

## OCURRENCE AND APPEARANCES OF MALARIA IN SOUTH THAILAND.\*

by

RUDOLF HOFBAUER M. D.

In writing about the occurrence and the appearances of malaria in South Thailand and my experiences there with this disease, I would like to state that the origin of the paper lies first in the lecture of Phra Jan Viddhivejj about Mosquito-Control, which he delivered before the Thailand Research Society on March 17th 1940, and in the article of Phya Chaiyos Sombat entitled *My Trip to Toh-Moh*, which appeared in the *Bangkok Chronicle* on November 20th 1941. Secondly, I would like to show that the tropical form of malaria—as affirmed by several authorities—really has two varieties and that one of these two varieties is a very disagreeable one; it is this variety that I met with in the South.

Before coming to the chief point, I may be allowed to tell something about the trip itself and its difficulties, because, not travelling in an official mission, there are many more difficulties than those described by Phya Chaiyos Sombat, and after this I shall speak about malaria and the measures which were taken for a destruction as complete as possible of the larvae and the mosquitos. I was working in the South from September 1940 until August 1941.

When I was offered the position of chief of the medical service of the Société des Mines d'Or de Litcho, a French Company, which was taken over by the Thai Government in February 1941, I accepted at once with great pleasure as I had heard already a lot about the malaria in South Thailand and especially about the different symptoms of the tropical form of this disease. I was also not afraid when I got the information that Litcho is situated in the jungle and that this would mean

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complete isolation. It was indeed like this: foodstuffs at that time—before the war—were brought from Kelantan, Malaya; the frontier is about 50 minutes from Litcho and the Malay people did not come every day. When something had to be brought from Sungei-Golok, a coolie had to walk with his load for two days during the dry season; during the rainy season a transport took about 7—8 days and fresh beef was a rarity. When the Malays killed a bullock, every one who brought fresh beef was greeted with greatest joy. The rainy season in the district of Litcho means 7 days of 24 hours' heavy rain without any interruption; then half a day or at last one day when there was no rain, and then rain and rain again for several days and nights. Such a rainy period lasts for about two months.

The necessary preparations having been made, we left for Sungei-Golok by the Southern Express and then by F. M. S. Railway to Passimas. After having crossed the river there by a big motor-boat, we arrived in Khota-Bahru, the capital of Kelantan. Khota-Bahru means New-Town; the next day from there to Kuala-Krai, two hours by motor-car from Khota-Bahru and then 2 days and nights by motor-boat along the Kelantan river to Kuala-Tadoh. The beauty of the wonderful kingdom of nature which we saw from the boat was more than a reward for all the troubles and difficulties of the trip. When speaking about such beautiful and pleasant natural surroundings one can imagine only a bit of all that—birds, monkeys, virgin-forest, etc. After the second night in the motor-boat we proceeded by small boats to Kuala-Chenong, also still in Kelantan, which took 5 hours; two Malays rowing each boat. There I met my predecessor, who came downstream and who had left Litcho early in the morning of that day. In Kuala-Chenong ten tall Indian watchmen, headed by their chief-jaga, waited for us to take our bags etc. or *barangs* as the Malays say. The Malay language was predominant in the district of Litcho at that time. With all those people walking behind us, we went up a great hill for about one hour—no pleasure in the bright sunshine at about 2 p.m.—and on the top we passed the boundary-stone: we were back in Thailand. Suddenly we saw before us the small village of Patcho, the seat of the sub *amphoe* of Tomoh, or Weng, as that town near Sungei-Golok is generally called. We went down the hill and were welcomed by the *Nai Amphoe*, who invited us to have some tea, cake and beer: it was the 20th September, the birthday anniversary of His Majesty the King. After some words of welcome from the *Nai Amphoe*

I answered thanking him for the kind reception and, taking it for a good sign that we arrived on that day, I finished with the most respectful wishes for the health of His Majesty the King and for the prosperity of Thailand. An official of the mine, who accompanied us, acted as interpreter. After this short rest we walked uphill again for about 35 minutes and then finally—after a trip of 6 days—we reached Litcho, where we found a wonderful house prepared for us. Litcho is situated in a hollow, the climate is pleasant indeed; the days from about 11 a.m. to 4 p.m. are as hot as here in Bangkok, but soon after sun-set a cool breeze starts and the nights are always refreshing and sometimes really cold. The district of Litcho used to have thick jungle, impenetrable undergrowth and tall trees; I shall come back to this later.

