each end of the house are the women's apartments. They are dark rooms, dimly lit by one or two narrow windows with wooden bars opening on to the veranda. They communicate with the common room by a side door with a high threshold. Their furniture consists of camp-beds and chests for clothing, which also serve for the storage of the rice and valuables.

At right angles to the main building on one side of the court is another simpler building serving as a store-house, shed and stable. In front of it is the kitchen, an even simpler building, with fireplaces on the ground consisting of three pieces of baked clay or iron tripods. A very low camp-bed and a dresser of bamboo constitute the whole of its furniture. Beside it are the poultry-yard, piggery and ricks of straw.

The house described is a typical house of a moderately well-to-do country family.

The house of a poorer peasant consists of a main building with three bays barely raised above the level of the ground, a kitchen serving as a tool-shed and a piggery. The Altar of the Ancestors and two or three camp-beds represent the whole of the furniture (Figure 6).

A still humbler peasant lives in a very dark and very low cabin, which cannot be entered without bending. Straw spread on the ground serves as a bed, and the cooking is done in a corner of the house on three bricks used as a tripod. The pigs and poultry move freely about the dwelling-house. There is a small garden by the side of the cabin (Figure 4).

The pile dwellings are of a very different design. They are generally square buildings, raised from one and a half to two metres above the ground. The pillars and the framework are of wood ; the roof is of bamboo or thatch. The floor is of wood or bamboo lattice (Figures 8 and 9). The house is nearly always divided into three separate parts—viz., a reception-room, which is wide open and accessible to all, a common room, which is the men's room, and the private rooms for the women.

Inside all pile dwellings there are one or more fireplaces consisting of a box full of earth, on which a fire is kept going day and night. Above the fireplace is a kind of larder which holds the foodstuffs that are to be heat-preserved or smoked to protect them from damp and mould (Figure 10).

The space below the house serves as a stable for the animals and for storing agricultural implements.

This is the general type of house in Lao, Cambodia, Thai, Muong, etc.

The houses in Lao are square with a fairly large veranda serving as a hall, reception-room and weaving-room. The interior is divided into two parts by partitions of planking or bamboo ; one part is the common room, while the other consists of small rooms for the women.

The veranda is reached by a staircase, and a second staircase leads to a small open-air platform at the other end of the house which serves as a kitchen.

There is no furniture. Mats and quilts are spread on the floor.

The Cambodian house also has a veranda, a common room and separate rooms for the women. It is often built on the bank

of a river with its back to a dyke. In well-to-do families, it consists of two main buildings. The kitchen is in a penthouse apart situated behind the main building and connected by a bridge. The interior arrangements may differ somewhat. The common room is in the centre of the house ; and the two parts of the house on each side of it are divided into small rooms for married couples and for the women (Figure 11).

The houses in Thai are grouped in villages surrounded by a bamboo palisade. Between the piles are the piggeries, the poultry-yards and the stables. The house is reached by a small ladder, at the foot of which is a receptacle full of water in which all persons entering the house can wash their feet. The ladder leads to a platform, constituting a sort of ante-chamber, from which a door opens into the common room. In the middle of this room is the fireplace and at the back the Altar of the Ancestors. A few very low camp-beds make up the whole of the furniture. Beyond, on each side of a kind of corridor of fair width, which traverses the house from end to end, there are small bedrooms separated by light partitions. At the end is the kitchen which opens on to an outside platform, where there is a second ladder of approach (Figures 9 and 10).

Finally, attention must be drawn to another form of dwelling, very common in Indo-China—namely, the floating houses. Fishermen, coasting-traders and owners of sampans pass the whole of their lives aboard their vessels.

On the deck is the dwelling properly so called. The roof is generally of plaited bamboo. On each side there are two planks of wood with openings in the shape of two small windows with bamboo curtains fore and aft.

But the real floating houses are those which are built on rafts, sometimes of wood, but generally of bamboo, bound together in bundles. These rafts have an average surface of 20 to 30 square metres. The dwellings constructed on them are in the traditional form of three bays, the centre bay being reserved for the Altar of the Ancestors. The roof is of plaited bamboo thatch or latania leaves. The walls are of cob or of wood, and the partitions of bamboo (Figure 12).

The building of a house, whether it be the yamen of a mandarin or the dwelling of a peasant, is an incident of capital importance

in the life of a man, and much thought is given to the subject.

Whenever possible, the Annamite follows the principles of geomancy in regard to the orientation of his house. The frontage of the main building should never be in a line with a road ; nor should it face the angle of a pond or of a pagoda. Care must be taken before building to eliminate all evil influences. With rare exceptions, the main front of an Annamite house always faces south. This is for magical reasons, since the North Pole is identified with the Yin principle and the South Pole with the Yang principle, which form the Chinese monomial Yin-Yang (male and female). The house should be orientated towards the fecundating Yang principle, which brings prosperity—that is to say, towards the south.

When the site has been selected and the orientation determined by the geomant, an experienced man of letters is approached with the request that he will consult the almanach, so as to fix the year, month, day, and sometimes the hour, most propitious for construction. Dwellings of private persons must not be higher than pagodas ; in the event of this rule being infringed, the owner would incur the wrath of the presiding spirit. The walls must not be pierced with windows, as windows afford openings for the penetration of evil spirits, who dare not use the main gate, which is reserved for the gods. The house must not be so constructed as to cut across the occult beneficent currents known as " dragon's veins ", the flow of which is indicated by the local sorcerer. Infringement of this rule is liable to bring harm on the whole village.

When all these requirements are complied with, the work is begun by a ceremony of dedication to the spirit of the soil. The builder foreman then prepares a measuring-rod by marking off a standard Annamite metre on a lath of bamboo. This measuring-rod is then used by the builders until the work is completed, when it is placed on the roof tree of the house and remains there until the building is no more. Its loss would mean the loss of the peace and happiness of the inhabitants of the house. A second ceremony is observed when the ridge-beam is placed in position, and on the close of the work a feast is offered to the workmen.

Other races consult the Bonzes and sorcerers, who make it their business to draw away evil spirits from the spot and to determine the site, orientation and date of construction.

So far as its hygienic qualities are concerned, the Annamite house is low and damp. It is ventilated, but badly lit. In the case of the poorer inhabitants it is frequently dirty, and the promiscuity of life in common with the animals renders it more miserable still.

But, whenever he can, the Annamite is at pains to add charm to his house. The poorest villager plants some ornamental shrub and a hedge to surround the house. The threshold is carefully swept. The entry of a stranger is always the signal for a rapid touch of the brush or broom in an attempt at cleanliness, and the offer of as clean a mat as possible. Dirt in this country is a consequence of poverty. By instinct the Annamite is clean, both in his house and in his person. If he washes in dirty water, it is because he has no other available. If his house frequently gives a painful impression of not being clean, that is because of the overcrowding and the lack of the most indispensable necessities of life.

In the poorer and more thickly populated areas, the Annamite village has too often a wretched appearance, which reflects the indigence of the inhabitants. The scarcity of land and the successive partitions of the soil lead to a confused disarray in the siting of the houses and to excessive narrowness of the pathways. But in the more favoured areas, the villages are charming, with well-kept gardens and orchards and paths paved with large stone slabs to prevent the accumulation of mud in time of rain. It is true the houses are often too close to one another ; but the ventilation is not bad. In spite of the absence of windows on one side of the house, the circulation of air is generally satisfactory, owing to the gap left between the roof and the wall and below the doors and the partitions. There is thus an upward draught, which is one of the advantages of a mud house. When he builds in brick, the Annamite still puts in no windows ; and, as there are no longer any gaps between the roof and the walls or at the bottom of the walls, there is no ventilation at all. Except in the case of genuine European houses—which are not common—replacement of the traditional

house by brick structures is undesirable. Incidentally, the higher price of brick houses means a higher rent or higher instalment payments, and is an incitement to overcrowding.

One desirable improvement would be to raise the houses by building them on a small embankment—this is the practice in certain districts—and to determine the orientation of the house on rational, in preference to magical, lines ; there is, in fact, a movement in this direction. It would be a great step forward if it were possible to provide sanitary latrines. The difficulties in the way of this fundamental improvement will be referred to below. The cleansing of ponds and the embankment of their borders are matters of education. The development of inexpensive wells making it possible to draw uncontaminated water should lead the population to use clean water for their domestic water-tanks and diminish the dangers attaching to the traditional use of the ponds. These are the directions in which educational and propagandist efforts should be pursued, every respect being shown to tradition where it admits of adaptation to hygienic requirements.

The house on piles is a hygienic type of dwelling for tropical countries. In appearance frequently charming, it calls for improvement only in respect of exterior details (such as latrines and improved water-supply). The stabling of animals underneath the house has the disadvantage of attracting flies, but involves no serious danger. It may even be some kind of safeguard against malaria.

2. Supply of Drinking-water.

The drinking-water problem has engaged the special attention of the Government-General, the local governments and the health authorities of Indo-China. The chapter on the budgets has shown that the purification and supply of drinking-water in the different districts has, since 1931, involved the expenditure of more than three million piastres from the loan fund, to which there has been added an almost equivalent sum appropriated from the normal budgets. The execution of a programme, the principles and technical achievements of which will be set out hereunder, has thus been made possible.

In this matter, the Government is certain to have the full approval of the population. Indeed, contrary to certain opinions which are based on purely superficial observations, the Annamite of the poorer classes appreciates water that is clear, limpid, fresh, tasteless and odourless. Though he sometimes blames the water of the pipe systems for hardening the rice, for making it less white, for blackening the tea or for destroying its aroma (when the water comes from deep-lying levels and contains iron), he nevertheless very soon becomes accustomed to it and the throngs of water-carriers around the street hydrants furnish sufficient proof of the success of the water-supply systems established.

In the villages, the Annamite prefers rain-water above all. This is carefully stored in earthenware jars or in cisterns. Failing this, he uses the water from shallow wells (Figure 13) or rivers. Only too frequently, in the deltas, he is reduced to using the water from pools which, in the dry season, become nothing more than sheets of mud. This water is used for bathing, for washing linen and for drinking purposes. Fortunately, it is usually drunk only in the form of infusions of tea or its substitutes.

The Annamite knows how to decant muddy water and to clarify it by the use of alum. As soon as villages can find the necessary financial means, they gladly dig wells. The sinking of wells is governed by religious and traditional rules. They must be at a distance from the cemeteries ; their site is fixed by the geomancers ; they are not dug (or filled in) in years when a calamity has fallen on the village or the family. In some of the delta provinces, many of the villages are thus provided with communal wells, the cost of which varies between 30 and 100 piastres. Some villages have been able to afford wells which are more in harmony with hygienic requirements and cost about 500 to 600 piastres. These examples show that the co-operation of the population is assured whenever it is offered the possibility of having clean and wholesome water. (Figure 14).

The geographical diversity of Indo-China and the different characteristics of its soil and subsoil raised a number of varied problems for the hygienist. Some of these problems—new ones—

were solved in ways that were novel but adequate. Though, in the case of the first installations, the traditional methods of purifying water adopted in France were followed, these were soon abandoned. Indeed, the joint efforts of the Health Service and the Public Works Service resulted in the application of new methods called for by local conditions.

What has been done in the big centres during the past thirty years may be stated briefly.

Saigon and Cholon are supplied from wells tapping the subsoil water, but this proved to be inadequate as the requirements of the population increased. The need to go 30 kilometres north of Saigon in order to get beyond the limit reached by the brackish water and the fact that it was impossible to find water in sufficient quantities in the neighbourhood of the city led the administration to have deep wells sunk (Layne system). The yield from these wells makes it possible to distribute more than 70,000 cubic metres of drinking-water each day in the two cities and to provide for any future increase in consumption. A few deep wells give water that is chemically and bacteriologically suitable for drinking purposes. The water from other wells has to be freed from iron, either under pressure in closed tanks (Degremont) —and the water is then distributed without sterilisation—or in the open air (American system), and the water is then sterilised with chloride of lime. The surface wells give water which always needs to be purified with chloride of lime.

Hanoi draws 18,000 cubic metres of water each day from the deep-lying level (from 40 to 60 metres). The iron is removed from this water partly in the open air (Puech-Chabal system) and partly in closed tanks (Degremont), and the water is sterilised with chloride of lime.

At *Haiphong*, the fact that it is impossible to find surface or subsoil water that is not brackish led to the establishment of a purifying plant at a distance of 35 kilometres from the city. This plant draws from the river 12,000 cubic metres of unpurified water which, after clarification with alum and rapid filtration, flows down by force of gravity to the city, where it is distributed after treatment with chloride of lime.

Hué draws from the "River of Perfumes" water which is purified after pre-filtration followed by slow filtration through sand. The supply amounts to 5,000 cubic metres a day.

Pnom-Penh uses the water of the Mekong and this, after clarification by decantation, treatment with alum and rapid filtration, is also sterilised with chloride of lime. The average daily supply is 10,000 cubic metres.

Cantho and Mytho in Cochin-China, Battambang in Cambodia, Vinh, Dalat and Nhatrang in Annam and Nam-dinh and Langson in Tongking were next provided with a water-supply. Sometimes the source was river water, sometimes surface water and sometimes recourse was had to wells.

Next, the rural centres were supplied with drinking-water—first of all the capitals of provinces, and nearly all these have now a proper water-supply. Since then, efforts have been made to supply the smaller rural centres also.

The programme of the work done in rural districts may be divided into two parts :

(1) In rural centres of a certain size (usually with a population of more than 1,000), comparatively large-scale works have been carried out, to provide everywhere a pumping station (and treatment plant where necessary) supplying from 5 to 60 cubic metres an hour, a high-level reservoir and a distributing system.

The water comes from rivers, reserve supplies of fresh water or wells, or even from anti-malaria drainage.

(2) In the smaller villages (usually with a population between 100 and 1,000), a small purifying plant is set up with a reservoir of treated water but without any distributing system, the unpurified water being drawn from a well, a river or an irrigation canal.

Having abandoned, except in a few special cases, the solution provided by surface wells (which necessitate numerous borings in order to secure supplies that, even then, are frequently inadequate) and rejected also the solution provided by deep wells, which are often costly, the decision was taken to draw water from the place where it was to be found in abundance—namely,

the river. Experience had shown that by certain simple and easily applied processes water can be made fit for drinking purposes, even when it comes from the most unsatisfactory sources.

The plants first set up used material of the kind which had given good results in France. Some of the stations were of the Desrumeaux type (Kratié, Kompong-Thom and a few others) and some of the Dépoit type (Cantho, Battambang, Laokay, Phuly and a few others).

But it gradually became clear that, in order to reduce installation and treatment costs to a minimum, special plant would have to be designed to deal with water containing large quantities of colloidal matter. The Red River, for instance, carries in suspension an average of 850 grammes of ooze per cubic metre and, during the flood season, the quantity increases to 6.5 kilogrammes per cubic metre (August 1935).

Studies and experiments were started at Baria in 1927 and, after many trials and adaptations, they resulted in the setting-up of a model plant, in 1933, at Cai-Lay. Others of the same type are now being constructed in about a hundred centres.

Let us take as an example Cochin-China, where the problem of the drinking-water supply for rural centres was particularly difficult but has nevertheless been solved in a very interesting way.

Cochin-China, except for the provinces situated north and east of Saigon, is a vast, low-lying plain formed of the deltas of the Mekong and the Donnaï, very little above sea-level. It is split up, not only by the numerous branches of these two rivers, but also by an infinite number of water-channels, some of which are natural—the rachs and the arroyos—whilst others are man-made, constituting the canal system which covers the whole country. All these channels are affected by the tides. Thus, there is no lack of water in Cochin-China, but, in its natural state, the water is not fit for drinking purposes. The rachs, the arroyos and the canals serve, not only as the streets of the villages built on their banks, but also as their sewers, and the water is thick and muddy. Moreover, in the dry season, the salt water comes up and drives back the water of the Mekong and the Donnaï, thus forming a fresh-water zone and a brackish-water

zone. If this boundary-line is drawn on the map, it will be seen that, in the absence of subsoil water, a great part of the delta of Cochin-China can count only on the rain-water stored in cisterns or reservoirs for its drinking-water supply during the dry season.

Live-stock has then to be moved elsewhere, and, when the family reserves in jars are exhausted, the householder must buy fresh water from the water-sellers who set up their stalls on the vessels which fetch their supplies, frequently from great distances, from the fresh-water zone. This water is sold at P.o.10 a touque of 18 litres—*i.e.*, 55 francs a cubic metre. Fortunately, the boundary-line between fresh water and salt water is not immovable throughout the year.

This period—which varies according to the region—is not less than fifteen days ; this has made it possible to assist waterless districts by means of a procedure which is merely a modernised form of the old method of solving the problem by making ponds. At the favourable season, fresh water is collected in reservoirs of appropriate size, which are dug in the ground near a river. The bottom and sides are coated with beaten clay from 25 to 30 centimetres in thickness. The object of this coating is to prevent the brackish water from seeping into the reservoir. The reservoir is usually filled simply by the force of gravity, but this process is supplemented by pumping when excess pressure is necessary to prevent any water seeping through the clay coating. When fresh water is obtainable, the reservoir is not used, and the water needed for consumption is pumped directly from the river, as is, of course, done throughout the fresh-water area (Figure 15).

This water, whether it is obtained from the river or the reservoir, is always treated before it is distributed (Figures 16 and 17).

The crude water is conducted to a vertical sedimentation chamber (Figure 18) after being mixed with a solution of sulphate of alumina drawn in by the suction of the pump in quantities varying from 10 to 50 grammes per cubic metre, according to the nature of the crude water, with or without lime treatment according to the pH of this water. While it is passing through the sedimentation chamber, the densest matter in suspension settles, flocculation occurs, and the water falls by the force of

gravity on to a fast filter consisting of a layer about 1 metre thick of crushed granite gravel of a fineness of from 2 to 4 millimetres. A tank placed under the filter receives the purified water, a chlorinated solution being poured into it at the same time (Figures 19 and 20). In some cases, the solution is drawn in by the suction of the pump which takes out the filtered water.

The respective capacities of the sedimentation chamber, filter and tank are usually equivalent to the hourly output of the plant.

The filtered water is sucked from the tank by a pump, which conveys it directly to the distributing main, a branch pipe of which terminates in a high-level overflow reservoir, which receives the amount pumped in excess of the consumption at that particular moment. By this means, pumping is carried on in the day-time. The reservoir forms a reserve supply, and its capacity for small centres may be fixed at about one-half the daily output of the works based on a ten-hour day.

The first plant of this type was installed at the waterworks of Cai-Lay, in the Province of Mytho. The population of this rural centre is exclusively native. It consists of 5,000 inhabitants. The output capacity is 10 cubic metres per hour. An average consumption of 20 litres of water per head has been provided for. This is sufficient for small rural centres and is, in fact, based on experience. Each family usually obtains from the river as many " touques " of water as there are members. This quantity has been found to be adequate in these districts; but the amount consumed in more advanced centres is very much larger, and the supply has been calculated accordingly. The works are equipped with a 5-h.p. petrol engine driving two Rateau centrifugal pumps, one of which draws the water from the river and forces it into the sedimentation chamber, while the other draws it from the tank and forces it into the distributing conduits, which include a branch pipe and a 50-cubic metre reservoir, giving an average head of water of 17 metres. The plant is looked after by a mechanic and a turncock. The mechanic is responsible for the working and upkeep of the plant. The preciseness of the Annamites in carrying out the instructions given them has made it possible to entrust a particularly delicate task to a low-salaried employee, who bears full

responsibility for the purity of the water-supply. This was made possible by adapting the apparatus employed so as to make it as simple as possible to handle. The complication of automatic gear has thus been eliminated, and it has been possible to leave the mechanic to adapt the treatment to the water to be purified. He checks the flow of the solutions as follows : The solution of sulphate of alumina is made in two twin vats, which are used alternately. It has a constant strength determined once and for all before it is despatched to the works and is made by dissolving a fixed amount of sulphate of alumina in a quantity of water determined by a mark on the sides of the vats.

The quantities of the product needed for treatment are poured into the suction pipes through a feed-pipe with three cocks (Figure 21). The first (A) makes it possible to use one or other of the solution vats ; the third (C) is movable and is placed in front of a graduated dial ; it serves to regulate the flow ; the middle one (B), when in one position, makes it possible to fill with solution the test-tube placed under the apparatus, and, when in another position, to empty the tube by means of suction from the pump. The quantity sucked up in one minute represents the output of the apparatus, and the corresponding quantity of the resulting concentration.

The chlorinating solution is manufactured each week. Like the solution of sulphate of alumina, it has a constant strength. Chlorine is used at the rate of 0.15 gramme to 0.50 gramme per cubic metre of water, in a solution of a strength varying from 1 gramme to 10 grammes per thousand prepared from chloride of lime. This product, which is very economical, gives results comparable to those obtained from other chlorinated products. The only precaution observed is to see that the requisite quantity is supplied to the stations in barrels of a size proportionate to the output, so that a barrel is never used for more than one month. The chlorinating solution is made from a fixed quantity of chloride of lime dissolved in a volume of water fixed by a mark on the container, and a certain quantity is removed each day to fill a second vat, from which it passes to the lower vat, kept at a constant level, and then flows through a calibrated nozzle into a glass funnel, which conducts it to the filter outlet.

The calibrated nozzle slides up and down on a vertical graduated rod ; its rate of flow depends on its position. If this is regulated so as to obtain a given quantity in the test-tube in one minute, the proper rate of flow of chlorinated solution will thus be assured.

A third method of treatment is also employed at Cai-Lay —*i.e.*, liming, which is necessary at certain periods to facilitate the action of the sulphate of alumina.

The output acquired is fixed by the Water Supervisory Service, which issues full instructions for treatment and analyses each month the quality of the water distributed.

The method of keeping a reserve supply was attempted for the first time at Mytho, the chief town of the province, the brackish period in the Mekong lasting two months. It was subsequently employed in the chief towns of the Bentré province (brackish period two months), at Gocong (brackish period eleven months) and at Hàtiên.

