

through the malarial districts of Italy, Sicily, and Sardinia will doubtless follow suit. It may be hoped that India and our malarial colonies in East and West Africa will not lag behind in the practical application of the mosquito-malaria theory.

In Professor Celli's laboratory, as in that of Professor Grassi, the British visitors were struck by the simplicity and, indeed, crudeness of the apparatus and methods by which these important results have been obtained.

DEMONSTRATIONS IN THE INSTITUTE OF HYGIENE.

Professor Celli showed experiments at the Institute of Hygiene with certain insecticide and larvicide substances which have been suggested as prophylactics against *Anopheles*. The insecticides are intended to destroy such mosquitos as may find their way into a room before the mosquito nets have been spread in the afternoon, or later through imperfections in the net. The larvicides are intended to be used for the destruction of mosquito larvæ and pupæ in pools and ditches. Two preparations seem to be particularly in favour both as insecticides and as larvicides—cinneraria and an aniline body of German manufacture known as "Larvicide III." As neither of these preparations is toxic to domestic animals or to plants they can be used freely in the neighbourhood of drinking ponds and pastures, Professor Celli placed some larvæ of *Anopheles* in infusion of cinneraria; others in solution of "Larvicide III." In the course of an hour all the larvæ were dead. There is some idea that good might result from extensive planting or sowing of cinneraria in and about the haunts of *Anopheles*. "Larvicide III" is equally, if not more, active as a poison to *Anopheles*, but the cost of the preparation would interfere with its employment on a large scale.

When either of these substances is used as an insecticide it is mixed with a little nitre and ignited. This mixture burns readily, producing a dense unirritating smoke, in which, though man is not seriously inconvenienced, mosquitos rapidly perish. A demonstration was given showing the substance in operation. A large number of *Culex* were liberated in a glass case; into this the insecticide was then introduced and set fire to. As soon as the case became filled with the smoke the insects, which before were lively enough, dropped down dead from the glass walls to which they had clung. Professor Celli informed his visitors that about three teaspoonfuls of powdered cinneraria sufficed to kill all mosquitos in a room of 30 c.m. in capacity. The cost is about one farthing. It appeared to some of the visitors that the use of these substances as larvicides, although giving satisfactory results in the laboratory, is not practicable on a large scale. On the other hand, as an insecticide the fuming of cinneraria, combined with the closing of doors and windows with mosquito netting, is not only a theoretically efficient measure, but is of real practical value.

"Larvicide III" throws off a dense smoke when ignited, filling the air not only with its fumes but also with large flakes of soot, which would probably be found objectionable on the score of cleanliness, and would militate strongly against its general adoption.

Dr. Bastianelli showed some exquisite microscopic preparations of the malaria parasite in *Anopheles*. The series was complete, and include the flagellated body in the lumen of the stomach, the travelling zygote, the sporozoit-filled capsule, and the free sporozoits.

Dr. Dionisi showed the three species of endocorpuscular parasites which he has recently discovered in bats. About 20 per cent. of the bats in some places are thus affected. Morphologically the parasites appear to correspond with the quartan, the benign tertian, and the æstivo-autumnal parasites of man. Unfortunately bats, it seems, do not live in captivity; the full cycle of these parasites, therefore, has not been ascertained, neither are the sporulating nor the gamete phases known.

DEPUTATION TO THE MINISTER OF PUBLIC INSTRUCTION.

Before leaving Rome a deputation from the British party waited on His Excellency, Professor Guido Baccelli, the Minister of Public Instruction, by whom they were most courteously received. His Excellency, who is Professor of Medicine in the University of Rome, expressed great interest in the conference which had taken place between the Italian and the British workers. On being asked whether he would be

disposed to grant facilities for experiments on the prophylaxis of malaria in the Campagna by British observers, he promised to do all in his power to further this object.

The representatives of the London School of Tropical Medicine then invited Professor Baccelli to be present at the ceremonial opening of the school in the spring. His Excellency graciously accepted the invitation.

PROFESSOR KOCH'S INVESTIGATIONS ON MALARIA.

SECOND REPORT TO THE GERMAN COLONIAL OFFICE.