Welcomed by the manager and his wife, everyone there showed great hospitality to us until we were accommodated in our house, which contained a good pharmacy with the most necessary medicaments, modern instruments and a microscope. The heavy baggage only arrived three weeks later and so I was very glad to have at least the most necessary things with me.

However the trip down to Litcho was not so strenuous as the journey back to Bangkok at the end of August 1941. The way through Kelantan having been closed and no elephants available, we had to walk about 2 hours until we came to an unknown place, where bamboo-rafts had been prepared for us. By these we went down the Patcho river and Pari river. The surroundings there were still more beautiful than those of the Kelantan river. After one and a half days by the rafts, we walked nine and a half hours through the jungle, up and down hills and mountains, until we reached Weng, whence by motorbus; finally we arrived in Sungai-Golok. There is also a short-cut through the mountains; but this could only be used by the Indians—the Sikhs—whom we called "runners" because in cases of emergency they make the distance from Litcho to Sungai-Golok in 8 hours and, after 3-4 hours rest there, they return to Litcho in 8 hours. On our way back I lost two cases containing much important data about my researches in the South; among these data there were also the microscopic preparations of the different cases of malaria, and I am more than very sorry that I cannot produce them now.

Coming back to my work in Litcho, which I had to start already in the evening of our arrival there, I remembered the words of the two well-known French parasitologists Charles Joyeux and André Sicé. They are very right in advising: "Le médecin, arrivant dans un district paludéen, se documentera bientôt sur ce qui a été fait dans la région par ses prédécesseurs." (The physician, arriving in a malarial district, will soon ask all information about what has been done in that region by his predecessors). I acted accordingly and went through the medical reports. I also gathered information by asking several persons and thereby I saw for myself within the shortest time what had been done, or rather all that had not been done, before my time. The results of my inquiries were rather deplorable. We know—not only from Phra Jan Viddivejj's lecture—that the destruction of the mosquitos, their breeding places, the provision of drainage, the cutting and clearing up of the jungle and drying up pools, ditches, etc. are the most important requirements to eliminate malaria as far as possible. Of course all this must be explained to the working people, who in Litcho consisted of Malays, Indians, Chinese and some Thai. There was, when I arrived in Litcho, no knowledge at all of these important points; and so I understood the reason why so many people there were suffering from malaria.

Speaking about drying up pools, ditches, etc., I would like to mention briefly here the most classical work in this respect: the former Pontine marshes near Rome in Italy, where this enormous area of marshes, by the order of Il Duce has been changed into a fertile habitable area with 4 communes and 5 flourishing towns. I myself saw this area, and especially the town of Littoria, in 1937, and I shall never forget the deep impression I felt, because we all know from our school days that the malaria in the Paludi Pontini has cost hundreds of thousands of lives. It was there where the Italian parasitologists Grassi, Feletti, Marchiafava and also Bignami have fought against malaria, before they discovered that the tropical form of malaria has not only one plasmodium, as well as other facts.

Now some remarks about the history of this disease. Historically, malaria is an ancient disease, as some of the earliest records of man show that it was recognized as a definite clinical entity. In the V century B.C. Hippocrates differentiated the fever into quotidian, tertian and quartan types. Little or no light was thrown then on the disease from that time. Then the Countess Chinchon was cured from tertian

fever by the bark of a tree which grew in Peru; she brought the bark to Europe, and in her honour it was called ohinchona-bark. In 1847 and 1848 the two Germans, Meckel and Rudolf Virchow, described the characteristic pigment and finally in 1880, on November 23rd, the French army-surgeon Laveran recognized the pigmented parasites in the red cells of a soldier in Algiers; Laveran was at once convinced that they were the cause of malaria. Soon all the different asexual stages of the parasites were recognized in the red cells. There are the names of Manson, a British army-surgeon in India, Ross, MacCallum and Golgi. I would like to mention here especially the world-famous German bacteriologist Robert Koch, who had the great merit to have differentiated in the clearest way the several kinds of parasites, especially the parasites of the tropical malaria. L. T. Coggeshall, after making a very long and extremely exact study of the different plasmodia, came to the same results, and also Wenyon, in 1926, Boyd in 1930, Dorland and Miller in 1931. A special mention is deserved here by the Italian Adolfo Missiroli, who in 1934 in his *Lezioni sulla etiologia, epidemiologia ed profilassi della Malaria* (Lectures about the etiology, epidemiology and prophylaxis of Malaria) gave a very clear statement about the plasmodia.