Reserve supplies have begun to be accumulated in the small rural centres of Thu-Thua (Province of Tan-an), where the brackish period lasts for nine months ; Gia-Rai (Bac-lieu), Con-Gioc (Cholon), Long-my, Phuloc, My-Phuoc, Mo-Cay, Ba-tri, Vinhloi, Dong-son, etc.

The so-called " Cochin-China type " of plant as installed at Cai-lay, which is the rural type *par excellence* both on account of the centres it serves and its simplicity and solidity, has now been installed in all the above-mentioned centres.

This plant has proved to be so satisfactory that other rural centres (Cai-Be, Tinh-Bien, Tri-Tôn) have also installed it.

At the present time, in Cochin-China alone, about thirty large centres and chief towns of the provinces have already been equipped, and thirty-seven rural centres in the fresh-water area and eighteen in the brackish area have been, or will shortly be, equipped with a drinking-water system based on this model.

The average cost of the plant works out at P.6.25 per head in the brackish area and P.3.00 in the fresh-water area.

In many cases the waterworks have a subsidiary electrical equipment, so that, after the day's water-supply has been pumped, power is available for electric lighting.

Lastly, in the rural centres of east and north Cochin-China, the nature of the ground is such that springs not infrequently emerge. Moreover, the wells sunk to tap the subsoil water provide an adequate supply for the villages they serve. For instance, small centres such as Go-Vap, Hoc-Mon and Ba-Diem obtain their supply from wells, and Hon-Quan, Tan-Uyen, and Thu-duc from springs, the very clear water from which is simply treated with chlorine added by means of an apparatus placed at the intake of the pump, which is inserted in a surface well and conducts the water directly to the water-tower.

A typical example of those centres with an exclusively native population is Ba-Diem, a small village in the province of Gia-Dinh. Ba-Diem possesses 800 inhabitants, and 60 cubic metres of water—*i.e.*, 75 litres per head—are distributed daily.

The water is drawn from a well 16 metres deep by a Diesel-driven pump. It is sterilised with 0.25 gramme of chlorine per cubic metre and raised into a water-tower holding 50 cubic metres, from which it passes to the distributing system, which possesses six street hydrants.

Some fifteen small centres are supplied in this way.

In Cambodia, most of the provincial towns have a supply of drinking-water ; in nearly every case the water is obtained from the rivers, sedimented by the use of alum, filtered through sand and chlorinated. A large number of waterworks are being constructed. The plant is in every case of the " Cochin-China type ".

In Tongking, attempts are being made to obtain drinking-water by two different methods.

The first method is to tap the subsoil water.

In the Tongking delta, subsoil water exists at a depth increasing from 5 to 25 metres from the mountains to the sea ; the supply is plentiful but it is impure. At a depth increasing from 20 metres to 60 metres, more water is found ; it is very plentiful and has been found to be sterile wherever the boring was well done. Outside the immense basin formed by the delta, this water is ferruginous.

Deep wells supply the centres of Sontay and Vinh-yen with water which is chemically and bacteriologically fit for consumption.

In the centres of Bac-Ninh, Hadong, Bach-Mai and Hung-Yen, the iron has to be removed from the underground water either in the open air or in Degremont closed tanks.

In some cases, as at Thai-Nguyen, a well is sunk in the sandy and clayey bank of a river. Treatment is then confined to chlorination. Recourse is occasionally had to filtering-galleries (Kien-An).

A second method which is now being generally employed is to draw water from the river. Both in the delta and in the Upper Region the water, in spite of the large quantity of mud and colloidal substances which it always carries in suspension, is drawn from the river. Nine waterworks of the Dépoit type are nearly completed and six waterworks of the " Cochin-China type ", which is now being adopted everywhere, are under construction. In every case the water is sedimented with sulphate of alumina, filtered through fast filters and chlorinated.

Only a few centres in the Upper Region (Chapa, Lang-son) catch the clear water from various springs, which is always chlorinated.

Lastly, in Laos, the centres of Vientiane and Luang-Prabang, which already have a supply of drinking-water obtained in the one case from wells and in the other from a spring, are extending and modernising their plant.

In Annam, and particularly in South Annam, the prolonged periods of drought render the use of modern plant particularly advantageous.

At the present time all the chief towns in the provinces have been provided with plant which is already in use or on the point of completion (schemes in process or execution or works under construction). All these installations are provided with a system of conduits for distribution.

According to circumstances, the water is either pumped from shallow wells which yield water clear enough to make alum treatment unnecessary, or the water from rivers, dams, reservoirs or irrigation canals is used, in which case it is clarified. The water is always chlorinated. Song-Câu, Tuy-Hoa, Banmé-thuot, Pleiku, Faifoo, Tamky and Quang-Tri, rural centres of medium size, receive from 20 to 80 litres per head with, on an average, one street hydrant to every 250 inhabitants.

A similar policy is pursued in regard to small rural centres of from 100 to 1,000 inhabitants, for which the problem is limited to the source, without provision of a distributing system.

Two cases arise :

In the delta areas, where the soil is usually clayey, the villages obtain the water they need either from ponds or from irrigation canals. This water is always impure.

If it is obtained from the irrigation canals, it is purified by means of the following devices (Figure 22) :

Through a special inlet with a sluice, the canal is made to feed a storage basin holding sufficient water to supply the inhabitants when the ordinary system is not working. A filter-bed, through which the water circulates by force of gravity, is connected to the basin ; this bed has four compartments, the first one containing gravel, the second charcoal, the third sand and the fourth the filtered water. According to the lie of the land, the filtered water is either distributed by force of gravity by means of cocks or is raised with a piston-pump.

Although the water produced by it is not perfect, this very simple plant provides the rural population with a much improved quality of water, and has given complete satisfaction wherever it has been installed. The inhabitants of neighbouring villages themselves ask for similar works to be carried out, bringing their contribution in kind or in cash. A complete plant costs less than P.1,000, including the contributions of the villagers, and works out at less than P.3 per head.

In many districts, particularly those which have no irrigation system, the villages draw their water-supply from wells. The water from the latter, which are badly placed, badly built and inadequately protected, is of very poor quality.

With the voluntary participation of the landowners, a series of rural wells is being sunk. This work, which is to be speeded up during 1937, will mark an important stage in the programme. The wells are from 1.20 to 1.50 metre in diameter. They are usually made by lining over reinforced concrete cribbing. The sides of the wells are of brickwork, 22 centimetres thick. Openings fitted with removable filtering plugs (zinc pipes filled

with coarse sand) are made in these walls to let the water in laterally, free from earth ; while the water coming from the bottom passes through three superimposed layers of crushed stone, charcoal and fine gravel.

The wells are provided with a reinforced concrete cover, and with a manhole leading to a ladder. They have a concrete surround to protect them from immediate contamination. Lastly, there is a protected fenced-in area around the wells. There should be enough wells to meet a daily consumption of at least 40 litres per head in a ten-hour day. In practice, there should be one well to every 1,000 inhabitants, the output of the well being 4 cubic metres per hour.

All these wells are fitted with hand-pumps of a specially strong type. Piston-pumps, chains of buckets or of scoops are used according to the depth from which the water is to be drawn. The output of these pumps is 4 cubic metres per hour.

Certain rural wells are provided with a simple chlorinating plant which is not used all the time but enables the water to be sterilised at periods (usually seasonal) when it becomes suspect, and, if necessary, during epidemics.

The cost of installing a plant of this type works out at about P.o.75 per head.

It was found to be necessary to set up a special service for the technical study of the type of plant best suited to various local conditions, to supervise the results obtained and advise on the necessary improvements. This special service has been established at Hanoi and Saigon by the Water Supervisory Services. Close co-operation has been established, under the direction of the Public Health Department, between the Public Works Department and the water laboratories of the Pasteur Institutes. The Public Works Department is responsible for drawing up and carrying out the plans and supervising the working of the stations. The Saigon Pasteur Institute, for the southern part of the country, and the Hanoi Pasteur Institute, for the northern part, analyse the water as it comes from the source, so as to determine the type of purifying apparatus to be employed. At the stations which are already working, they fix the proportion of alum and chlorine to be used, undertake

the monthly chemical and bacteriological examination of the treated water and, in agreement with the Public Works Department, decide upon the necessary alterations or repairs.

Periodical visits are made by officials of these two departments, so as to see that the stations are working properly (Figures 23 and 24).

3. Disposal of House and Other Wastes.

In view of the importance of fecal contamination and of the part played by flies in communicating disease, house refuse, human excreta, manure and other wastes are a very serious menace to rural health. Indo-China is no exception to this very general rule ; living conditions in its most densely populated areas, the nearness of the subsoil water to the surface, the frequent occurrence of floods which spread abroad the impurities in the soil, make the question of house refuse even more important here than in more thinly populated or mountainous areas.

Unfortunately, attempts to solve the problem meet with considerable difficulties, which are inherent in the system of agriculture and in traditions created by genuine needs.

In most cases, the Indo-Chinese farmer—and the Annamite farmer in particular—owns no cattle because he is too poor and because the nature of the soil and the crops he grows are not suitable for animal husbandry in the deltas. Artificial manure is too expensive for the peasant ; manure crops are now being more widely grown thanks to the efforts of the agricultural services, but they can only play a subsidiary part. The chief fertiliser is, and will long remain, domestic manure —house refuse and human excreta.

The Annamite considers human excreta to be the best of all fertilisers. In the deltas there are villages whose main business is the trade in human excreta. The work is usually done by women carrying bamboo baskets or, occasionally, pushing hand-carts which are more or less closed. They go around the villages at night and collect the excreta by the roadside or from the pits. The only precaution they take is to cover the refuse with ashes, straw or leaves.

The fecal matter thus collected is mixed with household ashes or the ashes from burnt leaves, straw or domestic rubbish. This fertiliser is sold for use in the rice-fields and gardens.

To the peasant who wants to get the greatest possible yield from a poor soil and who has little or no animal manure, this human fertiliser is wealth, and he would fail to understand why he should be deprived of it. In these circumstances, anyone who spoke to the people of the " destruction " of human excreta would not be understood by them or would be regarded with hostility.

True, in regular settlements, on plantations and in labour camps, excellent results have been obtained with ordinary privies, either of the Java type or of the following (also a very simple) type : a pit is dug 5 to 6 metres deep and 70 centimetres to 1 metre in diameter. The pit, together with the ground immediately adjacent, is kept regularly disinfected. Above the pit is placed a small circular bamboo structure with four separate compartments formed by two partitions at right angles to each other. Each compartment thus consists of a right-angled sector. Such a privy affords very good protection against flies and also prevents the dissemination of the larvæ of ankylostoma.

In the real rural districts, however, improvement will necessarily be slow and will depend very largely on the development of more rational methods of farming. The first step is to protect the sources of drinking-water from fecal impurities. This is the aim of the drinking-water supply scheme and of the propaganda carried on in the villages for sanitary wells and the protection of places from which water is drawn. A distinct improvement would also follow if the country people could be taught to utilise human excreta and house refuse in the form of less dangerous composts than the mixtures they commonly use as manure (human excreta with ashes or straw). This question ought to be examined, and discussion on the subject would be helpful.

For the rest, the solution of the problem depends largely on the education of the younger generation and on improved facilities for hygiene and cleanliness afforded by better living conditions.

4. Campaign against Flies.

Like all tropical areas, Indo-China is infested with flies. They are worst in the country districts, where the conditions are most favourable for their development.

This question, however, has only recently been the subject of systematic study ; the entomological laboratories of the Pasteur Institutes have been fully occupied with the malaria problem and have directed all their efforts to the classification and biology of the anopheles. The study of the *muscidæ* had been largely neglected. With a view to participation in the researches proposed by the Health Organisation of the League of Nations, a first attempt at classification has now been started. Insects are caught on the survey trips undertaken by the Anti-Malaria Department, and they are identified and preserved. These investigations will lead to an accurate knowledge of the various kinds which have to be destroyed.

No general measure of fly control has yet been taken. The sanitation work has, of course, contributed directly to the destruction of flies, but this cannot give the results that would be obtained by methodical action conducted on thoroughly scientific lines. As in the case of mosquitoes, each variety of fly has its special habits, its favourite breeding-places, its optimum conditions of increase. Only when we have exact knowledge of these various factors can measures be taken that will be suited to each variety and that will produce the best possible results.

Isolated efforts have been made, which have achieved results within a small radius ; but no systematic action similar to that against the anopheles has yet been undertaken.

The Pasteur Institute at Nhatrang uses a very simple type of manure-pit which completely eliminates the fly nuisance in spite of the unfavourable conditions (there are a thousand animals in the town itself).

The Institute's pits have a total capacity of 264 cubic metres, the individual tanks taking 12 cubic metres of manure in some cases and 6 cubic metres in other cases. Fifty centimetres from the bottom of each pit is a grating to separate the liquid manure, which can then be drawn away through a drain-tank.

The larvæ that try to escape fall into the cresyl dilution in the hydraulic seals of the lids and are quickly killed. These seals are the important feature of the system. Two latticed air-chambers are also fitted with hydraulic seals carefully disinfected with cresyl.

There is a similar pit at the Pasteur Institute at Hanoi, where the manure undergoes the fermentation necessary for its further use. The absence of flies in the neighbourhood clearly proves the efficiency of these installations. Such pits can be easily constructed on farms.

On plantations and in labour camps, flies are combated by adopting hygienic privies of the type described above.

In the countryside itself, an interesting experiment is being carried on under the supervision of the entomological laboratory in a large village in the Province of Haiduong (Tongking Delta). Thanks to the energy of the head mandarin of the district, orders are periodically given to whitewash the houses and care is taken to see that this is done. The night-soil is drawn off into pits prepared for the purpose, and the pools beside the houses are cleaned out. In spite of the indifference shown by the population, a very definite improvement is already perceptible, even in the middle of the hot season, as is proved by frequent inspections in this rural centre.

IV. NUTRITION.

1. Composition of Food and Methods of its Preparation.

Rice is the staple food of the twenty-two million people of French Indo-China. This graminaceous plant of the genus *Oryza* is grown throughout the territory, which produces over seven million tons, five millions being consumed locally. The numerous varieties of rice can all be classified in a few main groups:

(1) Ordinary or marsh rice (*Oryza sativa*), mainly grown in the deltas;

(2) Mountain rice (*Oryza montana*), grown in hilly country;

(3) Floating rice (*Oryza fluctans*), found in regions exposed to periodical inundations.

There are also :

(4) Glutinous rice (*Oryza glutinosa*), and

(5) Perennial rice (*Oryza perennis*).

The cultivation and treatment of rice differ according to whether it is to be used for local domestic consumption or for export. Between primitive husking with the pestle, which yields a grain of greyish colour, this tint being due to an integument surrounding the cotyledon and the germ, and the mechanical husking performed in the big modern rice-factories, there are intermediate processes which produce rice sufficiently white and clean for local consumption.

Several kinds of rice are known to the trade :

(1) Paddy or crude rice, still in the husk ;

(2) Cargo rice, obtained by divesting the paddy of its husk and a portion of the germ ;

(3) White rice, which is the same divested of most of the germ and integument, and is used for local consumption ;

(4) Polished rice, which is used for European consumption.

Apart from these trade varieties, mention must be made of the glutinous rice or " nêp " of the Annamites. This is obtained by steaming glutinous rice (*Oryza glutinosa*). It is of a pasty consistency and is used for making cakes, and especially—after fermentation—for native liquors.

Rice, which is the Annamites' staple food, is prepared in countless ways. Apart from the ordinary rice dishes, it is made into kinds of bread, such as banh-duc, and into vermicelli, cakes, etc.

Maize is a food plant widely used in Indo-China, where it sometimes serves as the staple in the absence of rice. Maize is consumed in various forms. The half-ripe corn-cobs are often eaten toasted. Sometimes they are made into flour, which forms an ingredient of a kind of bread and of pastries.

Apart from rice and maize, one of the most important food crops in the Far East is the *soya bean* (*Glycine hispida*). This bean is rich in proteins and fatty matter, but has a very low carbohydrate content. Eaten in its natural state as a vegetable,

or, better still, in the form of a variety of appetising preparations in which the casein is partly distintegrated, the soya bean makes good the deficiency of fatty and nitrogenous matter in the native diet, which consists almost entirely of the rice carbohydrates.

Its chief derivatives are nuoc-dâu, or soya milk ; dâu-phu, a fresh soya cheese obtained by precipitating the casein of soya milk ; dâu-tuong, or soya sauce, which is often used instead of nuoc-mam, especially in Tongking ; and dâu-phu-chuc, or soya cream.

Soya milk is a yellowish-white liquid, with a slight smell of burnt bread and a peculiar flavour greatly appreciated by the Annamites. It is prepared by peeling the beans, pounding them in water, straining, and boiling up the resulting liquid.

Soya cheese appears in trade in the form of faintly yellowish-white rectangular cakes, weighing about 150 grammes each.

Ten kg. of soya beans will produce 100 litres of milk, which in turn yield 300 cakes, or 45 kg., of cheese. This very cheap product, of which several thousand kilogrammes are sold every day in the Hanoi market alone, is eaten either raw with salad, or stewed with vegetables, or fried in oil.

Soya sauce, or dâu-tuong, is a preparation obtained by fermenting a mixture of glutinous rice and roasted soya beans. It is a condiment both salty and sweet, which frequently replaces nuoc-mam, a relatively dear food, especially in regions distant from the sea.

Dâu-tuong is commonly found in commerce in the form of a heterogeneous mixture, consisting of a liquid (nuoc-tuong) in which floats a somewhat coarse paste called tuong-cai, made of incompletely powdered soya beans.

Dâu-phu-chuc is prepared by drying the skin that forms on the surface of soya milk after prolonged heating. It is sold in shiny, pale yellow, crinkly sheets, and smells like cow's milk. It is a food rich in proteins and fatty matter, and is consumed by the Annamites in small pieces, either in soup, or in pork, beef, or chicken stew.

Among the secondary crops mention should be made of :

(1) *Manioc* (cu san tây)—*Mannihot utilissima*—cultivated throughout Indo-China. The root is freely used by the

Annamites, especially in the absence of rice. It is also often cooked with rice.

(2) *Yams* (cu cai mo)—*Diossorea alata*—grown in gardens almost everywhere. The root is boiled in water, or made into a soup with minced meat, or prepared with sugar. It also produces a flour used for pastry.

(3) *Taro* (khoai so)—*Colocasia indica.* The root is rich in carbohydrates, and is eaten either steamed or fried in lard.

(4) *Sweet potatoes* (khoai day)—*Ipomea batatas.* The roots are chiefly used, but sometimes the leaves also. In years of food shortage, it forms, together with maize, the staple food of the peasants.

(5) *The Annam bean* (dâu xanh)—*Phaseolus radiatus*—eaten either green, or in the grain, or in the form of sprouting beans or " gia ". It is also used for making vermicelli (song thân), which forms part of many Annamite dishes.

(6) *The dolichos bean* (dâu do)—*Dolichos purpurea*—which is eaten with glutinous rice, and is also used by the poor for making various kinds of pastry.

(7) The *pipingkai* or native cucumber (muop tâu), the fruit of *Longa acutangula.*

(8) *The China cabbage* (cai trang)—*Brassica sinensis*—the leaves of which are eaten fresh as vegetables, or pickled in the manner of sauerkraut.

(9) *Sesame seeds* (*Sesamum indicum*).

(10) *The sugar-cane.*

There are also various vegetables used by the natives so far as their means allow—cabbages, turnips, onions, vegetable marrows, melons, spinach, duckweed, etc.

The necessary protective ingredients are furnished by fruit, whenever the Annamites can afford such a luxury. We find in Indo-China the banana (chuôi), the Chinese potato (na), the orange (cam), the lemon (chanh), the pineapple (dua), the papaw (du du), the shaddock (buoi), the breadfruit (mit), the coconut (dua), the litchi (vai), the persimmon (hông), the mango

(xoai), etc., among which the banana, the lemon, the shaddock and the pineapple are the most frequently consumed.

According to the district and the individual's means, the animal protein part of the diet is provided by *meat, fish, fresh or pickled.*

Meat. — The commonest meat in Indo-China is pork. The Annamite pig is small, black and saddlebacked. Pigs are extensively bred in the country districts. Much poultry is also eaten, as well as eggs, especially ducks' eggs. Dog and buffalo meat are eaten only in the country districts, especially in Tongking and Northern Annam. Beef is eaten chiefly in the towns.

Fish. — Fish occupies a much larger place than meat in the Indo-Chinese dietary. It is from fish, fresh or smoked, that the nitrogenous matters are obtained. No Annamite meal is complete without fish or shellfish. Both freshwater and sea fish are caught. The abundance of fish and shellfish in Indo-China has led the Annamites to preserve these foods, which are highly nutritive owing to their richness in nitrogen, by salting, smoking or pickling in brine. Thus, throughout French Indo-China, one frequently meets with such combinations of condiment and food as nuoc-mam, mam-tôm, prahôc, and pâdec.

Nuoc-mam is a condiment produced by the autodigestion, with fermentation, of fresh fish in sea salt. The fish most commonly used for making it are " ca chi ", " ca lep ", " ca moi ", and " ca nuc ". The flesh of these fish is particularly rich in nitrogen.

Nuoc-mam is a clear, amber-coloured liquid with a peculiar smell and an agreeable salty flavour ; it contains a relatively large proportion of partly broken-down proteins.

Mam-tôm is an unctuous liquid produced by the autodigestion of shrimps.

It is a kind of pasty nuoc-mam, and is consumed in Cochin-China, in Annam and Tongking. Prahôc, on the other hand, is consumed only in Cambodia, and pâdec in Laos.

These last two products differ from mam-tôm in being made from fresh fish instead of shrimps.

* * *

The traditional meal consists of rice, vegetables cooked in water or fat and flavoured with various condiments, fish, eggs or meat or fowl, in proportions which will be given later when we discuss the nutritive value of the dietary. Such a meal, however, implies comparative affluence ; it is given to hospital patients, but is not the kind of thing that the peasants can generally get in daily life.