THE *Deutsche medicinische Wochenschrift* of February 1st publishes a second report from Professor Robert Koch on the work of the Malaria Expedition conducted under his direction in the Dutch Indies. The report is dated Batavia, December 9th, 1899. The following is a translation:

The Malaria Expedition arrived, as I have already announced, at Batavia on September 21st, and was able without delay to proceed with its researches. The Chief of the Military and Civil Medical Department in the Dutch Indies, Colonel de Freytag, placed work tables in the laboratory of the Military Hospital at Weltewreden at our disposal, assigned us a military medical officer, Dr. Kunst, as collaborator, and arranged for the supply of research material by sending malaria patients to the military hospital. By the receipt of information from all parts of the Colony and of supplies of gnats, I was posted as fully as possible as to the position of affairs in regard to malaria in the Dutch Indies. For the trouble thus taken by Colonel de Freytag in furthering our labours, the sincere thanks of the expedition are due to him. I am also greatly indebted to Dr. Kunst for the indefatigable zeal with which he assisted us. For the rest the expedition was favoured with the support of the authorities, and in particular of the medical profession; in this connection I feel it my duty to mention with grateful acknowledgment the help given us by Drs. Grijns and de Does of Batavia, Van Haafden of Ambarawa, Vorstmann of Soekaboemi, and Van Barmen't Loo of Tosari.

DECLINE OF MALARIA IN BATAVIA.

The first investigations on the malaria cases in the military hospital, and the result of the inquiries addressed to the medical practitioners of Batavia, made it clear that malaria now plays a far smaller part in Batavia than was formerly the case, and than I, from what I had heard and read on the subject in Europe, had presupposed. Not only in Batavia, but in the other principal places in the colony, malaria has in recent times considerably abated. In Batavia itself we were in the course of five weeks able to discover only 30 cases of malaria suitable for the purposes of our research. In other hospitals in Tjimahi, Magelang, and Oenarang, to which also malaria patients had been sent, we found only single characteristic cases. All the other cases—and these were not numerous—were under treatment with quinine, or were already cured of malaria proper, and were suffering only from its sequelæ.

The decrease of malaria was most marked in the colonial army, in which the number of cases has diminished by 50 per cent. in the last fifteen years. This is believed, and with justice, to be partly due to hygienic improvements, such as the judicious care for the health and welfare of the troops, the abandonment of stations recognised as especially dangerous, such as Tjilatjap, and the quartering of recruits fresh from Europe in the healthiest possible garrisons.

With regard to Batavia itself, it is believed that a marked influence is to be ascribed to improvement in the drinking water supply, but there is no warrant for this belief. The city has certainly, by means of artesian wells which have been recently bored, obtained a drinking water which is quite free from infective material, and as a consequence of this dysentery has almost disappeared from Batavia. But this can have no influence on malaria, as in the malaria-haunted harbour of Batavia, at Tandjonk Priok, which is surrounded by marshes, it has not abated, although that district also gets its water from artesian wells.

THE GRATUITOUS SUPPLY OF QUININE.

Among the factors which I am convinced have had a special influence in bringing about the abatement of malaria here, I

consider that the gratuitous supply of quinine to the people should be included. To what an extent this has been done may be estimated from the fact that during the last ten years an average of 2,000 kilos. of quinine have been supplied from the State drug store of Batavia. Part of that amount has served for the treatment of the troops, but by far the larger part has been distributed gratuitously to the civil population, especially the natives. In the year 1899 up to the beginning of October 2,394 kilos. of quinine were consumed. Countless foci of malaria which might have been productive of mischief by transmission of the disease to healthy persons must by this means have been annihilated. Especially has this been the case in the European settlements and their environs, where quinine was distributed in largest quantity.

The gratuitous supply of quinine is in any case a measure well worthy of trial, and all countries infested with malaria cannot be too urgently recommended to follow the example of the Dutch East Indies as soon as possible.

MALARIA NOT TRANSMISSIBLE TO APES.