We know that malaria is an infectious, febrile disease, produced by several species of protozoa belonging to the single genus *Plasmodium*. It is transmitted naturally from host to host only by the bite of an infected anopheline mosquito. In the mosquito the development of the parasite is observed on the stomach wall—these are the sexual forms or gametocytes—and in the salivary glands—these are the sporozoites—, while in man it is in the red blood corpuscles. The two German authors Müller and Bitterf are quite right in saying: "Ohne Anopheles keine Malaria" (Without anopheline mosquito there is no Malaria). Clinically the disease is characterized by paroxysms of severe chills, fever and sweating. These paroxysms may occur daily (quotidian), on alternate days (tertian), and with an interval of 3 days between chills (quartan). The quotidian type, with daily fever, is the tropical form of malaria. Each type has its own plasmodium: *Plasmodium vivax* is the species which causes the benign tertian malaria in the patient, and Schüffner's dots in a parasitized red blood cell. *Plasmodium malariae* causes the quartan form, it shows the "band-form" of the schizonts. *Plasmodium immaculatum* causes the *Malaria tropica* and this plasmodium

is also called *Plasmodium falciparum quotidianum*. It produces very minute ringforms of the parasite—the trophozoites—and another characteristic is the pronounced smallness of the ring-parasite and the small size of the crescent, which is not longer than the diameter of its original red corpuscle (Fig. 1); we call this form also malignant quotidian malaria. This plasmodium was first described, in part, by Grassi and Feletti in 1890, and later in 1891—1892 Marchiafava and Bignami separated it from the *Plasmodium falciparum* and called it “the quotidian aestivo-autumnal plasmodium”. So we hear at that period for the first time about two kinds of the tropical malaria. Marchiafava and Bignami separated these two plasmodia according to the peculiarities of the sickness and they published their results in 1898 in the *Atti della Reala Accademia di Lincei* (Protocols of the Royal Academy of Lincei). In Germany it was Ziemann, Mannaberg and others, who also discovered two varieties of the parasite of the tropical fever, and the denomination *Plasmodium immaculatum* has not only been recognized by the German authors concerned, but also by English and American authors as French, Craig, Dorland, Miller, and others. It was Craig who in 1909, after having studied a lot of infections with the organism, regarded it as a sub-species of *Plasmodium falciparum*, giving it the name *Plasmodium falciparum quotidianum*. It is apparently distinct, both morphologically and clinically, from *Plasmodium falciparum*, from which it differs morphologically by its much smaller size at every stage of development, by the richness of the ring-forms, the trophozoites, in chromatine, the time of schizogony, 24 hours, and in the number of the merozoites, which varies from 6 to 18, the average being from 12 to 14. The gametocytes are crescentic or bean-like in shape, but smaller than those of *Plasmodium falciparum*. Clinically, this *Plasmodium falciparum quotidianum* causes a malarial paroxysm every 24 hours due to the segmentation of the organism at that interval. In 1926 Craig could again prove these things and he has laid down all his observations and experiences in his book, *Parasitic Protozoa of Man*.

We come now to the other species of the tropical malaria, caused by *Plasmodium falciparum*, and this form of malaria is also called malignant subtertian malaria. It is clear that these two plasmodia have caused very much trouble among the scientists concerned; but there cannot be any doubt any more that these two forms of tropical malaria really exist! It is a very great pity that I have lost my material—as I men-

tioned already before—on my way back, because I could have proved by the microscopic preparations that the red blood cells in both forms of malaria showed always a fresh aspect, to eliminate the assertion that the greater ring-forms or the greater crescents of the *Plasmodium falciparum* might be the progressed states of the smaller ring-forms or the smaller crescents of the *Plasmodium immaculatum*. If that would be the case, the red blood cells ought to have lost their haemoglobine and their fresh aspect together with their normal form: I could never find this! The *Plasmodium falciparum* is characterized by the following points: the ring is very much bigger and larger than that of the *Plasmodium immaculatum*, the pigments are few and large and the crescent is longer than is the red corpuscle infected by it (*Fig. 2.*).