There is no doubt that natives in hospital and in prison are privileged as regards diet. Apart from breakfast, they are given two meals, which, though mainly composed of rice, are pleasantly flavoured with meat or fish and vegetables. By no means all the natives are so well fed. The town labourer, whose wages are higher than those of the village labourer, also gets three meals a day. For the morning meal, he eats glutinous rice with peanuts (50 grammes) or a rice soup, sometimes accompanied by cane sugar or soya cheese fried in lard. For the midday meal, he adds to 400 grammes of medium-quality rice a little fried meat or dried or fresh fish and a vegetable of some sort (lettuce, beans or cabbage). The evening meal is much the same as the midday meal, but smaller.

The agricultural labourer, however, represents the largest and poorest class. His life consists of a regular alternation of two periods, in one of which he gets just enough to eat, while in the other he starves. When field-work is going on (ploughing, planting-out and harvesting), the peasant's labour is in demand. His employer feeds him, and he is paid, in Tongking, from 12 to 15 cents, and gets three meals a day. The morning meal consists of 250 grammes of rice, husked in the native fashion, a vegetable, cooked in water or raw, a little meat (pork or buffalo), and a little fresh or dried fish cooked in brine. At noon, he eats, beside his work, 100 grammes of rice with peanuts and a little soya cheese or sesame seeds. Sometimes all he gets is a treacle broth. His evening meal, after a twelve-hour day, is the same as his midday meal.

Except at harvest-time, however, the poorest and largest class of the rural population is generally under-nourished. At four or five o'clock in the morning, before going to the fields or the market, the peasant eats one or two bowls of rice (100 to 200 grammes of dry rice), or a few sweet potatoes, or a handful of maize cooked in water or roasted.

Not until about noon does he take his only real meal, which consists of ordinary rice, husked in the native manner, sometimes mixed with maize or sweet potatoes, with some tuong (soya) or nuoc-cay (small crabs from the rice-fields, pickled) or nuoc-mam, a few vegetables, occasionally some dried or fresh fish, and very seldom some meat. In the evening, he has a little rice and generally sweet potatoes or manioc, with a few vegetables.

Generally speaking, the poorer country people know no food but rice with salt or preserves (nuoc-mam, tuong) as a flavouring. Vegetables, fish and meat are eaten in Cochin-China, Cambodia and Southern Annam, but they are rarities in Tongking and some provinces of Northern Annam (Hatinh, Nghe-An).

It is difficult to determine the exact composition of a diet subject to so many chances and seasonal variations. Consequently, the estimates made in the next section will necessarily apply to average diets.

2. Nutritive Value of the Principal Foods.

The chemical constitution and caloric value of the principal foodstuffs used in Indo-China are given in the two tables below :

Table I. — Composition (in Percentages) and Caloric Value of Some Foodstuffs used in Indo-China.

	Water	Ash	Carbo-hydrates	Proteins	Fats	Cellulose	Caloric value per 100 grm.
Rice, not hulled	13.9	1.3	69.8	10.5	4.6	1.3	352
Rice, cargo	12.9	1.3	73.2	8.7	1.5	0.9	350
Rice, white, No. 1	13	0.6	75.1	8.1	0.6	Traces	345
Rice, native-hulled	13.7	0.9	73.4	9.9	1.1	0.6	360
Rice, polished	10.2	0.2	80.2	3.7	0.3	Traces	340
Maize	14.67	1.32	66.31	9.47	5.18	3.25	348
Manioc (fresh)	67.6	0.6	28.6	1.37	0.4	1.5	120
Manioc (dried roots)	16.5	1.2	72.8	1.36	0.25	2	298
Manioc (flour)	10	1.9	83.4	1.84	0.36	—	343
Taro (fresh)	82.5	0.8	14	1.7	0.1	0.4	64
Taro (dried)	28	1.9	65	1.8	0.48	—	271
Beans (dry)	—	—	65.7	19.25	1.5	—	338
Yams (fresh)	77.6	0.9	16.7	2.1	0.2	0.7	78
Yams (dried)	12.43	1.46	80.93	2.78	0.7	1.5	341
Sweet potatoes	65.1	0.9	28.1	1	0.3	1.0	120
Cabbage	90.5	1.2	4.8	1.9	0.2	1.8	28
Spinach	88.5	2.1	4.4	3.5	0.6	0.9	35
Onions	86	0.7	10.8	0.1	0.7	—	50

Table I. — Composition (in Percentages) and Caloric Value of Some Foodstuffs used in Indo-China (*continued*).

	Water	Ash	Carbo-hydrates	Proteins	Fats	Cellulose	Caloric value per 100 grm.
Turnips	87.8	0.9	8.2	1.5	0.2	1.3	40
Vegetable marrows	90.3	1.2	6.5	0.1	1.2	—	30
Melons	90.4	1.1	6.5	0.3	1.1	—	30
Bananas	73.1	1	23	1.8	0.6	0.2	—
Papaws	—	0.22	14	0.52	0	0	56
Breadfruit	85	2.5	1.2	0.6	0.2	10.3	9
Pineapple	75.7	0.24	18.4	0.68	0	4.92	77
Mangoes	82	0.4	12.5	3.45	1	0.5	75.
Mangosteens	87	0.2	6	0.5	1	5	35
Sugar-cane	75.4	0.7	14.34	1.49	0	9.4	64
Soya beans (white)	11.3	4.97	22.22	39.23	16.93	4.96	399
Soya milk (raw)	—	0.24	0.3	1.98	0.75	0.56	17.4
Soya milk (cooked)	—	0.27	0.37	2.04	0.91	0.56	15.3
Dâu-phu	81.4	0.67	0.5	11.43	5.66	—	98
Dâu-phu-chuc	8.6	2.82	Traces	51.75	28.96	0.38	468
Dâu-tuong { Tuong cai	—	5.42	41.05	19.4	8.48	—	339
Dâu-tuong { Nuoc tuong.	74.35	12.4	8.5	4.5	—	—	52
Pork (fat)	50	—	0	20	32	—	368
Pork (without fat)	62	—	0	20.8	13.2	—	190
Beef (lean)	74	1	1	21	3	—	120
Beef (fat)	53	1	1	17	28	—	324
Fish (fresh)	72	1.8	0.3	17.3	4.3	—	101
Fish (dried)	—	6.5	—	22	12.1	—	185.6
Shrimps (fresh)	—	1.8	—	29.12	1.5	—	135
Shrimps (dried)	—	1.8	—	58	11.1	—	340
Eggs (complete)	73	1	—	14	12	—	136

Table II. — Composition (in Percentages) of Some Combinations of Foods and Condiment used in Indo-China.

	Chlorides (in NaCl)	Total nitrogen	Organic nitrogen	Formol nitrogen	Ammonium nitrate	Amino-nitrogen
Nuoc-mam :						
Finest quality (Phanthiet)	262.0	20.4	10.7	12.6	3.4	9.2
First quality (Phu-Quôc)	258.0	18.4	16.6	9.2	1.9	7.8
Second quality (Cochin-China and Tongking)	290.0	18.0	7.4	6.7	2.9	3.8
Inferior quality (Tongking)	242.0	5.4	3.9	3.2	1.5	1.7
Mam-tôm (soluble part)	180.0	20.6	14.2	12.4	6.4	6.0
Prahôc (soluble part)	170.0	22.4	17.9	11.7	4.5	4.3
Pâdec (soluble part)	160.0	17.4	13.05	8.9	4.3	4.7
Nuoc-tuong	114.7	7.3	6.4	2.4	0.9	1.6

These data may be of use for a theoretical and practical study of the Annamite diet. The dietaries of the non-Annamite peoples have not been sufficiently investigated ; but they are very similar to that of the Annamites, the difference being chiefly in the method of preparation and the choice of condiments.

Quantitatively, the Technical Commission of the League of Nations Health Committee has fixed at 2,400 the net allowance of calories necessary per day for an adult, male or female, living an ordinary everyday life in a temperate climate and not engaged in manual work. In the case of the Annamites, this basic figure requires modification.

According to MAUREL, calorie requirements are reduced by one-sixth in the tropics. On the other hand, as only 90%, on an average, of food is digestible, the allowance should be increased by 10% to obtain the desired number of calories. The common assertion that the yellow race seems able to do equal work on less food does not appear to rest on any sound scientific foundation.

We have also to consider the question of body-weight, which cannot be neglected, although the Commission gives the basic figure of 2,400 calories for both males and females. Bearing in mind that an Annamite weighs 50 kg., whereas the energy yield of the standard ration was fixed for a European weighing on an average 70 kg., we obtain as our basic figure for the Annamite's ration :

$$2{,}400 \times \frac{5}{6} \times \frac{5}{7} \times \frac{10}{9} = 1{,}600 \text{ calories.}$$

According to the amount of manual labour, we shall get the following figures in calories per day :

	Calories per day
Light manual work	2,000
Moderate manual work	2,400
Heavy manualwork	3,400
Very heavy manual work.	over 4,000

For adolescents, the basic figure of 2,400 calories should be adopted.

Do these theoretical evaluations tally with the practical data available ? Armand GAUTIER assumes that an adult European engaged in fatiguing manual labour requires in his daily ration the thermo-chemical equivalent of 3,500 calories—*i.e.*, 50 calories per kg. body-weight. Applying the same rule to the Annamite, we obtain a total of 2,500 calories, which squares with the figures obtained in practice by Japanese authors (Tsubol, Murato, Kumagawa) who have measured, in the case of certain Japanese, totals of 2,355 calories for 46 kg., 2,478 calories for 48 kg., and 2,578 calories for 59 kg. Despite these findings, we think it wise to regard the figure of 2,500 calories as a minimum. Moreover, consideration must be given to yet more complex factors connected with the qualitative composition of the dietary. It is a well-known fact that, of each type of nutrient, there is a minimum amount compatible with the proper working of the organism. For example, the average proportion of nitrogenous matter may be fixed at 1 gramme per kg. ; furthermore, a portion of those substances must be of animal origin.

There is also a minimum fat requirement, though the disorders that have been observed seem to be connected not so much with a chemical as with a ferment deficiency. The quantity necessary cannot at present be fixed. The carbohydrate minimum is present in the Annamite diet.

Until the minimum mineral requirements have been determined by systematic investigation, we may assume the following figures : NaCl, 1.250 ; K, 2.50 ; Ca, 0.40 ; P, 2.80 ; Mg, 0.40, with the indispensable traces of Fe, Br, Mn, As, Cu, Zn, etc.

Lastly, the balancing of the diet—especially the relative proportions of nitrogenous matter and carbohydrates—is of particular importance in this country.

The balance to be aimed at is this :

$$\frac{\text{Proteins}}{\text{Carbohydrate}} = 15 \text{ to } 25\ \%$$

$$\frac{\text{Fats}}{\text{Carbohydrate}} = 11 \text{ to } 20\ \%$$

In practice, the daily ration is infinitely variable according to social class and financial position. We can only rely upon a standard ration, such as that fixed until 1933 for native soldiers, which has been taken as a basis for the rations of agricultural labourers, factory workers and miners.

The standard ration of a soldier in garrison, as laid down, comprised :

	Grammes
Rice	750
Fish	190
Meat	60
Salt	24
Nuoc-mam	15
Tea	5

In the field, the ration is slightly increased, as follows :

	Grammes
Rice	800
Fish	200
Meat	70

In these two cases (standard ration and extra ration), we may select two extreme types of composition, one including No. 1 white rice (the commonest kind in trade) and fresh fish (minimum type), and the other including rice hulled with the pestle and dried fish (maximum type). In both cases, the meat has been assumed to be pork, as that is the kind of meat chiefly eaten by the natives.

The energy yield and body-building value of these types of ration, and the corresponding ratios, are shown in the following table :

Ration	Total calories	Proteins		Ratios	
		Total	Animal	Proteins / Carbohydrates	Fats / Carbohydrates
Normal minimum.	2,751	107	46.0	18	7.8
High minimum.	2,943	115	50.5	18	8.0
Normal maximum	2,955	130	55.6	22	15.0
High maximum	3,185	139	60.0	22	16.0

The necessary classification according to value is therefore :

High maximum ration : Very rich and well balanced ;
Normal maximum ration : Rich and well balanced.
High minimum ration : Moderately rich and ill balanced.
Normal minimum ration : Poor and ill balanced.

As to minerals, we find an undoubted surplus of sodium chloride, 29 grammes, but partly making up for the general deficit of minerals, especially calcium (almost completely absent), potassium, and magnesium (except in native-hulled rice, which yields 0.55 gramme of magnesium from the quantity under consideration—an adequate proportion).

Phosphorus is deficient in both cases, but much less so in the ration containing native-hulled rice (2.45—instead of 1.65—out of a necessary quantity of 2.80).

We may therefore say that this standard ration has a thermo-chemical and body-building value sufficient for maintenance, but the proper chemical balance of ingredients is not obtained except when native-hulled rice is substituted for white rice and dried fish for fresh fish. Only this last ration can be called normal, and then only provided that it is supplemented by some small addition of fresh vegetables and fruit.

A most desirable change was made in this ration in 1933 as follows :

Annam—Tongking	Grammes	*Cochin-China—Cambodia*	Grammes
Rice	750	Rice	700
Beef	300	Beef	300
or pork	240	or pork	240
or fresh fish	400	or fresh fish	400
Salt	24	or pork	120
Tea	5	and fresh fish	200
		Salt	24
		Tea	5

The average caloric value of such a ration may be put at from 3,000 to 3,100 calories. With the regular addition of green vegetables and condiments, for which each man receives a

special daily cash allowance, the soldier's ration is thoroughly satisfactory in its energy yield and body-building value, and is chemically well balanced.

Attention has likewise been paid to the customary native diet and to past experience in fixing the daily ration for prison inmates. This ration is more or less uniformly as follows :

	Grammes
Dry rice	700
Fresh fish	250
or dried fish.	30
or pork.	60
Green vegetables . . .	120
Nuoc-mam	20
Pork fat	4
Salt	25
Tea	5

The energy yield of this ration varies from 2,660 to 2,770 calories. It also contains an adequate quantity of total proteins (from 119 grammes to 92 grammes), including animal proteins (from 50 grammes to 32 grammes), and a sufficiency of protective foods is provided by the fats and green vegetables.

When, however, the prisoners are required to perform heavy manual labour (navvying and road-making), they are given an additional allowance of sugar, in the form of a cake made of 50 grammes of rice (weighed dry) and 20 grammes of moist sugar, representing 250 calories. The value of the daily ration is then about 3,000 calories.

The daily ration for free patients in the hospitals of the different countries of the Union is approximately the same, but greater variety is attempted, in order to stimulate the appetite of patients and convalescents. We give as an illustration the daily ration of a patient on normal diet in a Cochin-China hospital :

Java rice	0.550 kg.
Pork	0.140 »
or beef	0.140 »
or poultry (chicken, duck)	0.140 »
or fresh sausage	0.100 »
or Chinese sausage	0.050 »
Pork for broth	0.020 »
Fresh fish	0.150 »
or dried fish	0.090 »
or duck eggs	2 eggs
Fresh fish for broth and breakfast soup	0.040 kg.
Vegetables (tomatoes, China cabbage, mushrooms, Chinese sauerkraut, native spinach, cucumbers, green cabbage, pumpkins, egg-plants, turnips, etc.)	0.300 »
Banana	1
Cake	1 cake
Nuoc-mam (containing 12 grammes N per litre)	0.020 litre
Pork fat	0.005 kg.
Condiments (pimentos, green onions, dried onions, burnt sugar, vinegar, pepper, tuong-tâu, etc.)	0.050 »
Salt	0.025 »
Tea	0.010 »

Such a ration has an average energy yield of 2,600 calories per day.

A study of the daily ration at the Hanoi native hospital gives much the same results.

The ration for growing boys at the Annamite secondary school in Hanoi is as follows :

	Grammes	Proteins	Fats	Carbo-hydrates
Rice, white, ordinary	700	64.8	4.8	600
Rice, glutinous	100			
Meat (pork, beef, duck, chicken)	200	40	22	2
Fish	75	17.3	4.3	—
Fruit (bananas)	100	0.5	—	23
Vegetables, various	440	13.2	1	44
Nuoc-mam	20	2.16	—	—
Table oil	2	—	2	—
Salt	20	—	—	—
Tea	4	—	—	—

The constitution of each ration may be summarised as follows :

Carbohydrates	Proteins		Fats	Proteins / Carbohydrates	Fats / Carbohydrates
	Total	Animal			
669	138	59.4	34.1	20 %	5 %

It yields about 3,500 calories, which, as we know, is an adequate ration for an adult engaged in heavy work. It also fully meets the recommendations of the Health Committee of the League for European adolescents.

The rations considered above are rich rations. All are based on rice, which is generally provided in large enough quantities to cover the whole of the energy requirements. All furnish the organism with a proportion of proteins greater than 1 gramme per kg. All, moreover, are sufficiently rich in protective foods, since green vegetables are always included. The only comment on the balancing is that in most cases the quantity of fats is somewhat small, but it is perhaps adequate in a tropical climate.

In the case of the poorer classes, whose diet has been outlined in the previous section, there can be no doubt that, first and foremost, there is a very marked quantitative insufficiency.

The primary object, therefore, is to see that the adult has a *sufficient quantity* of food—that is to say, of rice, especially native-hulled rice. In young people during the period of growth, the problem is a different one. It is a known fact that, although the total proteins of rice are adequate to provide for growth, the quantity of proteins contained even in a ration yielding an adequate supply of energy is not sufficient. Accordingly, in the ration for growing children, rice must be supplemented by a certain quantity of proteins, vegetable (soya) or animal (meat, fish).

It is also essential to add to these rations green vegetables, which will complete the quantity of vitamins essential to the development, maintenance and proper working of the organism.

According to the statistics of rice consumption in Indo-China, the average daily consumption per head is 550 grammes.

If we accept the figures of Professor TERROINE, who considers that when a diet consists mainly of rice the individual requires 700 grammes of rice, we have every reason to suppose that this figure of 550 grammes is insufficient, even if allowance is made for the consumption of secondary foodstuffs—maize, soya, yams, sweet potatoes and taro—which frequently, instead of supplementing the rice, replace it to a certain extent. This quantity of rice is quite certainly insufficient if unaccompanied by animal proteins. Hence, since we know that little or no meat or even fish is eaten by a large part of the population, there is no doubt of the existence of this deficiency in the maintenance ration and, *a fortiori*, in the growth ration in the over-populated provinces of the Tongking Delta and Northern Annam, whose inhabitants, unlike those of Cochin-China and Southern Annam, cannot obtain the necessary additional calories and protective elements from meat and fish.

3. MINIMUM COST OF ADEQUATE NUTRITION.

With the help of our data on the composition of the necessary ration, we can determine the cost of an adequate diet ; and we shall see that poverty is the sole cause of nutritional deficiencies.

The native soldier's ration is now amply sufficient for a man doing heavier than average work. Its daily cost in the different countries of Indo-China ranged, in 1936, from P.0.143 (Tongking), through P.0.167 (Cochin-China and Laos) and P.0.170 (Annam), to P.0.185 (Cambodia).

The soldier is a well-nourished man ; with his various ration allowances, he can feed himself properly. The total daily ration allowance varies in different stations from P.0.175 to P.0.260.

In the various hospitals in the Union, the average cost of food for poor patients is P.0.18 in Cochin-China, P.0.165 in

Cambodia, P. 0.105 in Annam, P. 0.13 in Tongking, and P. 0.175 in Laos.

The standard ration for a poor patient in a Cochin-China hospital (described above) cost, in 1935, P. 0.119, and, in 1936, P. 0.144, per ration per day (350 rations drawn). The average wages of a hospital coolie at the same period averaged from P. 0.35 to P. 0.40 for a man, and from P. 0.30 to P. 0.35 for a woman. In this case, therefore, the proportion of the wages spent on food by a man living alone would be from 30 to 40%. In Tongking, the cost of the ration is P.0.13, while a coolie's wages are P. 0.24 for a man and P. 0.22 for a woman, so that a person living alone spends from 50 to 60% of his or her wages on food.

The well-constituted daily ration of a prisoner costs P. 0.065 at Haiphong (400 rations drawn) and P. 0.075 at Hanoi (1,000 rations drawn).

In the Protectorate Secondary School, the extremely rich dietary costs, for each pupil (200 rations drawn), from P. 0.18 to P. 0.20 per day. In the same school, a coolie earns P. 0.28, the cost of his daily ration being estimated at P. 0.10, or 36% of his wages. The cost of the average ration for a person living alone may be estimated at from P. 0.08 to P. 0.10.

These basic figures provide a certain check upon the results of the enquiry recently carried out in Tongking for the purpose of establishing, as nearly as possible, the daily budget of a man living alone.

This budget has been established as follows, for the suburbs of Haiphong :

	Piastre
Breakfast	0.02
Two chief meals . . .	0.12
Lodging	0.05
Clothing, laundry, medicines, etc.	0.06
Sundry expense . . .	0.04
	0.29

Food accounts for P. 0.14 out of a total daily outlay of P. 0.29, or about 48% of the workman's budget.

The enquiry in one province (Thai-Binh) gives the following figures for a coolie living in the centre :

	Piastre
Food	0.13
Lodging	0.025
Clothing and laundry. .	0.025
Sundry expenses . . .	0.03
	0.21

In the higher region, where the natives spend as much of their earnings as possible on food, the budget is roughly as follows :

	Piastre
Breakfast	0.03
Chief meals	0.14
Lodging	0.025
Clothing and laundry. .	0.025
Sundry expenses . . .	0.03
Total	0.25

In the neighbourhood of the industrial centres, lodging and clothing involve expenses that the man can meet by hiring his labour. The minimum wage at Haiphong is P. 0.30.

As we go farther away from the industrial centres, the proportion of expenditure on food to total expenditure increases, reaching 62 and even 68% as the standard of living declines.