The clinical material so scantily procurable in Batavia was not sufficient for exhaustive etiological researches, but it could be used for the solution of another important question, whether malaria is transmissible to animals. In the Malay Archipelago opportunities, which are scarcely to be had elsewhere, are afforded for experiments on animals most suitable for the purpose, inasmuch as they resemble man, namely, the higher apes. I accordingly procured—partly by purchase, partly by loan—three orang-outangs, and three specimens of *Hylobates agilis*, and one of *Hylobates syndactylus*, and on these animals I made as many infection experiments as possible. They received injections of malarial blood drawn from patients suffering from tertian and tropical fever. But, in spite of all endeavours, we did not succeed in conveying malarial infection to these apes. Thermometric observations were regularly made, and during each rise of body temperature the blood was examined, but the periodical fluctuations of temperature so characteristic of malaria never occurred, and malaria parasites were never found.

If even the higher apes are insusceptible to human malaria, as is proved by these experiments, it cannot well be supposed that other animals more remote from man can harbour human malaria parasites in their blood. Man therefore remains the only bearer of this parasite—a fact of the greatest importance in regards to the prophylaxis of malaria.

MALARIA AND RICE FIELDS.

Among the places in Java which at the time were more affected with malaria than Batavia, only Ambarawa came under our observation, as there is a military hospital there, and the accommodation necessary for microscopical work was available. As after a somewhat long stay in Batavia, and in spite of the oncoming of the rainy season, malaria did not increase, we began our journey to Ambarawa on October 28th, and on the way we were able to pay a short visit to several health stations which were used particularly for convalescents from malaria.

Ambarawa is situated in mid-Java, to the south of the well-known seaport Semarang. Adjoining Ambarawa are two fortified places, Fort Willem I and Banjoe Biroe, which together have a garrison of a little more than 2,000 men. Formerly recruits used to be sent by preference to Fort Willem I, and then the troops suffered severely from malaria. But since only older soldiers have been sent thither, the state of things has greatly improved.

In the space of two weeks we were able, in spite of diligent search, to discover only 21 cases of actual malaria, of which 11 were newly infected. Nevertheless here the conditions were as favourable as possible for the development of malaria. The district of Ambarawa, which is inhabited by more than 80,000 persons, has the form of a deep cauldron-like valley, surrounded by several active volcanoes, with intervening hills. In the bottom of the valley, which also appears to be the crater of an extinct volcano, there is an extensive marsh about 4.5 kilometres in length and breadth. Water plants, which grow with tropical luxuriance, cover it almost completely and only here and there are small clear spaces of water to be seen. Where the natural marsh ends there artificial marsh-making begins, as everywhere, where it is possible, ricefields with artificial irrigation are laid out.

Rice culture has insinuated itself even into the recesses of the hills, and it climbs upwards, particularly on the Oenarang Mountain above Ambarawa. It was therefore improbable that there should be so little malaria here as we were able to find.

CHILDREN AS TESTS OF MALARIAL PREVALENCE.

But how was one to learn the peculiar malarial conditions of this region? As it was possible that we had here to do with a population which in the course of time had acquired a certain degree of immunity, and as from my own researches in East Africa I knew that children are particularly susceptible of malarial infection, I determined to examine a large number of children, in a place which appeared especially favourable for malaria. For this purpose we chose a village lying island-like almost wholly in the swamp, and to which we had to go in boats. In this village we found the adults apparently healthy, and they stated that they suffered little or not at all from fever. But among 86 children whose blood was examined for malarial parasites in 8, that is, 9.2 per cent., parasites were found; of the children under 1 year of age 16 per cent., and of those above that age 4 per cent. were malarious. Thus malaria was proved to be present in the population in a previously unexpected proportion. The rapid diminution in the frequency of malaria with increasing age can be explained only in this way: that men in these malarious regions where they are constantly exposed to infection go through it in early youth, and if they do not succumb to it acquire a greater or less complete immunity. In harmony with this is the empirically-known fact that recruits from those districts very seldom suffer from malaria, while recruits from Europe and from the almost non-malarious island of Amboina hardly ever escape infection. The older men, however, show a certain power of resistance.

After arriving at this interesting result we extended our researches to the other villages of the Ambarawa Valley. We began with a large village lying close to the edge of the swamp. Here, of 141 children, 18 were malarious—that is, 12 per cent. (under one year 15.5 per cent., over one year 7 per cent.). Then followed a third, lying high on the edge of the valley (about 1,000 metres above the sea and about 500 above Ambarawa, on the Oenarang Mountain). In this village, among 189 children examined, 43—that is, 22.8 per cent.—were found with malaria parasites (under one year 41 per cent., above one year 14.6 per cent.).