It was the last form that I met with in Litcho; of course I saw there the other forms of malaria too. It was by no means easy to find out all these differences, because the conditions under which I had to work in Litcho were not all those of a modern laboratory, and so it was some time before I could differentiate the two different types as described above: today I can say from my own observations that the affirmations of Marchiafava and Bignami, those of Craig, Ziemann, Mannaberg and of all the others, who have stated that there are two types of the tropical malaria, both morphologically and clinically, are absolutely right and correct. I took the blood in all cases at the same time, after the beginning of the fever-attack, to avoid the charge that "perhaps the small rings had grown before the blood had been taken from the patient". The quotidian tropical malaria, and I have seen 99 cases of this form, never showed the severe symptoms which I saw in the other form. I never saw the great rings nor were the great crescents greater than the red blood cells in this form. I treated 45 cases of the subtertian form and in all cases in which I could find something under the microscope, I saw the great rings and the great crescents. In the cases of the quotidian tropical malaria there was in some cases cerebral symptoms, others showed slight vomiting or—as in three cases—slightest headaches; I saw also a great number of these cases with only the fever-attacks without any other symptoms. In the 45 special cases of subtertian malaria (*Plasmodium falciparum*), there were always cerebral symptoms and among them 15 cases with delirium, always vomiting and also more or less heavy pains in the bones. Of these 45 cases I would like to mention especially five, which were extremely severe: two of them died. The other three recover-

ed: two after five weeks and one after seven weeks. During the first severe case I had no Atebrine, and not even the recommended Quinine-injections brought any help and in spite of all cardiacs which had been given 3-4 times daily, the patient died on the 6th day of his sickness. The second case was that which recovered after 7 weeks. Heavy vomiting, cerebral symptoms with delirium, furthermore heavy bone pains; in this case I could not give Atebrine, because the medicament had not yet arrived due to a misunderstanding. Cardiacs, which were of great help in all 45 cases—except the two that died—and Quinine saved the patients. The third case died in spite of Atebrine, also on the 6th day of the sickness, it was the most severe one with coma; this patient had generally the same symptoms as in the second case but still heavier with diarrhoea too. The last two cases, which recovered after 5 weeks, were nearly the same as the second case; in these two cases the Atebrine showed an excellent and prompt effect. I would like to state expressly that in all other cases and in all other forms of malaria which I had to treat in Litcho, Atebrine showed its wonderful and prompt cutting off of the fever-attack and I could state this myself, when I got malaria too. I must mention furthermore that female patients resist the severe fever-attacks very much better than male patients.

Some words about Atebrine and Plasmoquine. The first trials and experiments to cure malaria with synthetic remedies were made with chemical compounds of the groups of the so-called dye-stuffs such as Methylene-blue. The results were not satisfactory until further experiments led to the dye-stuff Acridine and this is the essential and effective substance in the well-known Atebrine. It was produced in 1930 by Kikuth in collaboration with Mietzsch and Mauss in the Research Laboratories of the I. G. Farbenindustrie in Germany. About Plasmoquine, we can say that the experiments of the synthetic preparation of Quinine led to the Chinoline-ring, that is a chemical cyclic compound. It was found out that this compound had a special effect on the sexual forms of the parasites, the gametocytes, and the researches went on, until finally Plasmoquine was discovered. The greatest credit in this work belongs to Schulemann, Schönöfer and Wingler. The clinical tests went on for several years, especially by Röhl and Mülhens, and finally in 1930, this medicament could be used for public treatment. The difficulty of waiting for some days after the Atebrine-treatment then, to start the treatment with Plasmoquine, has been overcome by producing the medicament



ATEPE, which contains Atebrine against the asexual forms and Plasmo-quine against the sexual forms; but the supportability of this last named medicament is dependent on the climate: in some countries of the tropical zone it is—as reports say—not so effective as for instance in America, from where excellent results are reported.