In the villages of the delta, and especially in the Province of Thai-Binh, the family budget for a household where the man and wife both work and bring up one child is approximately as follows :

	Piastre
Food (three persons) . .	0.27
Lodging	0.035
Clothing and laundry. .	0.045
Sundry expenses . . .	0.04
Total	0.39

Here the proportion of the budget spent on food is 69%.

In a typical family of five persons in the Tongking Delta, chosen from the poorest class of agricultural labourer (husband, wife, three children), living on as poor a diet as we have

described, the cost of food is P.0.10 per day, or P.3 per month. Needless to say, the entire family is under-nourished. Whenever material conditions improve (during the period of field work) and hired labour (two or three persons out of five) brings in a little money, the expenditure on food rises to P.5, and sometimes even P.8, monthly—an amount which provides ample nourishment for the whole family.

It will be seen that the Annamite peasant spends as large a proportion of his income as he can afford on food. Poverty must be regarded as the main cause of under-nourishment, where the latter exists. In Indo-China, the effects of inadequate nutrition are to be seen almost exclusively in the Tongking Delta and Northern Annam, where in certain provinces the density of population is from 850 to 1,000 per square kilometre. In those areas, the very density of the population keeps agricultural wages down. Consequently, in far too many instances in the countryside, the earnings are too small to feed the family properly. On the other hand, in Upper Tongking, Southern Annam, Cambodia, and Cochin-China, the people are better off, and both peasants and industrial workers can provide adequately for their families.

4. Diet and Health : Deficiency Diseases.

We have already pointed out that, whatever defects there may be in the composition of the native diet, owing to the constant carbohydrate excess resulting from an almost exclusive use of rice, there is, in fact, almost throughout the country, a quantitative deficiency due to poverty. It is true that death-dealing famines no longer occur. If we exclude a localised famine in two northern provinces of Annam, occasioned in 1931 by political troubles which interfered with the harvest, we no longer see to-day, as we did twenty or thirty years ago, the distressing spectacle of unfortunate people dying of hunger by the wayside or falling victims to the epidemics of bacillary dysentery which attacked starving populations. Those times are long past ; yet it cannot be denied that in many districts and at more or less regular periods of the year the Annamite populations are under-nourished. The result is a seasonal

increase in the incidence of endemic diseases—especially malaria—which affects the least-nourished part of the population. The cure for this state of affairs must be sought through the general programme for the improvement of the standard of living of the native population which is discussed hereafter.

At the same time, it must be recognised that the population is increasing steadily throughout the country, except in Laos, at a rate which cannot be put at less than a million persons in every five years. Such an increase implies a high birth-rate and a power of resistance to pathological influences which precludes undue pessimism regarding the general state of health, and in particular the state of nutrition.

The most common deficiency disease, and the only one of general importance, is beriberi. Reference to the general statistics of classified diseases will show that beriberi accounts annually for a total number of hospital cases which in recent years (for all health institutions in Indo-China) has fluctuated between 3,000 and 4,000, with from 300 to 400 deaths. These figures cannot claim to represent the real incidence of the disease among the whole population, since the lack of data concerning causes of death outside hospitals prevents any exact estimate from being made. But, if we compare them with the total admissions of in-patients (200,000 to 280,000) and with deaths among these (14,000 to 17,000), we find that beriberi, which ranks eighth among diseases treated in hospitals, is only of limited importance in the pathology of Indo-China.

Beriberi has now been eliminated from among workers in the rubber plantations by administrative measures ensuring a certain percentage of incompletely husked rice in the standard diet (Java rice, 25% of broken grains, 4% flour-extraction). It occurs more especially in Cochin-China among the rural population, and less frequently in Tongking, where it was chiefly found in prisons. Here again supervision over the quality of the rice has almost completely eliminated this disease.

The relatively high incidence of beriberi in Cochin-China is due to the growing use, even in producing regions, of mechanically husked rice. Whereas the vast majority of the

population in Tongking and Annam still consumes rice husked by pounding, the Annamites in Cochin-China have acquired a taste for the whiter rice produced by mechanical huskers, which has come to be thought more nourishing, for, being less easily digested, it produces a more lasting sensation of repletion—which is what the native wants.

Discussions on the pathogeny of beriberi involve no conflict of views as to the best methods of prevention ; whatever the theory adopted, there is complete agreement on the fact that polished rice, deprived of the nutritive elements of the pericarp and germ, is the basic food of all persons suffering from this disease. But, although the appropriate preventive measures are easily applied in organised communities, among gangs of workers, in plantations, and so on, there is little hope of success in correcting the nutritional errors of consumers of milled rice. As a result of exhaustive studies carried out at the Pasteur Institute in Saigon, a committee on beriberi convened in pursuance of a recommendation of the Fifth Congress of the Far-Eastern Association of Tropical Medicine, held at Singapore in 1923, came to the conclusion that the most effective measure would be to use paddy-bran for the preparation of cheap foods (biscuits, cakes, etc.) to be offered for sale in native markets. This recommendation, although logical and undeniably valuable in theory, did not produce any result, for it encountered the usual resistance met by every attempt to modify ancestral customs, particularly in the matter of diet.

From the therapeutic point of view, however, the use of rice-bran cakes has always given encouraging results, especially when combined with the reduction or even suppression of the rice in the diet and with the addition of foods rich in vitamin B, accompanied or not by amino-acids.

It would seem that the best method of combating beriberi in future will be to enrich the diet by the addition of a variety of foods calculated to restore the balance of diets containing little else than carbohydrates ; such a development must be sought in the cultivation of secondary crops and a general raising of the standard of living. In this connection, a close supervision of the traditional nitrogenous condiments (*e.g.*, nuoc-mam) plays an important part, since the regulations

require such products to contain a minimum percentage of nitrates.

In the regions that are least well provided with food resources, along the coast of Central Annam, where fishing yields poor results and cattle is very scarce, syndromes of an endemic nature have been noted in the last twenty years in the form of œdema and nitrogen deficiency in the blood, which are found among the poorest sections of the population; certain investigators have given these the name of " Bouffissure d'Annam ". Such cases, in which the disease takes a severe course, frequently with violent diarrhœa and cachexia, appear to be closely connected with a diet deficient in vitamin B, and also doubtless in proteins and in fats. Amino-acid treatment has given good results. Prevention must be sought in a general policy of nutrition, which in these infertile regions assumes great importance and is now the subject of close study by the agricultural authorities.

This brief outline will show that the problem of deficiency diseases in Indo-China is only one aspect of the very wide problem of native nutrition, and that its solution is bound up with that of the general problem dealt with in the following section.

5. Proposals for a Co-ordinated Nutrition Policy.

The nutrition problem in Indo-China is primarily one of quantity; it arises out of the general problem of poverty among the rural population. As a subsidiary matter there arises a problem of quality : that of increasing the nitrogen content of a diet which is too exclusively based on rice. But here again, as we have seen, we are brought back to the question of poverty. The investigations outlined in the early sections of this chapter show clearly that, as soon as his means allow, and while remaining faithful to his customs and predilections, the Annamite provides himself with a diet adequate both in calorie and in protective value. The problem, therefore, is in every case how to give the peasant greater purchasing power, since, as soon as the standard of living rises, the diet tends to become more satisfactory.

In this almost exclusively agricultural country, in which there is little heavy industry and in which handicrafts are comparatively undeveloped, an increase in the purchasing power of the population implies, above all, an improvement in agricultural returns.

Such a result has been sought systematically for many years in Indo-China, and we have already noted the practical achievements of the agricultural and rural hydraulic engineering services.

We give below the programme being carried out by the agricultural authorities, more especially in so far as it relates to the improvement of nutrition through an increase in the yield of the rice-fields, the development of food crops and fruit-growing, fish-stocking and industrial crops. The carrying-out of this programme has been undertaken by the *Office indochinois du riz* and the *Institut des recherches agronomiques*, assisted, for purposes of education and propaganda, by the local agricultural services. The *Office du riz* made itself responsible for all the research and other work undertaken with a view to increasing the yield of the rice-fields, while the *Institut des recherches agronomiques* took over the encouragement, on the one hand, of fish-stocking, and, on the other, of dry-crop growing both in drained rice-fields to forestall crop failures and on other land so as to facilitate the transfer of the excess population from the deltas into neighbouring districts, by ensuring their livelihood.

An increase in the area of rice-fields was naturally the first objective ; land which had hitherto remained waste and unsuitable for cultivation was made fertile by irrigation.

Once an increase in the cultivated area had been secured, the next objective was an improvement in yields. Owing to the uncertain climate, rice production in this country involves considerable risks ; sometimes in one area drought will lead to crop failure, while in an adjacent area an excess of water destroys part of the yield. In many rice-fields, two crops can be grown, in the fifth and tenth Annamite months respectively, corresponding to spring and autumn ; but, according to atmospheric conditions, the area varies by as much as 100%

with an equivalent fluctuation in the amount of rice grown. These risks have been greatly reduced by appropriate hydraulic engineering works ; now that they have the water under control, growers have been able to keep their production at a regular level.

Yield per unit has been increased to a marked extent by an improvement in methods of cultivation, the use of fertilisers —especially manure crops within the reach of the poorest growers—the introduction of new varieties and the better selection of old varieties of seed, etc. All this part of the work has been done by the *Office indochinois du riz.*

Parallel with an improvement in rice production, efforts have been made to introduce or develop food-crops and fruit-growing. Particular attention has been paid to four products well able to supply the necessary nitrogen and starch to the diet : potatoes, beans, soya and maize.

Potato-growing is expanding steadily and has come into the front rank in certain provinces, such as Hadong and Phuly. The Annamites are beginning to consume potatoes regularly, and the stage during which production was intended for the sole use of the French settlers in Hanoi is now past. The varieties grown at present are accordingly perfectly acclimatised. Three new varieties from Japan, Yunan and Hong-Kong have just been successfully introduced, with a view to making use of the land during the dry season.

Beans have long been known, but the native variety is much inferior in quality to the European white varieties, the introduction of which has been attempted. Annamite growers declare themselves well satisfied with the latter, and the quality is so greatly appreciated by the natives that the crop is sold standing, and carried away as soon as it ripens.

Soya is of particular importance in view of its high nitrogen content. The main effort has therefore been concentrated on this bean, and fourteen foreign varieties have been introduced from the United States, Japan, Java, South America and Manchuria ; all these, especially the Java and South-American types, have given good results.

Maize is useful both for food and for semi-industrial purposes. Its advantage is that it can be consumed on the spot if the rice

crop fails, and exported if the latter is abundant. Considerable selection research has been, and is still being, conducted on the subject of maize. Thus, in the case of the white maize required by French breeders, the organisation of a regular supply of selected seed has enabled growers to obtain yields five and six times as large as those obtained formerly.

Apart from the four species mentioned above, market gardening—*i.e.*, the cultivation of European vegetables—is expanding steadily around the towns. Onions, French beans, salad, radishes, artichokes and asparagus (the latter introduced only after great difficulty) are now grown in large quantities and form part of the natives' diet. Cabbages are particularly appreciated by the native population, as can be seen from the strings of junks, laden with this product, which ply on all the rivers of Tongking and Northern Annam during the season.

One department of the *Institut des recherches agronomiques* has concentrated on developing fruit-growing, which was little known in the country. Apart from tropical fruits, which are mainly grown in the southern part of the colony, special efforts have been made to improve and expand citrus-fruit production. Beginning with imported foreign varieties and with local varieties selected through a series of provincial fruit-growing competitions, experimental stations have set up nurseries which have been used to feed nurseries set up in each province for large-scale production and at the same time to serve as training centres. The Annamite knows practically nothing of grafting, and has had to be taught from the beginning, but the success of these demonstrations has been great and has spread into the farthest corners of the military territories.

All these efforts, however, result chiefly in producing carbohydrates, whereas the supply of cheap nitrogen is what the population still requires.

Part of the population in the Far East, and particularly the Javanese, have, since the earliest times, obtained their nitrogen supply from fish, which has always played an important part in the economic life of the country. In Indo-China, there is very little pisciculture, and what there is is practised by primitive methods. The *Institut des recherches agronomiques*

has endeavoured to remedy this defect by setting up a Department of Pisciculture, which has already developed considerably. It includes :

(1) A laboratory at Hanoi ;

(2) An experimental station at Hadong ;

(3) An experimental station at Phu-Ho (Province of Phu-hô) ;

(4) A test fishery at Sontay ;

(5) A test fishery at Nghia-Thuong (Province of Bac-Giang).

Moreover, there has been set up in the Province of Thanh-Hoa, under the supervision of the *Institut des recherches agronomiques* a fish-stocking station at Bim-Son. The Higher Residency in Annam is shortly to set up a second station of this type in the neighbourhood of Hué.

The general aims are the following :

(1) Improvement of existing native pisciculture, with a view to increased yield and to exploitation of the numerous ponds found near villages and dwellings ;

(2) Encouragement of pisciculture wherever possible, especially in rice-swamps, in the less fertile uncultivated valleys which are frequently found at the foot of mountain ranges, and which can be transformed into ponds at low cost by simple engineering work, and finally in the natural brackish ponds which often cover extensive areas along the coast.

Results so far achieved are most encouraging. Thus, in one model fishery, carp weighing from 700 grammes to 1 kg. can be bred on a profitable basis in one year. Similarly, fisheries set up in rice-swamps can yield a gross return equivalent to from 25 to 50% of the gross return on rice. If we remember that the gross return of a fishery is practically equal to the net return, whereas this is far from being the case in rice cultivation, the prospects held out will easily be appreciated.

An extension of modern fishing methods will bring a very appreciable additional income to the population of the country, and add a most suitable item to its diet.

The production of foodstuffs on the spot is, however, but one of the solutions to the problem. Industrial crops had also to be introduced which could be exchanged against foodstuffs. In order to succeed, this necessitated making provision for the industrial processing of the products in question, the organisation of sales machinery, and the necessary finance.

The *Office de crédit agricole*, in close collaboration with the *Institut des recherches agronomiques*, concentrated on this part of the programme from the outset.

Tea-growing and the cultivation of tung-oil trees and the castor-oil plant were introduced or developed. These products, consumption of which increases daily, thanks to the new uses discovered in industry, are likely to expand very considerably. They grow wild in the northern parts of Indo-China, where conditions are particularly favourable and respond readily to all efforts at improved cultivation. To these primary products must be added numerous others, such as lac, stick-lac and the Chinese anise-tree. Among them, mention should also be made of a form of agricultural production undertaken in the neighbourhood of towns, which adds considerably to the income of the population—*i.e.*, horticulture. Roses, chrysanthemums, zinnias, lotus and carnations are now produced on an industrial scale, and sold in considerable quantities in the markets of the delta towns.

Some of these products require before export a degree of industrial processing which the natives are scarcely able to undertake successfully. A solution has been found by setting up co-operative organisations for manufacture and sale. The striking results achieved by these organisations have been referred to above, and it is intended to extend them further as and when the principle of co-operation finds wider application.

Here is where collaboration by educational authorities must play its part in the development of a nutrition policy. Schools obviously play a useful part in spreading practical knowledge and—by means of domestic courses and school gardens—technical information supplied by the competent departments concerning food crops or piscicultures, for instance, or concerning the value of certain foodstuffs and the need for

introducing certain constituents into the diet. But the school authorities can best further a policy aiming at improved nutrition by exerting their influence on the minds of the people, by demonstrating both in children's and in adults' classes the efficacy of modern methods, the advantages of co-operation, the dangers of usury, the part played by savings, etc. The help which education can give lies in the ability of its 10,800 teachers, male and female, and its 6,883 schools scattered over Indo-China to spread these ideas throughout the country.

V. MEASURES FOR COMBATING CERTAIN DISEASES IN RURAL AREAS.

The delegation of Indo-China, in accordance with instructions from the Inspectorate-General of Public Health, would be glad if, in addition to the diseases which already appear on the agenda, *trachoma* and *cholera*, could be discussed. It would welcome an exchange of views between the health authorities of Indo-China and those of neighbouring countries, concerning the must suitable measures for combating these two diseases, which are of particular importance in rural parts of Indo-China. A note concerning them appears at the end of this chapter.

Before proceeding to a brief review of the diseases proposed for discussion, one general remark should be made : a sharp distinction between rural and urban pathology would, in the case of Indo-China, be artificial, for this country is, in fact, as the report shows, essentially rural, towns being few and industrial centres rare. The vast majority of the capital towns of administrative districts are, in fact, nothing but large villages. The capitals themselves are surrounded with essentially rural suburbs, in which some considerable part of the native population lives. Some capitals, such as Hué, are only a collection of villages. Thus any preventive measures to be applied to Indo-China must be suitable for rural conditions.

1. Malaria.

Malaria is of outstanding importance in the pathology of Indo-China. A study of hospital statistics shows that, in the

last twenty years, it has accounted for the largest number of hospital cases (12% of the total) and that, next to cholera, it is responsible for the largest number of deaths in health institutions (10% of total hospital deaths) (see Figure 25).

The economic and social consequences are considerable ; not only is the working capacity of a large number of persons reduced each year, but malaria is the most serious obstacle to the development of districts suitable for industrial crops (particularly hevea-growing). Above all, malaria reduces the possibility of transferring people from the over-populated deltas. The migration of Annamites towards the central districts has always been checked by their fear of these regions, which is justified by the endemic character of malaria in the middle altitudes. This last factor is becoming more and more important.

The anti-malaria campaign, which was formerly confined to the protection of organised communities and to the combating of certain epidemic outbreaks, was given its present form in 1929.

Experiments were first made in the hevea plantations of Cochin-China, and later in public works undertakings. Soon afterwards, the Government-General requested the Pasteur Institute to extend its investigations and prophylactic measures to cover the whole country. An extensive survey was undertaken in 1930 and 1931, under the official guidance of the health services, in towns and localities recognised as being particularly unhealthy (Figure 26). The earliest sanitation works in urban centres were undertaken in Tongking in the summer of 1932. Each year since then, the fight against malaria has been intensified in each of the five countries of the Indo-Chinese Union. We have already seen that the sum allocated to anti-malarial measures, out of the loan budget alone, amounts to P.2,660,000, to be spread over several financial years. Expenditure charged to this budget since 1931 has exceeded P.1,500,000 by the end of 1936, and this did not include credits for anti-malarial measures appropriated out of the ordinary budgets (purchases of quinine, synthetic drugs, etc.).

A. *Measures against Individual Infection.*

Quinine prophylaxis is recommended by the antimalaria services wherever systematic treatment of the sick is neither

provided nor contemplated nor even conceivable owing to prevailing circumstances. The dose is 0.50 gramme quinine hydrochloride per diem. In view of the continuous supervision required, this method can only be applied with some real prospect of success in the case of communities under proper control.

Although it does not give protection against heavy experimental infections, quinine prophylaxis has given good results when applied to communities in the field. It has been found to reduce the daily sick-list by one-fifth to one-third and, when efficiently carried out, invariably reduces the death rate by half or even, where the disease is hyperendemic, by two-thirds.

Quinacrine (atebrin) and præquine (plasmoquine) have given the most encouraging prophylactic results in the hands of various investigators in Indo-China. A large number of tests, made since 1934 in various hevea plantations in Cochin-China, have shown that mass treatment by means of synthetic substances constitutes a very useful adjunct to anti-larval prophylaxis. It has proved of particular value in periods of specially severe malaria endemicity. In swampy districts, where the disease is hyperendemic, drug prophylaxis with the quinacrine-præquine combination enables the health of a sedentary community to be stabilised at a fairly constant level, even at the most dangerous periods of the year. Although the immediate effect is *certain*, however, local circumstances have so far always rendered it *ephemeral*.

To achieve lasting results in Indo-China, treatment spreading over the whole year should be provided for. This, however, is much too costly to be practicable. Moreover, it may be wondered what effect such protracted treatment would have on the human organism.

Medical prophylaxis as practised by antimalaria dispensaries rests on the principle of a systematic search among malaria-infected communities for all hæmatoozon-carriers, and their subsequent treatment until the parasites have completely disappeared. When the chain of transmission has thus been broken, the malaria rapidly declines as a social disease. The method has been applied with success in various parts of Indo-

China. The organisation and working of the anti-malaria dispensary of Binh-Dinh (Annam) may serve as an example. The dispensary, which is quite separate from the infirmary, is in the charge of an Indo-Chinese doctor with two assistants. It is fully equipped for blood examinations. The persons treated include, on the one hand, the free village population, which is attracted by organised propaganda (lectures, school-teaching, appeals by the mandarins and communal authorities, etc.), and, on the other hand, organised bodies under supervision, such as the militia, school-children, prisoners, etc., together with new arrivals from infected districts. Each subject is provided with a record-card, given a blood examination and treated systematically under microscopic control.

The Indo-Chinese doctor in charge does not confine his activity to examinations in the dispensaries ; whenever possible, he goes into the village with one of his assistants and a representative of the public authority, examines the inhabitants and, by a house-to-house search, hunts out those sick persons who endeavour to conceal themselves.

This type of organisation is adequate for a large village and can perhaps also cover a few neighbouring isolated communities, but it cannot in any way ensure adequate medical prophylaxis throughout a district. Recourse must therefore be had to flying squads consisting of experienced auxiliary attendants, skilled in performing the various therapeutic injections, well equipped with anti-malarial drugs and, if possible, under the orders of a local doctor. These squads proceed from village to village, previous notice being given with orders for sick persons to attend. Experience has shown that each squad must spend at least four days in each village or group of villages (Phu-Qui district, 1930).

Finally, there are cases where malaria is so frequent and so severe that more vigorous action becomes necessary, and *large-scale campaigns* must be undertaken.