To the results of these researches I attach great importance. In the first place, they have placed in our hands a method by which one may in the shortest time obtain an absolutely trustworthy knowledge of the malaria conditions of a population. Moreover, they afford a plausible explanation of the fact that the children of Europeans in the tropics, where malaria exists more or less everywhere, thrive so ill; namely, that in regard to malaria they are obviously in a much more disadvantageous position than native children born of immune parents; when the latter become infected with malaria, they have it in a milder form than the highly susceptible European children. Finally, the prophylaxis of malaria, as far as it has to do with diseased men, may derive the greatest advantage from this discovery.

In the Ambarawa Valley, therefore, we learnt how to recognise a population radically infected with malaria; the next step was for purposes of comparison to make similar investigations in a region free from malaria. Such a locality was indicated to me in Tosari situated in the Tengger Mountains at an altitude of 1,777 metres. Another reason for visiting Tosari was that it is the only place in Java where no mosquitos are to be found, while, nevertheless, cases of malaria are met with there.

On November 26th, we arrived at Tosari, and on the 28th we examined 82 children of ages up to 2 years. In not a single one of those children did we find malaria parasites. From this it could be inferred that malaria is not present in the Tosari region in an endemic form, and yet we were able to convince ourselves that malaria is not entirely absent in Tosari. We came across an adult man who had been ill for sixteen days, and had consequently become very weak. Malaria parasites were found in his blood. This patient, however, about twelve days before the beginning of his illness, had gone down from the mountain to the coast, and had stayed a night in Passeroean, where malaria is endemic.

Here he must have become infected, since, although he left the malarious region the next day, the disease had come on after the usual incubation period. As the result of further inquiries, we found that such cases are not infrequent, but they never occur except in persons who go down to the plain and there contract malaria. As we were able to satisfy ourselves that there are no mosquitos in Tosari, the conditions are perfectly analogous to those which I had formerly met with in the Usambara Mountains of East Africa, that is to say, a mosquito-free region without endemic malaria, but with sporadic cases introduced from without.

The climatic and telluric conditions of the Tengger Mountains form a complete contrast to those of Ambarawa: here natural and artificial swamps and numerous mosquitos; there a dry climate with little water, no rice cultivation, and no mosquitos.

It appears also that it is to these conditions far more than to its high altitude that the absence of malaria in Tosari is due, for in Poespo (630 metres high), which lies more than 1,000 metres below Tosari, we did not find among 35 children a single one with malaria. Like Tosari, Poespo has no rice fields, and scarcely any mosquitos. At least, we did not succeed in obtaining a single specimen.

As the examination of children had in both these cases shown itself so valuable a means of determining the malaria conditions of a region, on the way back from Tosari to Batavia we collected preparations of children's blood at different places, such as Oenarang, Magelang, Sindanglaia, and Soekaboemi, which are of special interest as health stations. Blood from children was also obtained on the following days in villages adjoining the notorious Tandjong Priok. I can only report on the results of these last-mentioned researches later, as the examination of the abundant material—nearly 1,000 specimens of blood—will take a considerable time.

In connection with this subject I think it right to mention that in these extensive examinations of the children of natives we never met with any opposition from the people, as would certainly have been the case in other regions. One does not know which to wonder at most, the ready compliance of the people or the authority of the ruling powers and the righteous manner in which it is used. For instance, in Soekaboemi 780 children were brought to us, of whom we selected about 200 who appeared especially suitable. Many mothers had come a great distance and were dismissed only after long waiting; nevertheless all went in the most peaceful and orderly manner, mainly because the Patti, the chief native official, was present and exerted the great influence which these officials have over those under them.

MOSQUITOS AND MALARIA.

One of the objects of the Expedition was to test how far the oft-repeated assertion, that there are places in Java where there are no mosquitos while nevertheless malaria occurs, is well founded. For this purpose I obtained information from many old and experienced practitioners; Colonel de Freytag instituted an inquiry among the military medical officers, and I succeeded in getting the question brought before the Medical Society of Batavia. But no one could point to a malarious district in Java where there are no mosquitos. All previous statements to this effect are found on close examination to be erroneous. Where no mosquitos were said to have been met with, they were found after more careful search in small and often in large numbers. These statements clearly come from persons who have formed an opinion only on hearsay evidence, without taking the trouble to look for themselves, or who have not known how to find the mosquitos. In several places where it was said that there were no mosquitos, or very few, we were able after a brief search to collect a large number, among them the suspect *Anopheles*.