Among the 4054 sick people, whom I saw during nearly twelve months in Litcho, *i. e.*, visits in the houses, in the small huts of the workmen and consultations in my office, I had 289 malaria-patients, *i. e.*, 7.8%. During the time of my predecessors, September 1935 until the beginning of September 1940, the average was 30.63%. The malaria statistics of the League of Nations shows that for instance in India among 100,000,000 cases of malaria during one year 1,000,000 deaths occur *i. e.* 1%. In U. S. A., where malaria is found especially in the South-Eastern States and the Mississippi River basin, there are about 1,000,000 cases per year with 5,000 deaths, *i. e.* 0.5%. According to statistics published in the *Thai-Mai* on April 19th 1942, the population of Thailand in 1940 was approximately 16,000,000; 2,000,000 were affected by malaria, *i. e.* 12½% and of these about 40,000 people died, *i. e.* 2%. In Wang-Ka-Chao, near Tark (North Thailand), as I learnt from a letter from that small place of about 600-700 people, malaria has claimed many victims. During September 1941, in the first two weeks, there were 1—2 deaths per day. In February 1942 there were heavy cases of malaria with sometimes only one fever-attack, but this attack then showed the following symptoms: vomiting, sometimes very heavy; heavy headaches with delirium in many cases, and bone-pains. These appearances are evidently the same as in my cases of malignant subtertian malaria, caused by *Plasmodium falciparum*. In March and April 1942 there were 2—3 new cases of malaria every day and 1—2 deaths weekly. I had among the 289 malaria patients 2 deaths—and those were all the deaths which occurred during my time in Litcho, in spite of several very heavy and severe accidents, *i. e.* 0.691%. During the time before, the average of malaria deaths was 1.989%. The graph (*Fig. 3.*) shows the malaria in Litcho during the different years, and 1939 was the worst year with 54.6% malaria during June and the yearly average of 34.50%. The average in January-August 1936-1940 was 29.71%; the same period during 1941 shows only 4.075%.

How was it possible to suppress malaria to such a low level and to keep it at that low level? The answer is very easy: by enlightenment

of the population, by trying to procure their confidence and last but not least by a scheme carefully worked out, prepared and carried out. I had 10 coolies in the medical service; 6 of them got the order to clear all the roads, or rather paths, of grass and all the vegetation, growing there in enormous abundance, and at the same time these 6 people had to take care of the drains at the side of the paths. The drains had been filled with sand and also with much vegetation before my work started and therefore they had to be renewed completely. Immediately after the cleaning of about every 150 meters, two other people sprayed anti-malaria solution over the newly cleaned area. The solution, used in Litcho, was the same as used here in Bangkok: Crude oil 1 part and Solar oil 2 parts. The remaining two men had the order to cut the high grass and the undergrowth. All the small pools and puddles were sprayed and where it was possible they were dried up. The spraying took place every 10 days, of course except during the rainy season. It was only by my personal supervision and control that this whole work was correctly carried out and so some success was reached: but this was not all. It was absolutely necessary to keep all the places, paths and drains clean and dry. When the grass was cut, it was put in heaps and after being dried, which was generally the case after at least 24 hours, it was burnt. This also has proved to be very useful. During the rainy season in February and March the chief work was to control the road-drains and the roads themselves and to keep them in good order. It was surely no pleasure for the people to work in the heavy rain, but seeing that the doctor went out for any purpose, they all came willingly to work under such hard conditions, which are sometimes not without danger there. It happens in Litcho during the rainy season that fairly big landslides take place. One year before we went there, one of these landslides, which came down from the mountains with an enormous vigour, buried a great wooden house and 14 people. There was a great rock about 80 meters high, some 150 meters from my house on the way up, and during the most critical days, when the danger was extremely great, all of us who had to pass it, were always happy when we had reached our houses again. During my time we had there smaller landslides with but slight damage and no casualties.

But it was not the cleaning work alone that helped to suppress malaria. Every one had to come three times a week to the medical office and to take Quinine as a preventative. I never saw any troubles or disturbances from the Quinine and only 3 or 4 people did not come regu-

larly. All this shows that the working population had got confidence in the medical service and I had the great satisfaction of seeing that people with the smallest ailments came for advice. They knew very well that they could call me at any time—day or night—for any medical purpose to their huts and this was not only a big help for my task: it was the basis of success! The population had got trained and everyone knew to keep his place, the drains and the surroundings of the huts clean. Every one knew that he had to cut the grass short and to keep his place dry. Since ancient times it has always been the highest duty of the physician to help everybody who needs medical help. Especially the poor people, who did not receive much education are always thankful for the help and especially for an explanation which they can understand. I have seen this in Germany, I saw the same in Italy and also here in Thailand. In Litcho, as I said already, every one came with the smallest ailment, and when the manager one day came to see me, he was extremely surprised to see a Mohamedan woman in my office: it was the first time that a Mohamedan woman had come to see the doctor since the mine existed.

When I now compare the figures reached during the period of my work in Litcho with the former period, I may be allowed to say that the results were really satisfactory.