Such a case occurred in 1928/29 at Phu-Diên, in the Vinh Province of Northern Annam. In this region, malaria is endemic in a mild form ; cases are scattered throughout the numerous villages and generally go unnoticed. In 1928, an epidemic broke out the origin of which remains obscure, but which, after a winter

lull, became so active in the summer of 1929 that 75% of the blood findings for all the subjects examined were positive, while a surprising proportion of cases involved unusually serious complications, such as pernicious attacks, blackwater fever ; in short, the whole district, comprising more than 25,000 inhabitants, was infected. A vigorous campaign of medical prophylaxis was undertaken. Sick persons were collected by the police in each village and given thorough medical treatment. The total number of cases treated was 7,492 of all ages, the total number of injections of quinine and arsenic exceeding 6,000 and doses of quinine *per os* 23,000. Cleaning operations were also undertaken in the villages, under the direct supervision of the police and of the local authorities.

Within one month (July 2nd to August 7 th), the epidemic was brought under control, and, during the next thre eyears, not a single active malaria focus could be found in the district. In 1931 and 1932, infantile endemic indices were negligible. Several different detachments of troops were garrisoned in the citadel for five consecutive years without suffering any appreciable loss from malaria ; this shows how completely successful was the method employed, although it must be added that ditch-draining operations carried out in 1930 certainly contributed to it.

In Indo-China, anti-malaria propaganda is somewhat complicated by the multiplicity of customs and languages, and assumes the most varied aspects. To reach the public, use is variously made of tracts, posters, postage stamps, lectures, talks in schools and the cinema screen. *Personal influence*, however, whether that of the mandarin, the doctor, the teacher, the plantation inspector or the sick-attendant, is always the most effective. Efforts, therefore, are mainly directed to training persons who are already more advanced and who, for one reason or another, exercise some influence over the population so as to enable them to combat the numerous forms of mass prejudice and to spread elementary ideas of hygiene.

Improvements in living conditions, whether moral or physical, help the campaign against malaria by strengthening natural

organic resistance. The closest attention is therefore paid, more particularly on plantations, to nutrition, clothing, housing and even personal cleanliness.

B. *Measures against Infection.*

Whenever a plantation or a road-making camp in a marshy district is started, care is taken first of all to select a place where all the labourers can be assembled at night. To protect the latter from infectious bites, the ideal site should comply with the following conditions :

It should be at a distance of at least 1,500 metres from any occupied or recently deserted native village ;

It should be at a distance of more than 800 or 1,000 metres from any breeding-place of vector anopheles ;

It should possess a drinking-water supply sufficient for the requirements of the workers at all seasons and so constructed as not to offer breeding facilities for anopheles ;

It should be at the centre of an area entirely cleared of undergrowth for a minimum radius of 300 metres measured from the outlying dwellings.

These conditions, which are based on experience and on our knowledge of the biology of the vector anopheles in Indo-China, are not often fulfilled in nature ; in practice, a site should be selected corresponding as closely as possible to the above conditions, and the ground should then be laid out satisfying all requirements.

In Indo-China, there are few screened houses, though some companies and administrations have set a splendid example.

On the other hand, individual mosquito nets are becoming more and more common among the population as a whole, but are not always rationally used, even among Europeans. Moreover, a net is still too often a costly luxury for the poor Annamite or Tongkingese peasant. If mosquito-nets are to be fully effective, their users must, in the first place, be educated in their use and, in the second place, supplied with cheap material. To this end, the Anti-Malaria Service of the Pasteur

Institute is trying to popularise an individual and a collective model based on the standard type widely used in the Philippines, and fitted like the latter with a closing device suitable for native beds. These models, which are made up in Annamite cotton net, now cost, the former, 1 piastre and, the latter, P.1.90, ready made (Figure 27). A propaganda campaign is also under consideration which would include : the free distribution of model mosquito-nets, the provision in country areas of stocks of mosquito-nets and Annamite net, an obligation for each school-child to make a mosquito-net and the general education of the population by posters, pictures and talks.

Before the destruction of the adult anopheles is taken up, an attempt is usually made to clear it out of living quarters. This is most commonly achieved by the cleansing and the careful upkeep of camps, the clearing of undergrowth and rough levelling of the surrounding areas, the maintenance of a clean-weeded belt of at least 300 metres around living quarters, the laying-out of gardens with flowers or vegetables without thick foliage, or better still, of lawns sown with *Gramineae* (such as Bermuda grass and bear grass, which grow quite well in the red soil of Cochin-China) and mown regularly every fortnight or month. Essential adjuncts are the ample ventilation of dwelling-houses (windows, skylights), daily exposure to the sun on as great a scale as possible, a strict ban on the storage of firewood, particularly under camp beds, and, lastly, the whitewashing of walls, thus making human dwelling-houses as uninhabitable as possible for anopheles.

The destruction, in the strict sense of the term, of adult anopheles is always regarded, in the case of a community, as a mere accessory to anti-larval action in areas where malaria is highly endemic, or as an emergency method of attack during the period of an epidemic. By itself, it can only be a very temporary and inadequate safeguard. In Indo-China, adult anopheles are usually destroyed in three ways : (*a*) by fumigating dwelling-houses through burning damp straw inside them, the old Moï method ; (*b*) by fumigating with cresyl fumes, an easy and extremely effective, but unfortunately rather expensive, method, and (*c*) by using powerful sprayers (spray-drums)

emitting poisonous pyrethrum fumes, which penetrate to the smallest crevices, and then thoroughly sweeping the floors.

Attempts to catch the insects in traps have, so far not proved successful in Indo-China.

The two principles underlying antilarval action in Indo-China are : (1) For a sheet of water to serve as a breeding-place for anopheline larvæ, it need only exist for as long as seven or eight days. Accordingly, larvæ in a permanent sheet of water need only be destroyed every seven days to prevent any breeding of anopheles. (2) To safeguard a community effectively against the creation of an endemic area, antilarval action need only be taken within a radius of 800 to 1,200 metres of the houses, this average distance representing the actual range of flight of the vector anopheles in Indo-China. The area to be laid out around a dwelling-house or populated centre is termed the anti-malarial protection belt.

Various methods of destroying larvæ are employed in Indo-China, varying according to the site and size of the community to be protected, its temporary or permanent character, the resources available, etc.

For several years, the Pasteur Institute has been studying the possibility of combating malaria in Indo-China by means of fish. Of the numerous local larvivorous species, four are worthy of attention as being more specifically and, above all, more consistently voracious—namely, *Anabas scandens*, *Macropodus opercularis*, *Aplocheilus javanicus* (found almost everywhere in Indo-China, but especially in the south—*A. latipes* in the north), *Aplocheilus panchax*. Two foreign species of American origin have also become gradually acclimatised : *Girardinus goupyi* and *Gambusia affinis*. The use of larvivorous fish for keeping down larvæ seems likely to spread, but with special adaptations for different places and conditions. Its application meets with numerous difficulties, due both to the climate (unfortunately, the time when it is most important to check the larvæ coincides with the cold season, when the appetite of the fish is at its lowest) and to human action (in this country, where the population will even eat tiny locusts, even the most useful animals are

relentlessly destroyed). The success of the method depends partly on the piscicultural services and partly on the education of the Annamite population.

Dusting with Paris green is a method usually kept for dealing with *large sheets of water* which it would be very expensive to drain, where the vegetation cannot in practice be permanently kept down and where all, or at any rate most, of the surface might serve for the breeding of larvæ of the vector species. Such are the brackish lagoons where *A. ludlowi* is found in Cambodia and Cochin-China ; the rice-fields and the innumerable pools in Annamite villages, where every house built means an excavation ; roads and railway-lines, both sides of which are sometimes lined for kilometres with a string of borrow-pits that in low-lying areas cannot be filled in or even drained, and where *A. aconitus*, *A. maculatus* and even in some cases, *A. jeyporiensis* and *A. minimus* are found.

As the ground requires no preliminary preparation, Paris green gives excellent practical results in cases where the area to be treated is large in proportion to the community to be protected and the labour available.

While highly effective in marshy areas with stagnant water, rice-fields, borrow-pits, etc., Paris grèen is a much more difficult form of attack when used on fast-running water-courses and, in practice, entails a rather complicated organisation, strict training of the staff responsible for spraying, and its supervision often leads to very great difficulties.

In the case of all bodies of water serving as breeding-places for the infecting species of anopheles and not used by man or animals either for obtaining food or for cultivation, the spraying of larvicide mixtures containing mineral oil is an invariably effective and relatively cheap method.

The typical mixture most commonly used in Indo-China contains one part of petroleum to nine parts of heavy oil, and is applied either by spraying with the vine-sprayer type of appliance or by a wholesale process of sweeping. The larva breeding-places must always be given some little attention beforehand by removing the grass, trimming of the banks, straightening out the bed in the case of a stream, etc.

In principle, oiling should be done once every seven days, except in the middle of the rainy season, when it must be repeated in the case of any breeding-place which has not been drenched by a heavy shower of rain in the previous six days at most.

No further proof is needed of the efficacy of oiling ; in Indo-China, as everywhere else, it is the ideal form of anti-larval action, except where there are permanent installations which make more drastic measures possible.

It may be of interest to mention that, certain makeeshift larvicides are frequently used on plantations and in mines, because they give really effective results at virtually no cost.

On rubber plantations, for instance—near the factory, at any rate—it is often useful (because of the bad smell) to lead off the discharge from the latex-treatment process through an underground drain to a stream infested with larvæ. Such discharges are extremely poisonous to the anopheles larvæ.

Similar use can be made of the waste oil from various types of combustion engines, provided it is mixed with sufficient petroleum to ensure its covering the surface of the water. Pyroligneous derivatives have been used with success.

At the tin-mines at Phontiou (Laos), excellent results have also been obtained from the " sterile " deposit from the washing-sheds which accumulates along the sides of the streams. Coal wastes containing traces of sulphur may also produce the same effect (Hongay).

At various places in Indo-China, water-flushing devices are operated and give good results. Others are being planned. Owing to its simplicity and its moderate price, this method should be more generally adopted.

In order to exterminate the larvæ of vector anopheles infesting the irrigation canals and ditches surrounding the rice-fields in the Phu-Nhon area (Annam), alternating irrigation has been tried. This method, in which *rice-fields and sheets of water are drained weekly and in rotation,* would seem to be the only really economic method of combating malaria in districts which are dependent on rice cultivation.

The sections of rice-fields thus treated (three days irrigation out of every six) at Phu-Nhon have been thoroughly cleared of all larvæ. From the agricultural point of view, the paddy harvested differed neither in quantity nor in quality from that simultaneously grown on neighbouring rice-fields which were always under water.

Besides filling in, anti-malarial drainage is the only radical method of coping with larvæ, since it does away with all pools of water in which the larvæ of vector anopheles breed. There are, in principle, two stages of reclamation by drainage :

The stage of semi-permanent works lasting for one year, during which the drains, which are all soil drains, are kept open so that their working, and their maximum and minimum discharge can be watched, and, if necessary, the lay-out altered. A year must be allowed to give soil that was formerly under water time to dry up completely, to change under the action of air, light and sun, and thus become suitable for farming. Soil drains are closely watched and kept in constant repair. They are oiled weekly during the dry season, and in the rainy season whenever more than six or seven days have passed without rain. Responsible, trained " anti-malarial squads " are specially seconded for this work.

The final stage of the work, which should be begun in the second year, and which comprises a whole system of works built with solid material (underground drainage by means of earthenware pipes, open drains in masonry, cement or bricks, and various equipment) which need not be specified here.

In practice, for obvious financial reasons, rural measures of protection against malaria in Indo-China usually stop short at the first stage. A policy of semi-permanent operations and oiling is most frequently adopted by plantation companies in Cochin-China and Cambodia. Taken together with quinine prophylaxis, they give after three months undeniably successful results, and in six months the general situation is absolutely transformed. In that time, daily absence from work (*i.e.*, the percentage of the total number of men absent from work through sickness of all kinds, compared with the total number

of labourers on the pay-roll of the concern—in other words, the index of labour output) fall from 20, 25, 30 and 40% to 5%. To reduce the latter figure usually takes another six months or a year, with all the measures still being strictly applied ; but some enterprises formerly undermined by malaria now have no more than 1 to 2% of absences from work due to sickness of all kinds.

Permanent works have so far been carried out in Indo-China only by three private companies at their own expense, in one administrative department, and in four urban centres by the Public Works Department.

The works were begun at the end of 1932 and are not yet all completed. In the four centres, however, an almost complete disappearance of serious indigenous forms of malaria has for some time been observable ; the death rate has fallen, and malaria cases have shown themselves unusually amenable to treatment with quinine. Index figures have unquestionably fallen everywhere (80 to 30, 35 to below 10, 40 to 10, 50 to 10, etc.)

Shading of drains. — The larvæ of vector anopheles in Indo-China cannot live in sheets of water which are constantly and strongly shaded. This result is artificially ensured by planting on either side of open drains—or narrow streams—very thickly leaved and branched bushes, which form a sufficiently dense dome of green above and at the sides of the drain. *Melastoma normale, Crotalaria anagyroides,* together with *Cassia hirsuta, Cassia alata,* have given good results in Tongking (Phu-Hô), *Lamtoro* in Cambodia and *Erythrina lithosperma* in Annam.

Drains made of rubble and fascines. — These are sometimes used in place of underground earthenware pipes. The former needed a fall of at least 1 centimetre per metre to prevent any risk of obstruction, while the latter, which are made of conical fascines about 3 metres long, consisting of small stalks of whole non-rottable bamboo, only need a much more gradual fall (3 to 5 millimetres per metre).

To remain in good repair and be efficient, anti-malarial drainage systems must be protected against two natural enemies :

storm water in the case of underground drains, and *cattle* in the case of open drains.

The effects of storm-water are countered by *anti-erosion devices ;* weirs and dykes, stepped dams, etc., which, by distributing the water over a large surface and reducing its speed, prevent erosion. Cattle are kept off by placing barbed-wire *fences,* crossed logs or thorn hedges parallel to the drains.

In agricultural and industrial enterprises, the work is done by private initiative, usually by the proprietors themselves, after a survey has been made by the Pasteur Institute, and under the latter's permanent supervision. For all cases where reclamation by means of major engineering works is contemplated, a special branch of the Public Works Department has been set up which has an engineer in each district in constant touch with the Pasteur Institute laboratories and junior officials who have undergone preliminary training at the Pasteur Institute in catching insects and applying practical anti-larval measures.

The Health Service indicates the points to be studied by the technical services. The Pasteur Institute makes an investigation. On the strength of its findings, a detailed survey of the conditions to be dealt with is drawn up by the anti-malarial engineer, who prepares a scheme, after discussing it on the spot with the head of the Anti-malarial Service. The chief engineer examines this scheme from the engineering standpoint. The chief of the Anti-malarial Service of the Pasteur Institute certifies that it will give the entomological results expected.

The head of the local administration, after consulting the Health Service, then has to decide whether the result anticipated justifies the expenditure and to order its inclusion in the draft budget to be submitted for approval first to the local assemblies and then to the Government Council.

Once these approvals have been obtained, the whole work is done under the technical supervision of the anti-malarial engineer, who controls the executive details. The Pasteur Institute records the entomological and epidemiological results of the action taken (Figure 28).

2. Plague.

Plague does not constitute a serious problem for Indo-China, and all the foci that have arisen during the last thirty years have disappeared spontaneously, or almost spontaneously. They were situated chiefly in urban centres. There was an endemic focus at Pnom-Penh, producing an epidemic flare-up from time to time in the town and a few small secondary foci in the province. There was another focus at Cholon, the disease being brought there by foreigners, and a small focus in certain ports and islands of South Annam, the infection being carried from one to another by vessels engaged in the coasting trade. There were sporadic foci in Tongking, where the disease usually started in the port of Haiphong, but these disappeared more than fifteen years ago. There was also a small focus in one island in the territory of Kwang-Chuong-Wan.

During the last ten years, the average annual number of notified cases was under 170, some of which were not bacteriologically confirmed.

Plague used to break out chiefly among the Chinese in Cochin-China and persisted at Pnom-Penh in the early days of the French protectorate, owing to popular opposition to preventive measures ; but it is now assuming a more and more sporadic character. From the standpoint of rural hygiene, it is of no moment whatever.

The task of Indo-Chinese hygienists is confined to keeping a look out for it and exercising supervision, mainly in Cambodia. The varieties of rats and lice have been systematically classified. The anti-rat campaign is conducted methodically in the threatened areas. It is not thought that the vaccines commonly employed would prove an adequate safeguard in case of need. In an emergency, use should be made of the Madagascar (Girard and Robic) or Java vaccines, which should be prepared locally if necessary.

3. Ankylostomiasis.

The prevalence of uncinariasis among the population of Indo-China is well known. It has formed the subject of various enquiries, the last of which, carried out in 1933 by the Medical Services, confirmed the data previously recorded.

In Tongking, in the delta region and in Northern and Central Annam, the percentage of ankylostoma egg-carriers averages about 50, rising in certain districts to 68. In Cochin-China, the rate of infestation varies from 15 to 25%. In South Annam, the average is 20%, falling to less than 10% in certain districts. In Cambodia, it is 17% on an average. In Laos, the average percentage is 29.

Local variations in the rate of infestation correspond fairly closely to climatic conditions : in Tongking and in the northern and central part of Annam, the dry seasons are shorter and less marked than in Cochin-China and South Annam. In Cambodia, the alternation of large scale floods and dry seasons, when the earth is completely dried up and parched, is not conducive to the development of the larvæ.

In Tongking, the working conditions of the rural population also increase the risk of infestation. The growing of two rice crops a year compels the peasants to work nearly all the year round on damp ground.

In one province of North Annam, where accurate data have been recorded, the proportion of school-children infested amounts to 31% in the swampy lagoon districts to 26% in the rice-field area, to 20% in the sandy districts along the river banks, and to less than 7% in the salt-marshes.

The traditional types of dwelling are also an important factor. The pile-dwellings in which Cambodians and the natives of Laos live, by reducing the length of time during which the inhabitants are in contact with the soil, render them less liable to infestation than the Annamite houses, which are built directly on the beaten earth and are often flooded during the rainy season and when the rivers rise.

The distribution by sex, age, social class and occupation tallies with established data. The most heavily infested groups are those whose bare feet come most into contact with the soil of the rice-fields or marshes. The rate is always lower among young children and old people than among adults, among women than among men, among artisans than among agricultural workers ; it is far lower among the well-to-do classes, who wear shoes, than among the masses of the people who go barefoot.

The variety found in nearly every case is *Necator americanus* in Cochin-China and Annam. In Tongking, the researches of MATHIS and LÉGER (1911) revealed the coexistence of this parasite with *Ankylostoma duodenale*. This distinction, which is difficult to make in the conditions of routine examinations, is, however, of no practical moment.

The proportion of ankylostoma carriers classified as " without any clinical symptoms " is considerable, varying from 80 to 90, or even 100%, according to the conditions under which the survey was carried out. Some caution should, however, be observed in crediting this absence of clinical symptoms, because the people concerned are simple folk, obliged to lead a laborious life, who only regard themselves as ill when they are no longer able to work. In point of fact, however, a high percentage of these so-called " non-apparent " carriers suffer from pronounced anæmia ; nearly 90% of ankylostoma hosts are anæmic ; from 45 to 80% have a blood count corresponding to pronounced anæmia (less than 3 millions). Cases of acute anæmia (less than 1 million, or even less than 500,000) are not infrequent. This being the case, one can hardly speak of healthy carriers. The absence of intestinal or other symptoms enables the ankylostoma carriers to follow their occupation, but their output is necessarily reduced and their resistance to other diseases is bound to be lowered.

It is on this account that uncinariasis, although only a few of the patients are taken to hospital, must be regarded, here as elsewhere, as a social disease.

In towns and among organised groups (plantations in particular) preventive action takes the form of measures of general hygiene and efforts to prevent infection of fæcal origin. The plantations and mines possess sanitary latrines. In many cases, the coolies are required to have a douche when they stop work, or at least to wash their feet in an antiseptic. Routine treatment of hospital patients suffering from other diseases but also infested with parasites is widespread, this should help to reduce the incidence of ankylostomiasis, although the masses of the peasant population do not benefit by these protective measures.

On the one hand, living conditions in the flooded rice-fields, contaminated by excrement, as must inevitably be the case until the masses have been educated, lead to constant infestation and reinfestation. On the other hand, the great difficulty of advocating the destruction of excreta, which is valuable to the population, has already been explained in the chapter on sanitation. This population lacks other fertilisers and cannot understand why an attempt should be made to deprive it of the one it possesses. Fortunately, it is the habit of the Annamite to make frequent use of vermifuges as contained in the traditional pharmacopœia.

Here, again, effective prophylaxis depends on a general improvement in living conditions. Only people possessing sufficiently comfortable homes can be expected to realise the danger which excrement represents. The necessity for washing their feet after they have finished their work can only be inculcated into peasants who are well enough off to acquire the habit of using soap. The prevention of uncinariasis in rural districts therefore forms part of the general programme of rural reconstruction, raising of the standard of living and education of the masses.

4. Tuberculosis.

The actual incidence of tuberculosis among the natives, and particularly among the rural population, is difficult to determine. The majority of patients are not examined by a doctor. In the vast majority of cases, the causes of death are not diagnosed. The only reliable data are the hospital statistics. During the last fifteen years, an average of 19.94 per mille of the patients admitted to hospital were suffering from tuberculosis, while deaths in hospital due to that disease amounted to 72.28 per mille. These figures for admissions vary very little from one year to another and are not increasing.

A large number of enquiries into the prevalence of tuberculosis have been based on tuberculin skin tests carried out serially, either in schools, among organised groups or among the population at large. The results obtained by the investigators are not always comparable, as the methods of classification

employed were not in every case identical. The following table shows the main findings expressed as a percentage of positive tuberculin skin reactions.

PERCENTAGE OF POSITIVE TUBERCULIN SKIN REACTIONS.

	Annam (1912)	Annam (1933)	Nha-trang, South Annam Province (1933)	Cholon (1923/24)	Cochin-china (two provinces) (1925)	Cochin-china (centres) (1933)	Cochin-china (rural districts) (1933)	Hanoi (1928)
	%	%	%	%	%	%	%	%
5 to 10 years . . .	24.75	30.94	22.50	45.59	21.48	24.65	22.38	17.6
10 to 15 years . .	23.32		32.00	66.98	37.33	34.70	32.48	32.6
Adults	54.72	64.22	,,	,,	,,	69.54 (militiamen)		65.0

The sampling investigations have confirmed the fact that tuberculosis is much more widespread in the few really urban towns (particularly industrial towns, such as Cholon) than in country districts and rural towns, under which heading the majority of provincial centres are to be classed.