The only region which is actually free from mosquitos but not from malaria is the Tengger Mountain with the Tosari and Poespo districts. The state of things in these places, however, has already been fully described.

These researches have therefore brought to light nothing against the so-called mosquito theory; on the contrary, they have supplied a complete confirmation of the law: Where there are no mosquitos there is no endemic malaria.

ANOPHELES AND RICE FIELDS.

As regards the mosquitos themselves, I have by my own

collections, but principally through consignments sent by military surgeons by permission of Colonel de Freytag, procured very abundant material for research, which has already in part been dealt with. At present I can only state that the mosquito fauna of the Dutch East Indies is of a very multifarious character. Of *Anopheles* alone I have obtained at least five different varieties. Apart from some few kinds of mosquitos the larvæ of which live in the water reservoirs in the immediate vicinity of houses, the occurrence of mosquitos in Java is connected with the extension of rice culture. The more rice fields there are in the neighbourhood of a place and the nearer they are, the greater is the abundance of mosquitos there. This holds good especially in regard to *Anopheles*.

We did not succeed in finding the *Anopheles* larvæ themselves in the rice fields, but the conditions of water and soil here are such that they find the conditions suitable to them only on these artificial marshes.

In any case, if the proposal recently made to destroy *Anopheles* larvæ is carried into effect, it will meet with insuperable difficulties in Java.

Neither did we succeed in the numerous *Anopheles* and other mosquitos which were found in malarious districts, for instance in Tandjong Priok, in finding the known coccidia in the stomach or the crescent germs in the poison glands. They are absent always in the kinds of *Anopheles* which have sucked blood with malaria parasites, and especially with those of the semilunar form.

FORMS OF MALARIA IN THE DUTCH INDIES.

It is noteworthy, however, that in the Dutch East Indies we met with no other forms of malaria but the three already known—quartan, tertian, and tropical fever. It is a remarkable fact that the more dangerous tropical fever occurs here considerably less frequently than in other tropical countries, especially in tropical Africa. Among 51 cases of malaria in Batavia and Ambarawa they were 8 per cent. of quartan, 45 per cent. of tertian, and only 47 per cent. of tropical fever. In East Africa, on the other hand, there were 89 per cent. of tropical fever, and in West Africa it seemed to be in still larger proportion. In the district of Ambarawa the quartan fever is particularly frequent.

BLACKWATER FEVER.

Blackwater fever appears to occur seldom here; I have only seen one case, which was in the stage of convalescence. In that case the onset of hæmoglobinuria was undoubtedly brought about by a subcutaneous injection of quinine which had been given shortly before.

SANATORIA FOR MALARIA.

I may conclude with a few remarks on the sanatoria for malaria which exist here. We visited a number of these—namely, Soekaboemi, Sindanglaia, Oenarang, and Tosari. Buitenzorg, which is also a health station, may be counted among them. About Salatiga I have obtained information by letter.

Buitenzorg is the lowest in situation (263 metres); then follow Oenarang at 500 metres, Salatiga at 580, Soekaboemi at 602, Sindanglaia at 1,074, and Tosari at 1,777. In all these places, even in Tosari, imported cases of malaria are met with, and convalescents relapse even after many weeks. The altitude climate, therefore, gives no protection against the disease, nor can it prevent relapse.

In none of these sanatoria is the cure of malaria left to the sole influence of the climate, but it is vigorously treated with quinine. From my previous researches I have formed the conviction that altitude has no specific effect on malaria parasites; this conviction has been strengthened by these observations. Nevertheless, I consider the sanatoria very useful institutions, which may be of the greatest service to convalescents from the most diverse diseases, and to soldiers in poor health.

THE EXPEDITION PROCEEDS TO DUTCH NEW GUINEA.

As I believe that the Malaria Expedition has fulfilled the purpose for which it came to the Dutch East Indies, it will proceed to Dutch New Guinea by the next ship, which sails on December 12th.