Summing up, I would like to state that it was the purpose of this paper to show that there is really a difference between the *Plasmodium immaculatum* or *Plasmodium falciparum quotidianum* and the *Plasmodium falciparum*. Furthermore I wanted to show that the conditions in such a district as Litcho with jungle, mountains, hills and an abundant vegetation are not the same as for instance here in Bangkok, for the cleaning of the roads, drains, and destruction of the mosquito-breeding places. The conditions are very much more difficult, and last but not least, we are not allowed to forget that a most important point is the confidence of the people concerned, who are then quite willing to help in the great work for Public Health and Public Welfare.

Malaria at the present time, and especially now in wartime, is one of humanity's chief scourges, and there are many fertile areas all over the world, that remain uninhabitable because of its influence. The struggle against this disease is a very heavy one and I would be more than glad, if my small contribution could perhaps help a little bit in this struggle against malaria for the benefit and the prosperity of Thailand.

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Fig. I

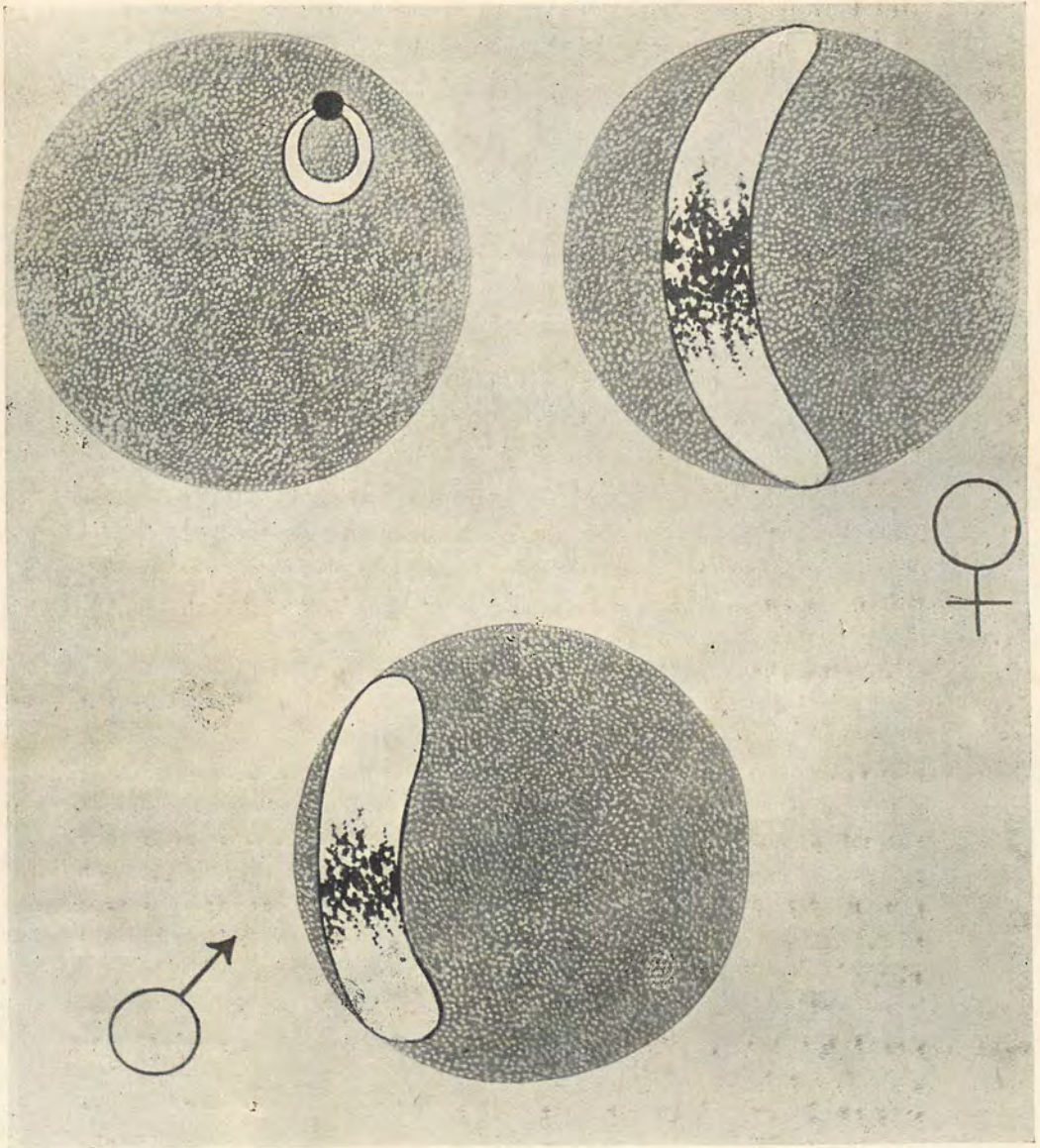


Fig. 11

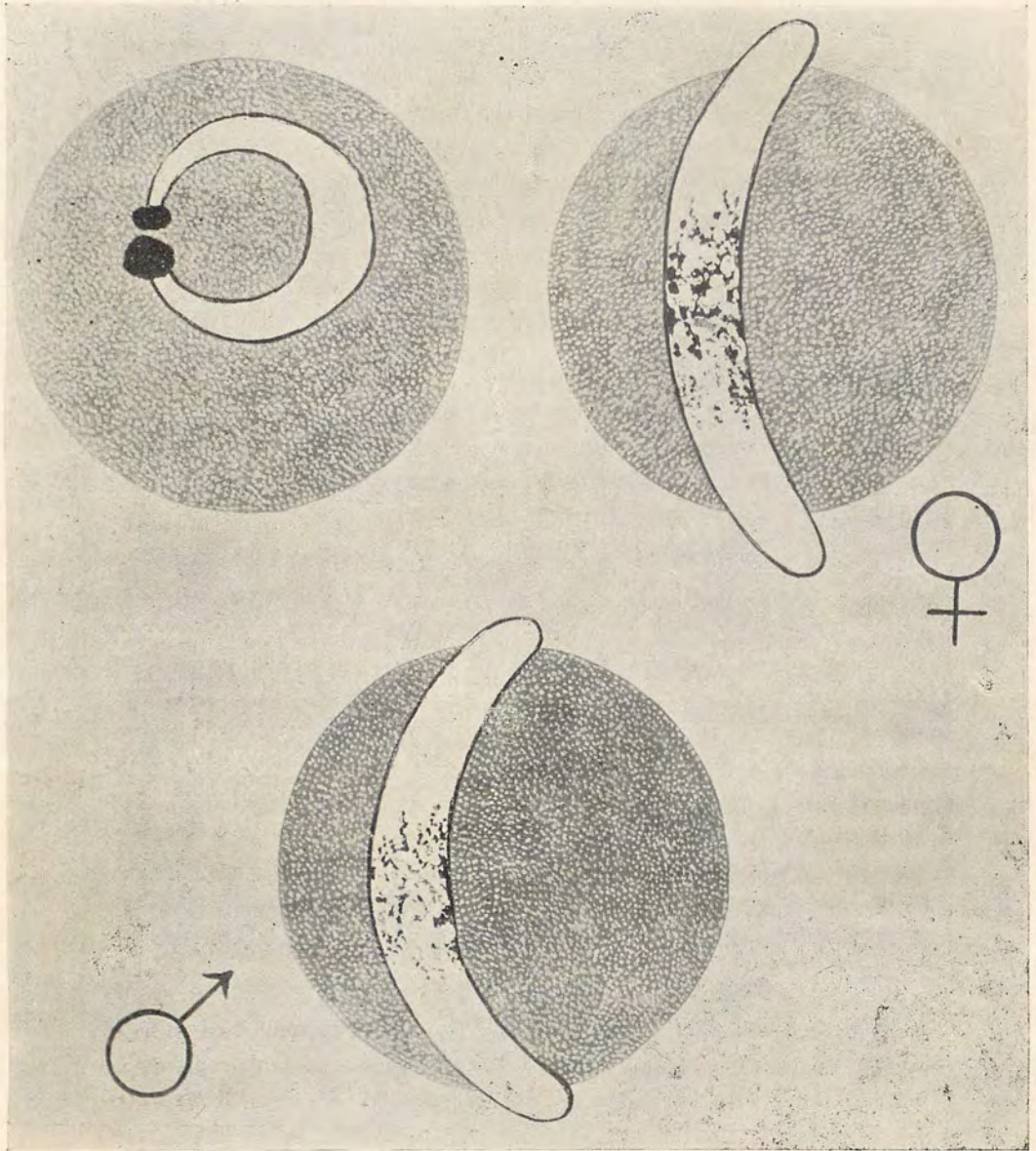


Fig. III.