The disease is more prevalent among adults of the well-to-do or middle classes (officials, secretaries, etc.) than among adults of the peasant class. The enquiry carried out at Cholon in 1923 and 1924 clearly showed that the greatest number of children with clinical symptoms of tuberculosis came from families living either in urban houses of the Chinese type (a narrow den without air or light) or in straw huts packed closely together, while the smallest number of cases were found among families living in isolated houses of the traditional type (houses with cob walls thatched with straw, with a small garden).

Although the incidence of tuberculosis is not as high among the population as a whole as has been alleged, nevertheless—and especially in towns—it constitutes a definite danger against which comprehensive action is being taken in accordance with the following programme :

(1) BCG vaccination at birth of the majority of infants born in the maternity hospitals ; on an average 48,000 vaccinations have been performed annually during the last few years. The vaccine is administered orally.

The Pasteur Institutes possess a BCG research laboratory at Saigon, where systematic investigations are carried out into the duration of the immunity obtained by the various methods of vaccination. It is proposed to establish an isolation ward for children coming from a tuberculous environment, where they would be kept for the necessary period after vaccination.

(2) Organisation of the anti-tuberculosis campaign in Cochin-China and Annam, expressly selected as experimental centres. As regards Central and Eastern Cochin-China, every part of the programme is being carried out at Saigon ; there is one service for the detection of cases, administration and control of treatment (at dispensaries) and another special hospital service for patients likely to benefit by treatment by modern methods (collapse-therapy, chryso-therapy, etc.) with 120 beds—increased this year to 180. There is also a motor dispensary with an-ray equipment car attached, for the examination of convalescents in the provinces and the detection of new cases. Incurable cases are isolated in a special establishment under medical supervision.

A similar organisation will be put into operation in Western Cochin-China with headquarters in the largest town of the district.

In Annam, there is a special hospital and dispensary with 160 beds at Hué.

In Annam and Cochin-China, the results achieved have, to a large extent, been made possible by the assistance of private associations which receive official support and are placed under official supervision.

The results obtained have led the authorities to contemplate the extension of the anti-tuberculosis organisation to Tongking, where it will be put into operation at the end of this year.

Lastly, as regards the administrative and teaching staff, native officials of all categories found to be tuberculous are given long leave (five years) with pay, as a prophylactic measure.

They are examined periodically and are not allowed to return to work until they are cured.

In rural centres properly so-called, the living conditions of the natives are not so conducive to the development of tuberculosis as has been alleged. The Annamite houses are ventilated, while those of the natives of Cambodia and Laos, built on piles, are excellent examples of healthy dwellings. The replacement of these traditional types by brick houses of the European type is undesirable ; it leads to overcrowding under deplorable conditions. The chief danger consists in the ignorance of the population, which is familiar with and fears tuberculosis, but has no idea of its infectious nature and, moreover, is not in a position to take the necessary precautions against infection. In regions where there is a severe winter (North Annam, Tongking), the inadequate protection against cold is a factor which brings about the onset of tuberculosis symptoms. Malnutrition, which is still too widespread in spite of a certain improvement in nutrition—as witness the cessation of the severe famines of former times—also promotes the spread of tuberculosis among the poorer classes, though it is not to be compared with the danger to town dwellers—even of the middle classes—of overcrowding in dark, airless dwellings.

Here, again, the possibility of effective prevention depends on an improvement in living conditions, which is the general aim of the sanitation, hydraulic and agricultural works that are being carried out.

5. Pneumonia.

Pneumonia and pneumococcus affections generally are not of any social importance in Indo-China. Characteristic forms of pneumococcus diseases account for barely 1% of cases admitted to medical institutions. The study of the various pathological effects produced by the pneumococcus is of some interest from a purely medical standpoint, but does not involve any important problem of prevention, and it has not been necessary in this country to take any special action against these diseases, which continue to be sporadic and seasonal.

6. Yaws.

Yaws exist in the five countries of the Indo-Chinese Union. In 1935, taking the health institutions as a whole, there were 1,200 hospital cases and nearly 34,000 consultations. The majority of patients are treated in the rural infirmaries or during the tours of inspection made by medical officers and sick attendants.

Yaws appear to be mainly prevalent among the population which has affinities with the Indo-Malay races and are found in Cambodia, Laos and Western Cochin-China. Similarly, in Annam, they occur principally in coastal districts where the Indo-Malay element is largest.

The treatment of this localised affection, with which the natives are quite familiar, is facilitated by the fact that it is very cheap. It is easy to trace because the native is rarely mistaken in the diagnosis of this disease, and the places on which preventive action should be concentrated can hence be easily determined. Treatment is given, on the one hand, by the assistance services : field ambulances, infirmaries and first-aid stations, and, on the other, by temporary treatment centres established in places with a high endemicity, which are visited periodically by the sick attendants. In Indo-China, the treatment regarded as most satisfactory is the injection of bismuth salicylate suspended in an oily mixture of guaiacol, which is very cheap (less than P.0.01 per injection). A series of from six to ten injections is usually sufficient to remove infectivity ; indeed, this result is sometimes obtained after a smaller number of injections, especially in primary or secondary cases. The treatment lasts one month ; the patient attends the treatment centre on the appointed days and is not obliged to give up his occupation. There are a large number of these centres, which are so situated as to make it unnecessary for the patients to travel greater distances than 6 to 8 kilometres, according to communication facilities.

In places where the campaign has been undertaken, it is often necessary to provide for a second period of treatment for the purpose, not only of completing the cure of improved patients, but also of consolidating it in the case of those who claim to

have recovered, and of treating new cases which may have occurred.

In view of the results obtained with bismuth salicylate, it appears to be unnecessary to have recourse, in combating yaws, to arsenical products, which are more dangerous and much more costly to use, and are therefore kept for hospital practice.

Wherever this campaign has been undertaken, its popularity among the natives bears witness to its efficacy. Proof is afforded by the two following concrete examples :

In the province of Cammon (Middle Laos) from 1926-1928, 2,894 yaws patients were treated with bismuth salicylate, some in the rural infirmaries, but most during the tours of inspection in villages too remote to permit of the establishment of treatment centres. Since the sick attendant cannot visit these villages more than once a week, large injections of bismuth were given to the patients : 5 c.c. and 6 c.c. in the case of adults, without any ill-effects.

In the province of Kwang-Ngai (Annam) in 1935/36, 9,992 yaws patients were treated with bismuth salicylate either in the rural infirmaries or in treatment centres which it has been possible to set up owing to the density of the population. The doses of bismuth were reduced to 2 c.c. in the case of adults, as it was possible to give injections at shorter intervals.

In every case, not only have the yaws patients treated been rendered non-infectious without difficulty and at little expense, but the increase in the endemicity of yaws has been checked. It may be said that, thanks to the development of communications and the increasing facilities of access to remote regions, yaws are becoming more and more rare and will finally disappear altogether from Indo-Chinese nosology.

7. Leprosy.

In Annam, the first known attempts to deal with leprosy by measures of social preventive medicine go back to the days of the great Emperor Gia-Long, the founder of the present dynasty, who, in 1814 and 1815, decreed the establishment of homes and later of special villages in which lepers could lead a normal life, with their own pagodas, bonzes and mandarins, while at the

same time being forbidden contact with other villages and use of the public roads. During the troubled times which preceded the establishment of the French Protectorate, Gia-Long's organisation fell almost completely into abeyance, and it is the Catholic missions which must be given the credit for taking over the heavy task of caring for the lepers, for whom they began to create small groups of villages in the vicinity of their Christian centres. It was in these villages that most of the present-day agricultural settlements had their origin.

It is difficult to give exact figures of leprosy in Indo-China. Among a population of over 20 millions scattered in tens of thousands of villages, a methodical survey is impossible and reliance must be placed upon the statements of the native authorities, which are verified whenever possible. The last attempt at a census gave a total figure of 12,000 lepers, which must, however, fall short of the real number. Though, indeed, the people of Indo-China are as a rule familiar with the symptoms of leprosy and dread the contact of lepers (in ancient Annam creditors used lepers as debt-collectors to force recalcitrant debtors to settle), certain of the atypical or less apparent forms are unperceived even in the patients' immediate circle and thus escape detection.

At the present day, almost 5,000 lepers are segregated in agricultural settlements, leprosaria or leper villages controlled either by the Administration direct or by subsidised missionary organisations. Ultimately, the whole of the cost of maintaining these institutions is borne by the local and provincial budgets. There are, in all, fifteen settlements or villages and one leper hospital.

In Tongking, the situation of the lepers segregated in special villages is regulated by a Government decision establishing their status and enabling them to obtain the necessary grants. Once settled in the village, however, they are entirely free from constraint ; the resident officials of the Assistance Service are there, not to guard, but to treat them. A certain number of lepers escape, but, in the long run, always return of their own free will. It is worthy of note that, at the time of the New Year celebrations, the authorities are obliged to have the segregated villages guarded by small detachments of the militia, not to keep

watch on the inhabitants themselves, but to protect them against thieves from the surrounding districts, who are attracted by the lepers' relatively easy circumstances. The villages are, of course, organised in the traditional way, with their own notables and pagodas or churches.

Apart from two villages set aside for the Indonesian tribes of the upper valleys, there are, in Annam, two chief agricultural settlements : one directed by the Paris Foreign Missions and the other by the Franciscan Nuns. The latter, which is situated near Kwi-Nhon in the beautiful coast valley of Kwi-Ho, is growing rapidly and with the agricultural land in its possession should be capable of considerable development. It possesses a hospital section with a crèche for the segregation of the children of leper parents and homestead districts in which the lepers are allotted gardens and fields.

In Cambodia, the colony at Troeng originated in a leper village, founded by a Cambodian healer who gained a great reputation by treating the inhabitants with the seeds of krabao (*Hydrocarpus anthelmica*). This settlement is now being developed and modernised with the assistance of grants from the Loan Fund. In Cochin-China, the only institutional leprosarium is situated on an island in the Me-kong river and is under the care of a women's religious order. The inmates of this establishment enjoy a peaceful and unfettered existence, but the system is costly and thus incapable of extension, and will therefore have to be discontinued.

In addition, many lepers are treated by consultation services open on stated days at certain hospitals (particularly in Cochin-China). It is to be feared that the results are not proportionate to the work and expenditure involved. This is due, not to any fault of the staff or of the methods employed, but rather to the advanced state of the disease, the irregular attendance of the patients who do not willingly submit to the necessary self-discipline and who, in the majority of cases, are also suffering from malnutrition. It must, indeed, be recognised that the majority of lepers come, in the long run, to be shunned on every hand and, being unable to earn a livelihood, degenerate into wrecks, for whom a refuge must be found. Home segregation must always be what it is at present—namely, an exceptional

method only appropriate to those rare sufferers who are sufficiently well-to-do to provide for their own needs and to ensure the proper observance of the rules of hygiene.

To attempt to apply in Indo-China the proposals for out-patient treatment sometimes put forward would be to court failure, and to incur the severe criticism of the healthy members of the community who are accustomed to the segregation of lepers and appreciate its valuable results. Treatment by travelling services would only be appropriate for patients of independent means who have become negative. Nor is there any reason to hope that, under present conditions, more active therapeutic measures might bring about the complete elimination of leprosy. Specialised hospital services must be retained and even further developed, but only in so far as they are required for clinical, biological and therapeutic research, training, and the classification and diagnosis of cases prior to their despatch to the agricultural settlements.

The present system of settlements and villages is in keeping with the wishes of the community and of the patients themselves (the latter are never forced to remain in them and escape is rare). The health authorities propose to extend the system while at the same time reducing its cost by making it more completely self-supporting. This would be perfectly feasible if all able-bodied lepers were provided with land and implements to produce their own food.

While not failing to test other methods of treatment, the Indo-Chinese authorities rely in the main upon the derivatives of the locally produced chaulmoogra. Cambodian krabao is amply sufficient for local requirements and is used in a variety of forms, more particularly in that of ingestible soaps perfected at the Saigon Pasteur Institute.

On the whole, it may be said that, while not a really vital menace to the people of Indo-China, leprosy is nevertheless receiving the closest attention on the part of the public authorities. It must, however, be recognised that, apart from the present policy of systematic segregation, which must be continued and developed, the solution of the problem can only be brought about by an improvement in the general standard of living.

8. Mental Diseases and Drug Addiction.

The relative prevalence of mental disease among the natives is shown by the growing success of the establishments for the treatment of the insane. In 1918, a lunatic asylum was opened at Bien-Hoa, in Cochin-China, and has since required yearly extension. It now accommodates more than 700 patients. In 1933, an asylum was opened at Voi, in Tongking, and is now full with almost 400 patients ; plans have been made for its extension in 1937. In Cambodia, an asylum is in course of erection at Pnom-Penh ; it will be used exclusively for mental patients of Cambodian origin. Apart from the asylums, there are specialised psychiatric observation services at Saigon, Pnom-Penh, Hué and Hanoi for the examination and classification of the insane before removal to an institution. Certain of these services are equipped for the treatment of outside patients suffering from acute but curable mental disease, or minor mental disorders.

As the provision of asylum accommodation for lunatics is limited by financial considerations, the extension of the existing establishments and the creation of new asylums can only be achieved gradually. There can be no doubt that, in the villages, there are many lunatics at large. In the first place, they could not at present all be taken into the asylums. In the second place, the native family spirit is so strong, and the village community so closely knit, that a great many cases of minor mental disorders, congenital or acquired mental deficiency, harmless hallucination and non-violent *dementia præcox*, whom social conditions in Europe would make it necessary to confine, can be allowed to remain in their villages without any great danger. The number of serious offences committed by lunatics left at liberty, though not high, is still greater than it should be, and it is gratifying to note that the native attitude in this matter is changing, and that nowadays there is an increasing tendency to send excitable or dangerous lunatics to the medical institutions, instead of chaining them, in the traditional manner, to a pillar of the family home and subjecting them to sometimes brutal forms of exorcism.

The type of institution adopted is the rural asylum, situated in an area where land is available. All the able-bodied and reasonably quiet inmates are treated by the method of freely

accepted work : market gardening, rice, tobacco and maize growing, tending of flocks and herds, husking, carpentry, etc. In this way, the patients are provided with a familiaro ccupation in their own environment. The results are excellent, and the by no means negligible output appreciably reduces maintenance costs. It is not proposed to make any change in the method now adopted, but merely to develop agricultural and horticultural work, which is thought to be most suitable as a means of curing the patients. Agricultural settlements as they are understood in Europe would scarcely be practicable here. The native mentality would not allow of the boarding-out even of non-violent patients in strange families ; supervision would be too difficult, and the patients would be too often exposed to exploitation. The present system, on the contrary, enjoys the growing confidence of the people.

In the mental pathology of Indo-China, drug addiction plays a very minor part.

The annual number of admissions to lunatic asylums due to alcoholism is very small (from five to ten). In 1935, only 319 cases of alcoholism, in any form, were admitted to health institutions in the whole of Indo-China. Though rice spirit is in current use, it is taken in small quantities and, as a rule, only on ritual occasions or at family celebrations. In the rural districts, chronic drunkenness is rare. Habitual drunkenness is almost entirely confined to town-dwellers and chiefly to those engaged in certain unusually exhausting occupations. In the rural districts, alcoholism is virtually non-existent.

This is even more completely true of opium addiction, with the exception of a few non-Annamite tribes who cultivate the poppy (and among whom it is only used in moderation and never by the young). It may be said that the Annamite peasant does not smoke opium. The peasant's only drugs are tobacco, which he smokes in a hookah, and alcohol, of which he drinks a few thimblefuls on the occasion of ceremonies in honour of his ancestors or of the spirits. Opium is entirely unknown to him, and in any case the price of the drug is quite beyond his means. Those who use opium in Indo-China are, first and foremost, the Chinese—merchants, manufacturers, small traders and even coolies (in Cochin-China) ; well-to-do Annamites on reaching

middle age, though sweeping generalisations should be avoided (many middle-class Annamites smoke opium either not at all or only at very irregular intervals) ; and the lower classes in the towns, who frequent the most squalid opium-dens, or collect their by-products (dross), which they smoke or eat. Whatever measures are taken by the authorities, consumption varies little. If the price of controlled opium is raised, the immediate result is an increase in the smuggling, which thus becomes highly remunerative, and which the 7,000 kilometres of frontier make it very difficult to eliminate completely. In any case, the high price of opium and the relatively low standard of life among the natives, even of the middle-classes, keep opium-smoking in general within moderate limits. Psychoses due to opium addiction are quite unknown. The admission of opium addicts to hospitals is quite exceptional (only seventy-five cases during the whole of 1935). Without attempting to defend indulgence in opium, it must be recognised that its place in Indo-Chinese nosology is very slight, and that, in any case, it has not the least bearing on the problem of rural hygiene.

9. Trachoma.

There are at least five million persons suffering from trachoma in Indo-China. Fortunately, two-thirds of them at least are chronic cases with mild lesions or no lesions at all. The rest are acute cases tending more or less quickly to become chronic, with or without complications ; the most frequent complication is entropion, with trichiasis and film of the cornea as its sequel. Trachoma impairs the sight, and causes partial incapacitation, but rarely involves complete blindness. It is the gonococcus which most frequently perforates the eye and is responsible for most of the cases of blindness. Its action is so rapid that the damage is generally irremediable when the patient comes for consultation.

Careful studies have been made for over thirty years past by qualified ophthalmologists. They have shown that the numbers of trachoma patients, which amount to 80% on the coast of Annam, diminish in proportion to the distance from the sea and

the proximity of the foothills of the Annamite mountains. Strong winds, sandstorms and glare unquestionably are contributing causes. It is further observed that the acute, contagious forms of the disease, accompanied by discharge, are most frequent in the case of very young children.

There is general agreement now in Indo-China that the contamination occurs in infancy, between the first and second year, through the handling and use of linen which has been used by trachoma patients. Contamination in the schools, which is often held responsible, in reality only accounts for reinfections and para-infections. It is these last which are the essential factors governing the seriousness of the disease. Another important feature is the tendency to a spontaneous cure, provided secondary infections are avoided. These are the factors of the situation—*viz.*, contamination in infancy, effect of insanitary conditions in the family, relative mildness of the disease and seriousness of its complications—on which the plan of campaign against trachoma has been based.

Long ago (some thirty years ago), an attempt was made to deal with the problem by mobile squads consisting of one doctor and two sick attendants, who travelled about the country treating all comers (brushing, instillation) ; but they were swiftly overwhelmed by the numbers of patients coming to consult them.

Preventive hygiene is of capital importance. Reference has been made to the achievements of the educational and propaganda work of the schoolteachers and the propaganda conducted by the health services in the schools or direct among the population. The question is bound up with the problem of a general improvement of the standard of living. The elimination of trachoma depends on the ventilation of dwellings and the use of soap and clean linen, and is, in short, primarily an economic problem.

Preventive medical action is required more especially with serious cases and where complications occur. In each country, there is an ophthalmological institute which deals with the more serious cases and serves as a post-graduate training hospital for the Indo-Chinese doctors, who then take over the direction of the special wards in the provincial hospitals. In all, there

were more than 6,000 trachoma in-patients, and 400,000 consultations were given to 150,000 out-patients in 1935.

In the rural districts properly so-called, the mistake was made of entrusting the treatment of trachoma to the schoolmasters. It is a thankless and repugnant task that takes up their time, reduces them to the level of a sick attendant and lowers their self-esteem. All that can be done is to ask them to have an eye to personal cleanliness and do their utmost in the way of giving opinions and advice.

Collyria, which act upon secondary conjunctivitis, have had considerable success with the population. Converted into terms of the Sino-Annamite pharmacopœia, they are sold by tens of thousands of bottles at an extremely low price, and are extensively advertised. The rural sick attendants also distribute large quantities to consulting patients, particularly the harmless and useful zinc sulphate, the cost price of which is negligible.

Preventive measures in the rural areas are mainly in the hands of the rural infirmaries and of the travelling medical and auxiliary staff. The methods employed may be illustrated by the particular case of a campaign against trachoma which has been proceeding for the last year and a half in a highly populated province of Northern Annam. During the period under consideration in this province, the ophthalmological service of the provincial hospital gave 5,000 consultations to trachoma patients living within a radius of 5 to 10 kilometres from the capital of the province ; there were only 105 in-patients, the 2,000 patients operated on (for entropion, the lachrymal ducts, etc.) being able to come in each day for dressing.

The cure of trachoma complications in the interior of the country has been the chief object of the medical tours around the rural infirmaries which have been described above. The following table gives the number of operations effected :

	Cures of entropion	Operations on the lachrymal ducts	Total
1935 :			
June	36	75	111
July	45	209	254
August	251	118	369
September	294	92	386
October	326	44	370
November	219	36	255
December	273	55	328
1936 :			
January	169	34	203
February	306	36	342
March	189	13	202
April	210	27	237
May	244	65	309
June	176	20	196
July	155	58	213
August	237	51	288
September	350	49	399
October	308	24	332
November	249	9	258
December	234	14	248
Total	4,271	1,029	5,300

The operations take place in eighteen different rural infirmaries, some of which are 100 kilometres from the capital of the province, though all are connected by roads accessible to motor traffic. A system of " Taylorised " organisation makes possible the high level of efficiency reached.

On the arrival of the doctor and his two assistants at the rural infirmary, the cases discovered by the rural hospital attendant are examined and the patient given a card, while the consulting-room is transformed into an operating theatre with instruments, surgical linen and dressings brought from the capital. The patient, his head covered with a sterilised and disinfected cap, is anæsthetised with cocaine by the first assistant. The doctor operates with the aid of the second assistant. The dressing after the operation is in the hands of the third assistant (*viz.*, the

rural sick attendant), who is also responsible for the subsequent daily dressings and the removal of the stitches in the case of entropion treatment. In this way, sixty cases of entropion have been dealt with in a single afternoon in certain infirmaries.

The methods described do not claim to cure trachoma, but merely to correct deformations so as to avoid eventual incurable infirmities, and to prevent serious complications by removing obstructions from the lachrymal ducts.

10. Cholera.

The Indo-Chinese delegation, voicing the desire expressed by the health authorities of Indo-China, asks the Conference to consider the possibility of discussing preventive measures against cholera, especially in rural districts.

Indo-China is greatly exposed to the spread of cholera epidemics. Its land frontiers, stretching over nearly 4,000 kilometres, separate it from China, Burma and Siam, all open to the great pandemics coming from India. Its maritime frontiers, stretching nearly 3,000 kilometres, expose it to the danger of contamination by the small coastal traffic which is very difficult to supervise. Its wealth of waterways and canals, and the density of its boat traffic, together with the over-population of the deltas and the constant contamination of the subsoil water, which lies very near the surface, all constitute favourable conditions for the development of epidemics, the spread of which is further facilitated by the manner of living of the inhabitants.

Without going as far back as the devastating epidemics which broke out among the French troops when they landed in the country, the last thirty years may be divided, so far as the history of epidemics is concerned, into three main periods—the epidemic of 1907-1912, followed by the lull of 1913-14, the epidemic of 1915-1922, followed by the lull of 1923-1925, and the big epidemic from 1926 to 1927 (in Tongking and Annam) and to 1932 (in Cochin-China and Cambodia), followed by a lull which has lasted from 1933 till now. The epidemic of 1926-1932 alone involved 73,000 cases in the whole of Indo-China, of which 55,000 were fatal.

In the intervals between the epidemic phases (as in the present interval ever since 1933), only a very few cases are reported—not more than 100 a year for the whole of Indo-China. Most of these are cases reported by the native authorities without being verified by the medical services ; or clinically diagnosed cholera syndromes without bacteriological confirmation. No cholera vibrio was, in fact, isolated from stools by the bacteriological laboratories of the Pasteur Institutes or of the Medical Service in 1934, 1935 or 1936. There is no question, therefore, in Indo-China of cholera being endemic. Outbreaks of cholera always seem to be epidemics of foreign origin, which find an exceptionally favourable field for their development in Indo-China but disappear completely over certain periods as a result of bacteriological and climatic factors, the determining action of which has been the subject of minute research—so far, without yielding any precise results.

The present respite will no doubt only be temporary. The lessons of the past preclude dangerous optimism. In 1935, cholera threatened from Siam ; but a sanitary cordon was established.

The campaign against the big epidemic of 1926/27 took the form of anti-cholera vaccination on a large scale. In seven months, the Saigon Pasteur Institute succeeded in preparing 36 million cubic centimetres of vaccine. But so violent and so rapid was the progress of the epidemic that the vaccination campaign could not, in practice, do more than follow in its wake. It would be impossible to deduce conclusions as to the efficacy or inefficacy of the vaccinations from the results obtained.

The precautionary measures at present taken are as follows :

(1) Preparation every year by the Pasteur Institute (at its vaccine department in Dalat) of 2,500,000 cubic centimetres of vaccine. The vaccine is a bacterial vaccine with a concentration of 4 to 6 thousand million germs per cubic centimetre, killed by heating for one hour at 56° C., and subsequently carbolised in the proportions of 5 per mille. The strains have been chosen from among nineteen isolated from clinical cases (at the Pasteur Institute in Saigon in 1931 and at the Queen Sowabha Memorial Institute at Bangkok in 1936).

Those found (by direct examination or by trypaflavine agglutination tests) to be capable of producing rough colonies and those found (by guinea-pig vaccination tests) to be lacking in adequate antigenic properties have been eliminated. The five strains retained are either spontaneously agglutinable or agglutinable by a specific serum. Research is proceeding in order to ascertain which of these strains have the highest somatic antigen O.

For mass vaccinations, the vaccine is used in a single injection with 12 thousand millions to the dose. This preparation has the advantage of enabling a constantly fresh supply to be kept up, while at the same time keeping the manufacturing personnel in training for the work. The quantities manufactured annually serve for the regular vaccination of specific groups (of militia, prisoners and school-children) which, in the event of an epidemic, would, as it were, constitute properly vaccinated islands, affording valuable evidence of the effectiveness of the vaccine, while (if really immunised) they would be an object-lesson to the population. Vaccination is also performed annually in Cochin-China at points regarded as specially liable to the reappearance of the disease.

(2) Steps taken at the Pasteur Institute and in the bacteriological laboratories of the Medical Department to accelerate or initiate the manufacture of vaccine in vast quantities at the first alarm, in order to be able to circumscribe and forestall any future epidemic, however rapidly it may appear.

(3) Study of the work in progress in India on the prevention of cholera by bacteriophages ; a bacteriologist from the Pasteur Institutes has been sent to India for the purpose.

But the basis of cholera prophylaxis is to be sought in the campaign against water-borne infection. A great deal is being done in this connection in Indo-China. In the chapter on the budgets, as also in that on sanitation, it has been seen that the work at present in progress involves an expenditure of more than 3 million piastres of loan money, and an almost equal sum in appropriations in the normal budget.

The Indo-Chinese delegation would be glad if the discussion could deal mainly with the value of prophylaxis by vaccination under the conditions in which it is practicable in rural districts —that is to say, where only a single inoculation is possible owing to local circumstances. Comparison of the methods employed in Indo-China with those of neighbouring countries would also be welcome in respect of such matters as the technique of vaccine production, cost price, choice of strains and the immunising value of these, and further in regard to the dose of germs necessary and sufficient to ensure immunity ; a reduction per dose from 12 thousand to 8 thousand million germs, for example, in the case of wholesale vaccination, may mean a big economy which, in turn, will enable the campaign to be carried on with still greater vigour.

Figure 1. — Chain of norias at Phuly (Tongking).

Figure 2. — Rural handicrafts. Province of Hadong (Tongking) : Home silk industry : The throwing process.

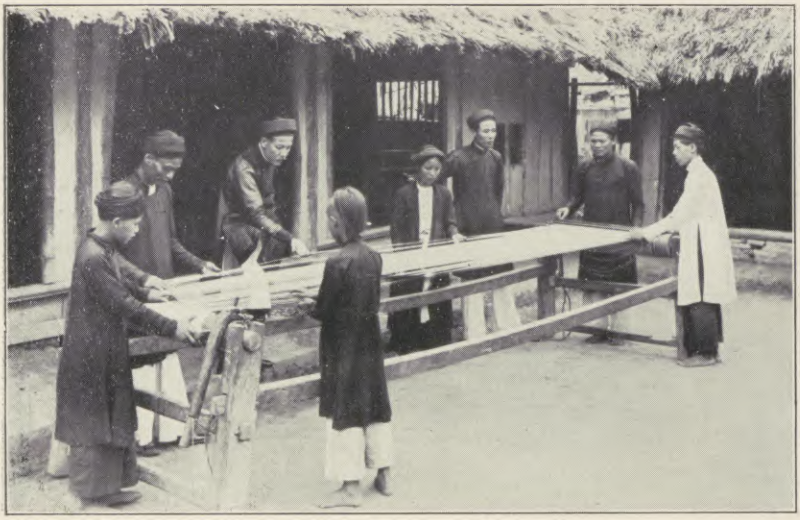

Figure 3. — Rural handicrafts. Province of Hadong (Tongking) : Home silk industry : Weighting of silk fibres.

Figure 4. — Annamite house (dwelling of a poor peasant).

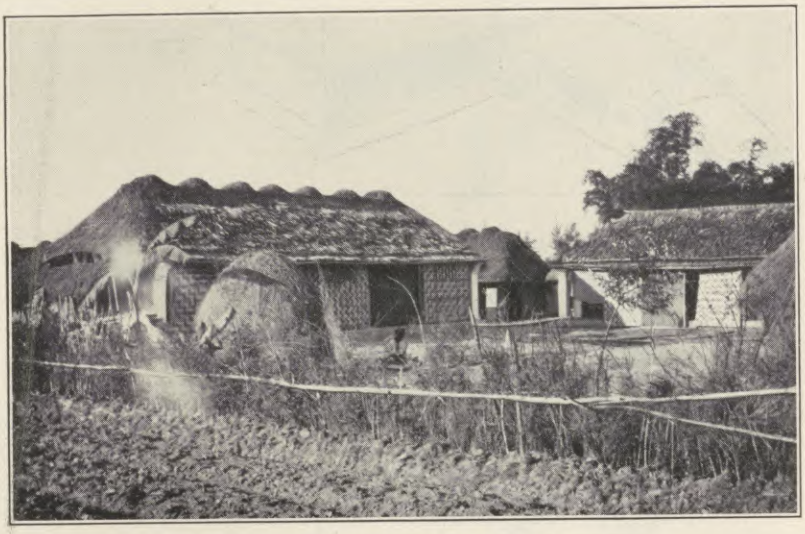

Figure 5. — Annamite farmer's house.

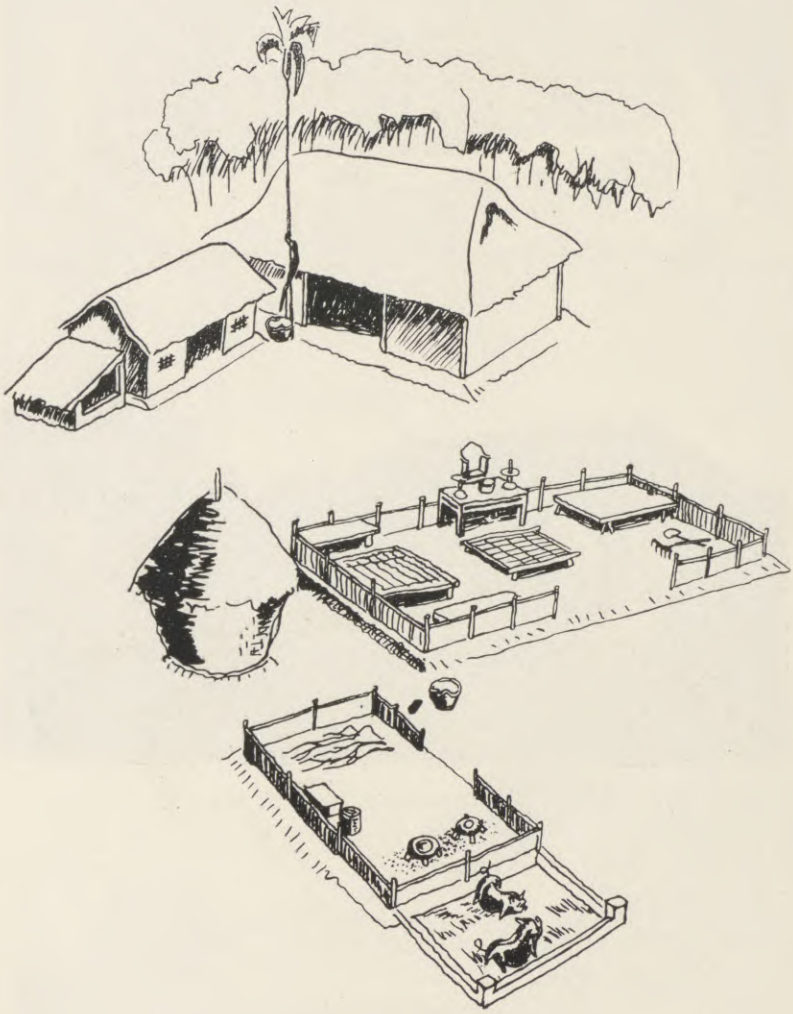

Figure 6. — Perspective plan and elevation of the house of an Annamite peasant in moderate circumstances.

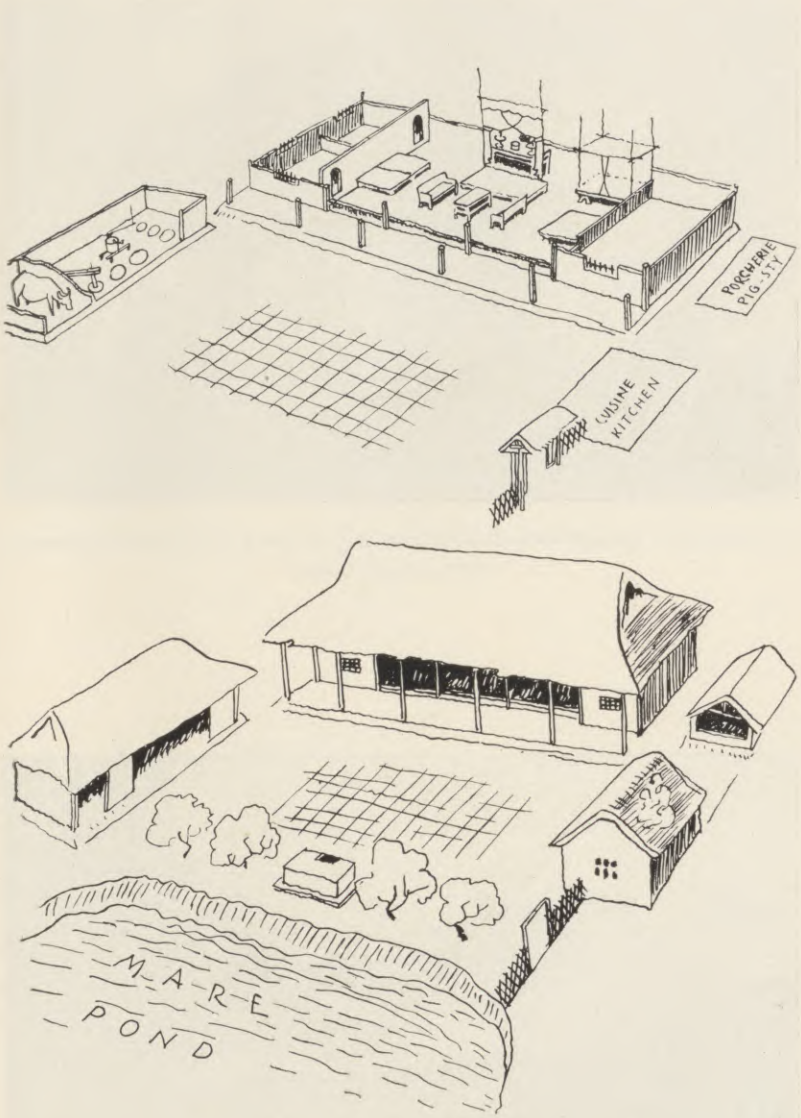

Figure 7. — Perspective plan and elevation of the house of a well-to-do Annamite peasant.

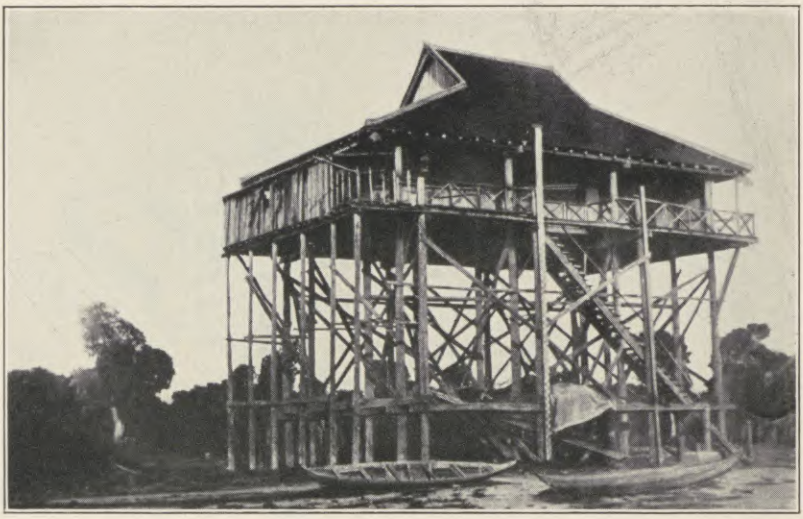

Figure 8. — Cambodian house on high piles in an area of severe periodical floods.

Figure 9. — Thai pile dwelling.

Figure 10. — Inside view of a pile dwelling : The hearth (Thai house).

Figure 11. — Cambodian village.

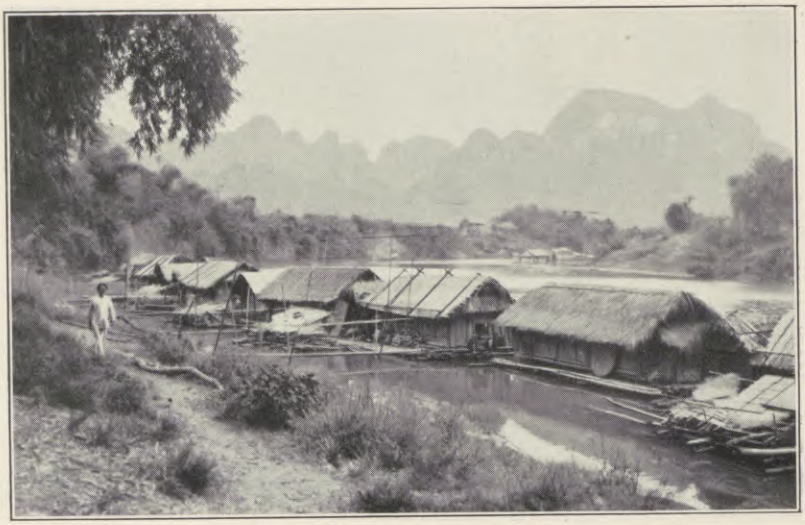

Figure 12. — Floating houses (Tongking).

Figure 13. — Traditional type of Annamite well.

Figure 14. — Cement well and reservoir built by a village (province of Hadong, Tongking).

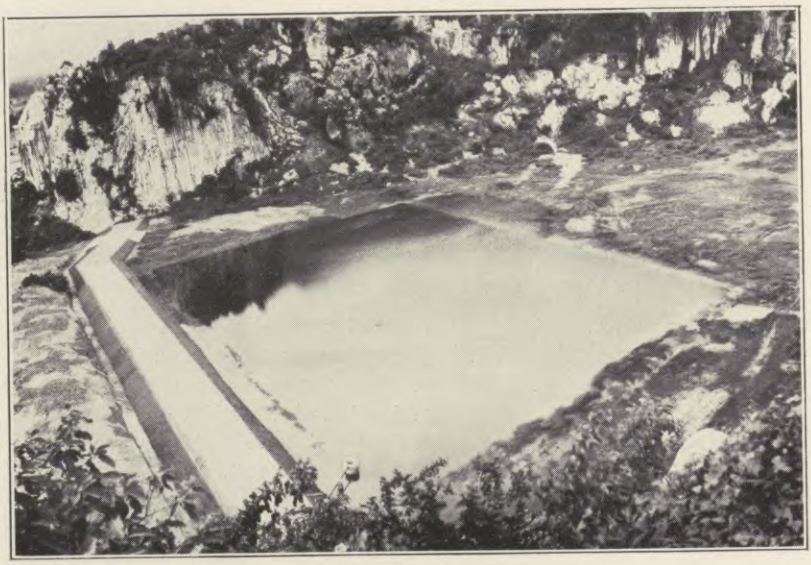

Figure 15. — Fresh water for reserve supply (Cambodia).

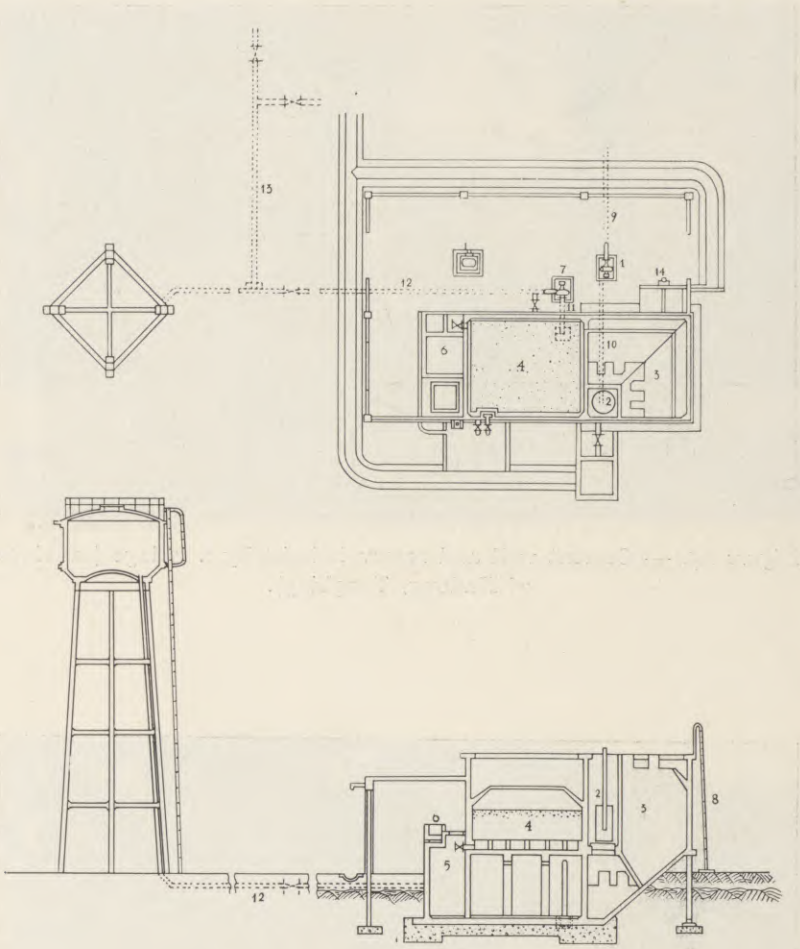

Figure 16. — Lay-out of the " Cochin-China type " of waterworks, with an output of 10 cubic metres per hour.

1. Crude-water pump.
2. Sedimentation chamber shaft.
3. Sedimentation chamber.
4. Gravel filter.
5. Cistern.
6. Chlorination solution vats.
7. Filtered-water pump.
8. Ladder to sedimentation chamber.
9. Suction pipe for the crude water.
10. Feed pipe to sedimentation chamber.
11. Suction pipe for filtered water.
12. Outlet pipe for treated water.
13. Water main to town.
14. Sulphate of alumina solution vats.

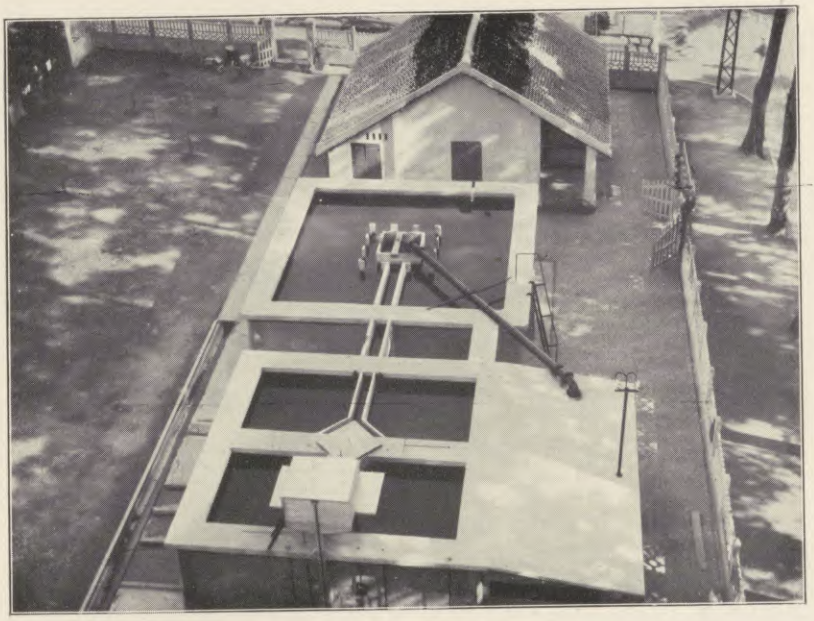

Figure 17. — Water-purification plant, "Cochin-China type" (Vinh-Long) : Details of the sedimentation chamber and filter, seen from above.

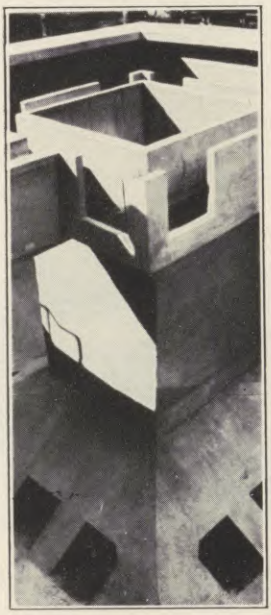

Figure 18. — Details of the shaft of the "Cochin-China type" sedimentation chamber.

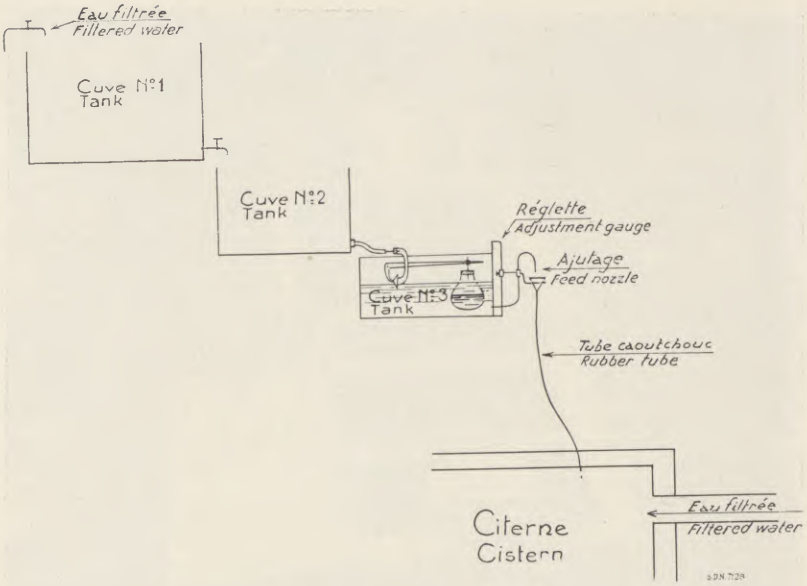

Figure 19. — Plan of the chlorination apparatus mounted on the cistern inlet.

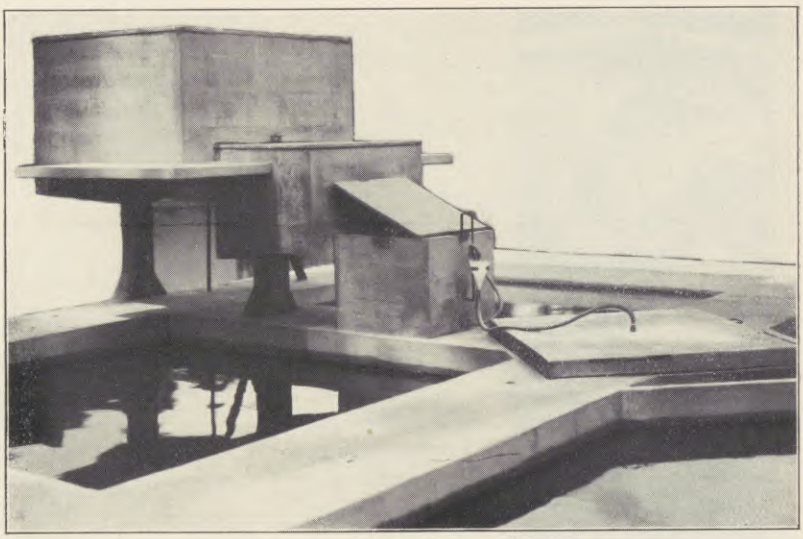

Figure 20. — " Cochin-China type " of water-purification plant : Chlorine solution vat for chlorination in the cistern at the filter outlet.

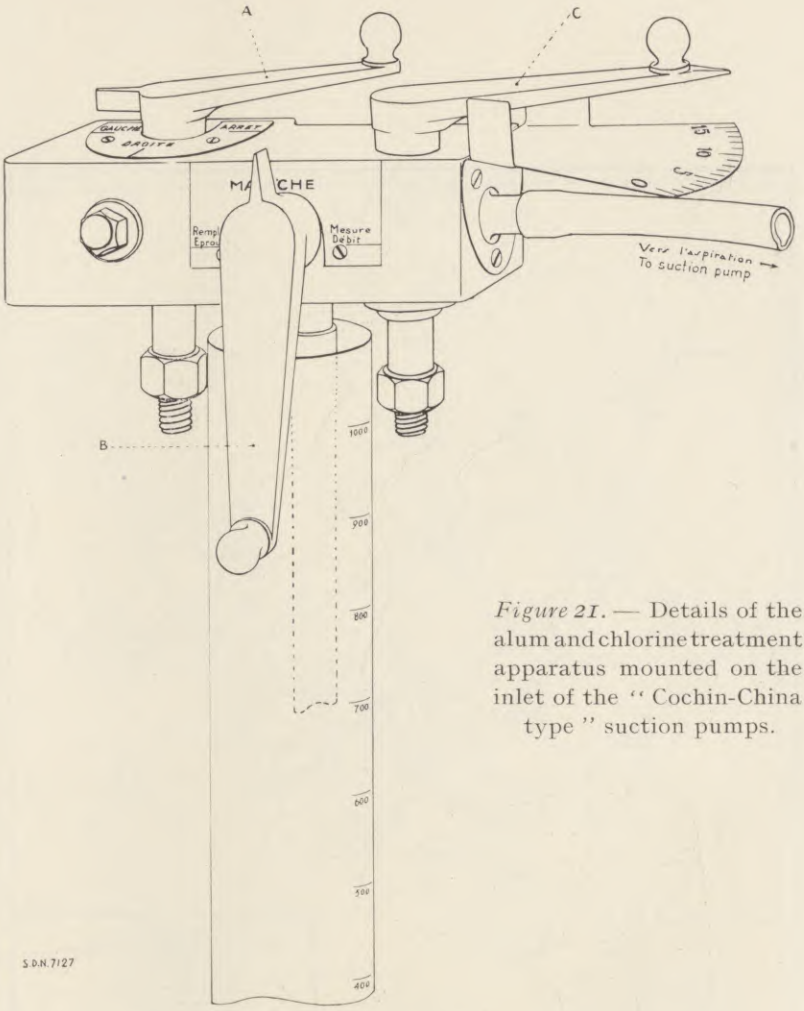

Figure 21. — Details of the alum and chlorine treatment apparatus mounted on the inlet of the " Cochin-China type " suction pumps.

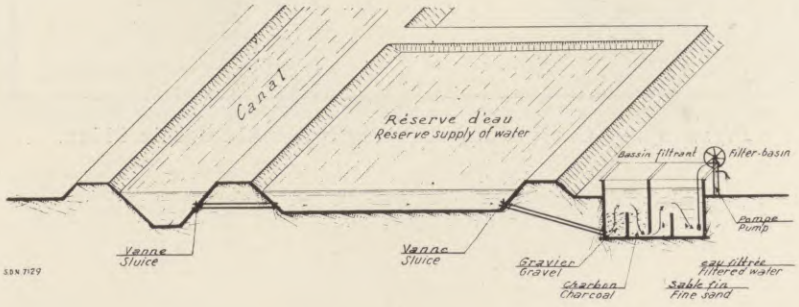

Figure 22. — Plan of lay-out for drawing water from irrigation canals.

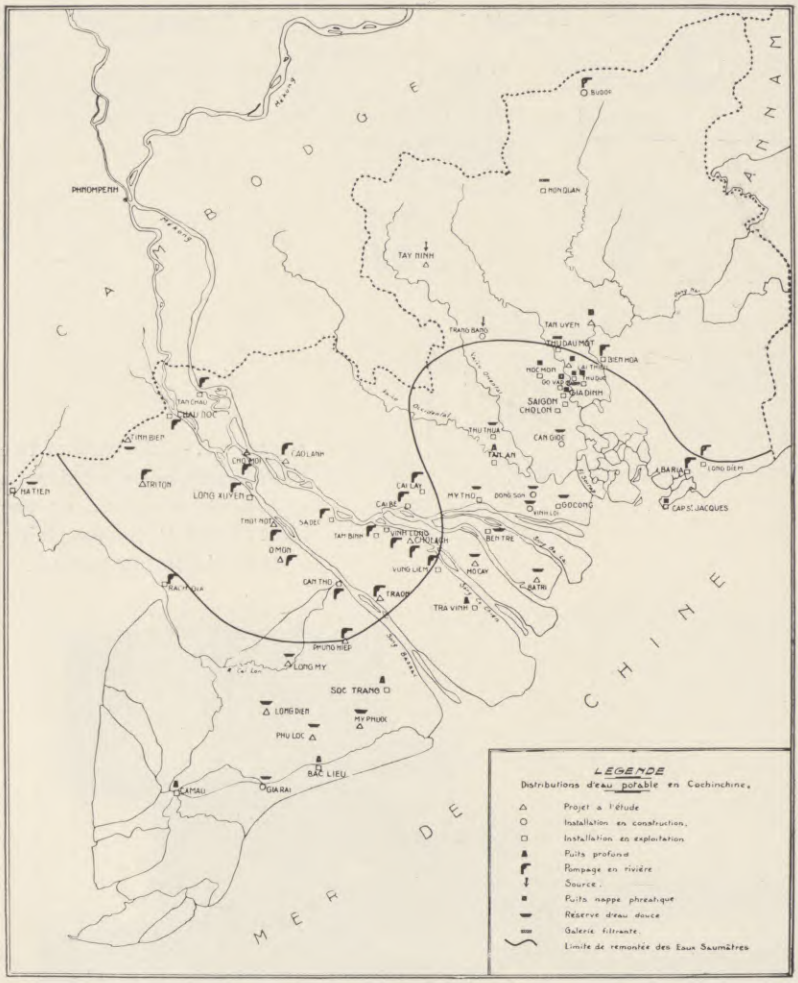

Figure 23. — Chart of water-supply systems in Cochin-China.

Figure 24. — Chart of water-supply systems in Tongking.

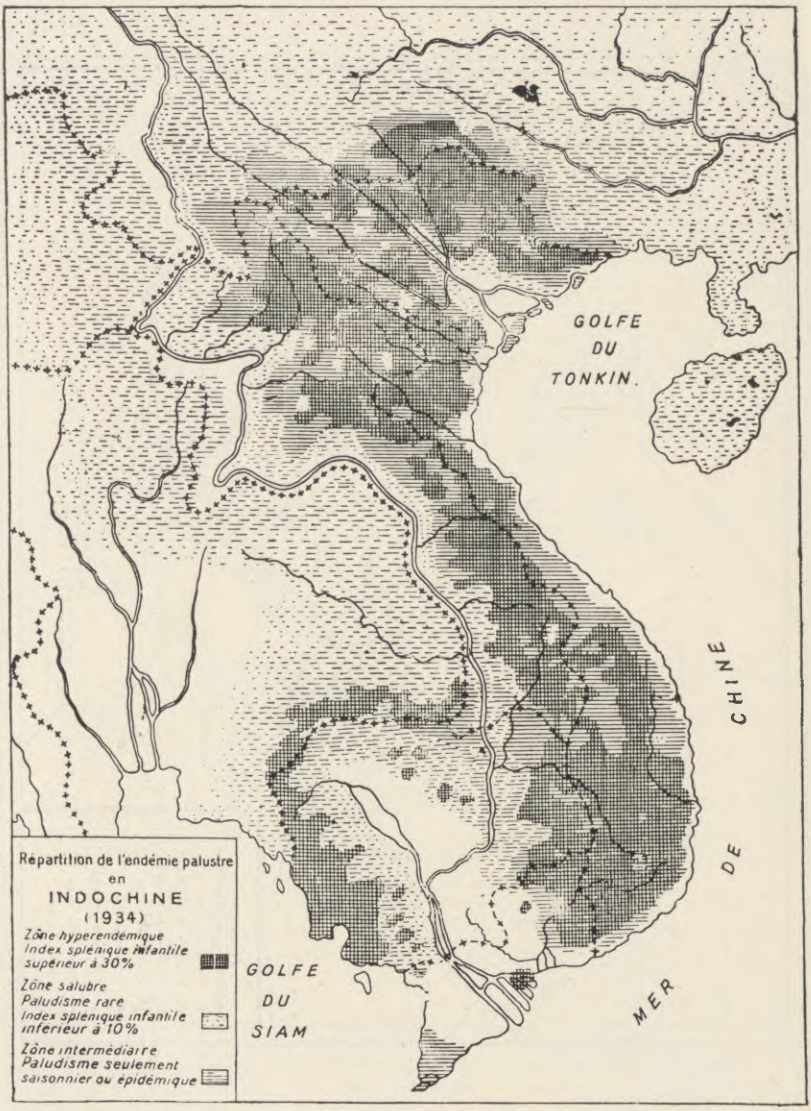

Figure 25. — Distribution of endemic malaria in Indo-China.

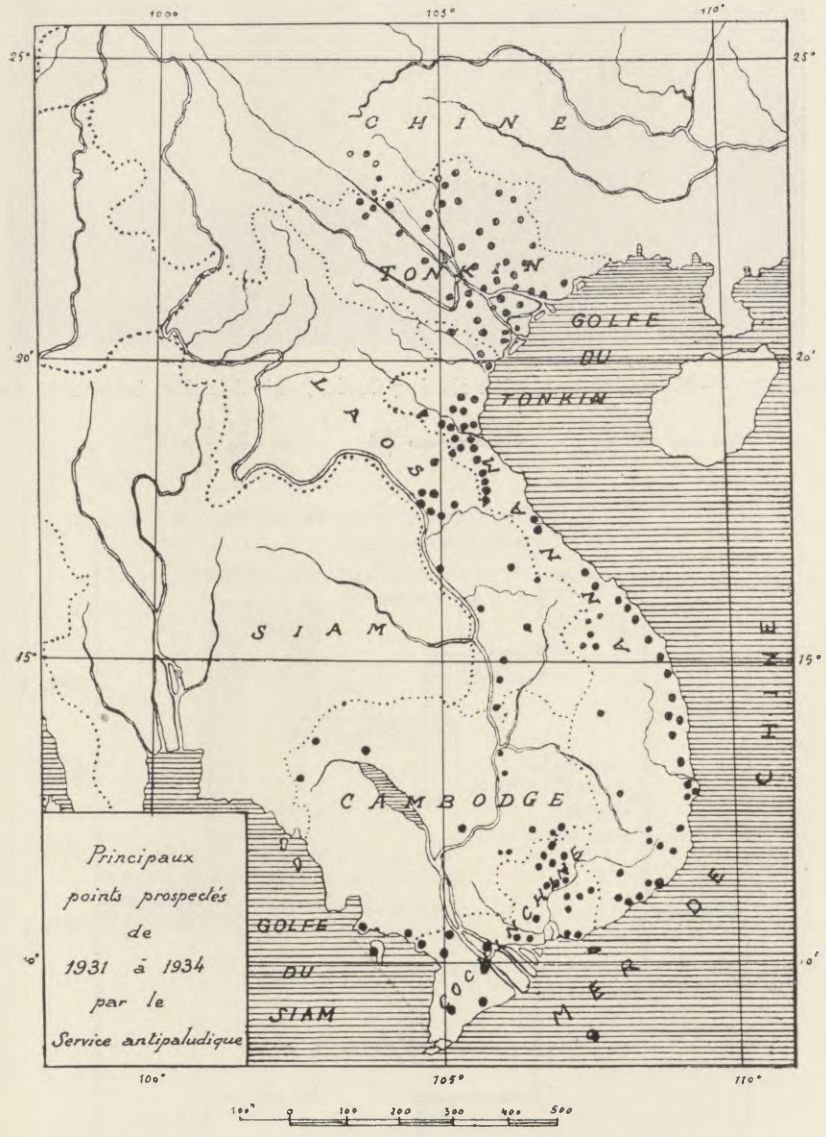

Figure 26. — Points surveyed between 1931 and 1934 by the Anti-malaria Service.

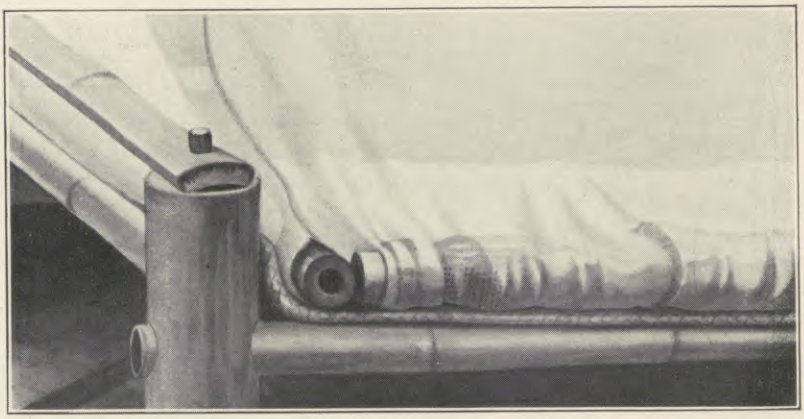

Figure 27. — Mosquito-net, with closing device, suitable for Annamite beds.

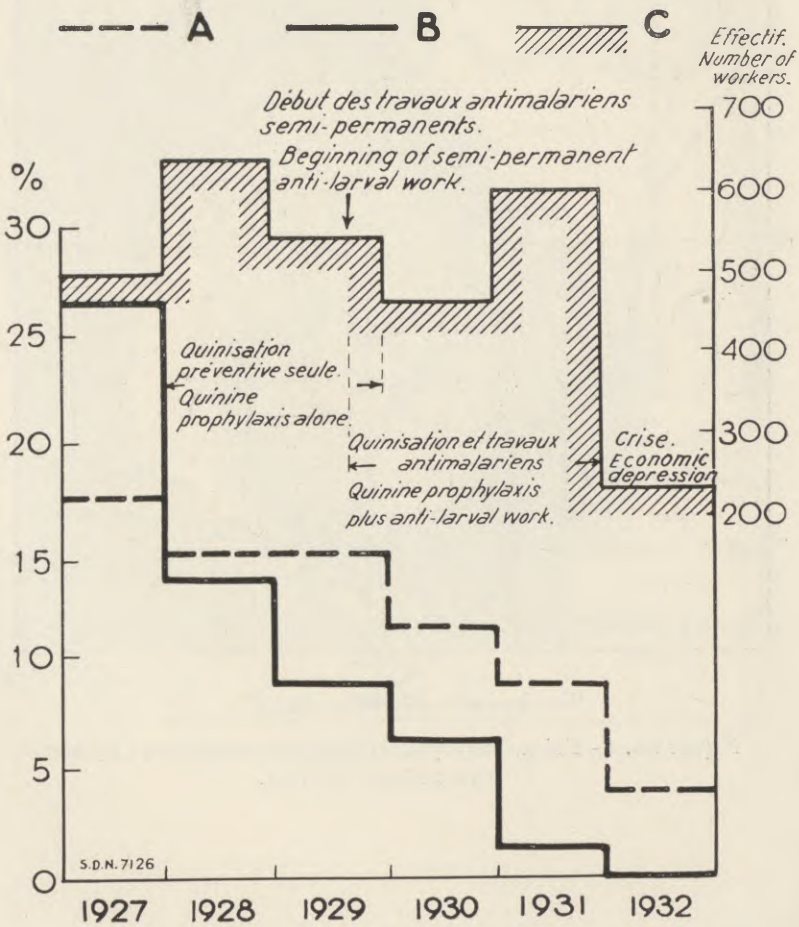

Figure 28. — Results of anti-larval measures. Estate at A (Cochin-China): A. Mean percentage incapacitated. B. Death-rate (per cent). C. Number of workers.

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