Declassified in Part - Sanitized Copy Approved for Release @ 50-Yr 2013/07/16 : CIA-RDP83-00423R000500280002-4

Unclassified

50X1

C 17920

The Epidemiology in Malaria Tertiana in Finland During the Years 1941—1945.

By

C. A. HERNBERG.

(Submitted for publication August 26, 1946.)

Declassified in Part - Sanitized Copy Approved for Release @ 50-Yr 2013/07/16 : CIA-RDP83-00423R000500280002-4

Declassified in Part - Sanitized Copy Approved for Release @ 50-Yr 2013/07/16 : CIA-RDP83-00423R000500280002-4

Acta Medica Scandinavica. Vol. CXXVII, fasc. III—IV, 1947.

The incubation time in malaria tertiana has been greatly debated in two respects. On the one hand the time of incubation has provoked a lively discussion, on the other hand, the habitat of the malaria plasmodium during the time of incubation has been unknown so far. Nor have the possibilities of the plasmodium to hibernate in Finland been investigated.

Up to the present plasmodium malariae has habitually been found after the time of incubation, which generally is of the duration of 10—14 days. It has then entered into a red blood corpuscle and has taken on the appearance of a signet ring. While the erythrocyte undergoes destruction the plasmodium gradually passes through a stage of development, and in 48 hours a manifold splitting up of the separate parts, the merozoites, placed in rosette-like formations, takes place. The merozoites detach themselves and spread into the blood channels. Simultaneously there is a sudden rise in the patient's temperature. The majority of merozoites penetrate into the new red blood corpuscles, and the cycle is again repeated. A few of the merozoites develop into gametocytes. The male gametocytes do not continue to live in man. The female gametocytes may multiply again by division. If gametocytes of both sexes enter into the mosquito by way of a fresh mosquito bite the sexual form develops further in the mosquito. At a temperature of 25° C the development takes place in 10 to 14 days, at a somewhat lower temperature in 14 to 18 days.

Declassified in Part - Sanitized Copy Approved for Release @ 50-Yr 2013/07/16 : CIA-RDP83-00423R000500280002-4

Declassified in Part - Sanitized Copy Approved for Release @ 50-Yr 2013/07/16 : CIA-RDP83-00423R000500280002-4

If the temperature is permanently below 15° C there is no further increase or development in the mosquito.

A pre-requisite condition for conveying malaria is that the Anopheles mosquito becomes infected with human blood and then continues to live until the plasmodium has had time to pass through the sexual phase, and that the mosquito bites and infects another human being. In Finland 14 to 18 days at least are required for this purpose. If the incubation time is added thereto, 24—36 days will be required for transmitting the fully developed disease from man to man.

Malaria is prevalent in enormously wide areas of the world, in its tropical and temperate countries. Very severe epidemics occurred in Finland in the nineteenth century and in the beginning of the present century. K. O. Renkonen mentions that the worst years included 20,000 to 40,000 cases, according to calculation. During the two decades preceding the second World War the disease was almost completely absent in Finland.

During the second World War malaria epidemics broke out in the majority of the armies. The Americans even considered malaria the most troublesome of all diseases at the front (Coggeshall).

In the temperate countries it has been noticed that the malaria epidemic appears fairly regularly in two phases, one with an accumulation of cases in April—May, and another one in August—September.

Until about 1930 common opinion was that malaria originates from hibernating mosquitoes infected with malaria. Robert Koch was the principal advocate of this theory. However, in 1877 Bergman, Sweden, and Korteweg, Holland, propounded the view that spring malaria was due to a long incubation time and that the patient had been infected already in the preceding summer.

After the first World War numerous cases of malaria appeared in Germany among young men who had served in South-European sectors during the previous year (Moberg). This occurrence does not, however, seem to have evoked discussion to any extent. But during the two latter decades several solitary cases were reported in which the incubation time for malaria must be calculated at about one year (Shute, Sade, Tillich, Bradild, Martini). These cases generally referred to travellers who had stayed for some short time in countries infected with malaria and who, later, had returned to their malaria-free home areas. Some of them sickened within the expected time, after a short incubation period, but

Declassified in Part - Sanitized Copy Approved for Release @ 50-Yr 2013/07/16 : CIA-RDP83-00423R000500280002-4

Declassified in Part - Sanitized Copy Approved for Release @ 50-Yr 2013/07/16 : CIA-RDP83-00423R000500280002-4

others again were not afflicted until about nine months later. The prolonged time of incubation was later demonstrated by Korteweg, 1929. The fact of a prolonged incubation time actually occurring has, however, always been doubted by South-Europeans, at least regarding sub-tropical areas. They refuse to accept it as a mass occurrence, in any case. (Missirolli, Berkesy, and others.)

In Finland, spring malaria was closely discussed in the beginning of the present century and the theory that the agents of malaria were domestic mosquitoes hibernating in stables or dwelling houses was accepted (Sivén). As late as in 1943 Renkonen pointed out the difficulties in considering malaria the result of a prolonged incubation period — without, however, taking a definite standpoint regarding the statement.

The question of malaria was brought into a new phase by observation made, independently, by Huff and Bloom 1935, Raffaele 1934, 1936, James and Tate, 1937, Kikuth and Mudrow 1937, Manwell and Goldstein 1939, and Schulemann 1940, who, besides the intra-erythrocytic forms of plasmodia, discovered pigment-free forms, localized extra-erythrocytically, generally in the endothelial cells of the capillaries of inner organs. In the literature the cells are stated to belong to the reticulo-endothelial system, RES.

By infecting animals with tissues containing extra-erythrocytic malaria plasmodia the time of incubation was considerably decreased. This had hitherto not been attained below a certain level.

A result was obtained, on the other hand, by irritation of RES with injections of colloidal palladium (Schulemann) some days before malaria infection. The incubation time was prolonged 25—30 days and the disease assumed, clinically, a more cerebral form. It was supposed that the changes in the disease were due to part of the parasites having become phagocyted by RES.

It was further noticed that malaria which has arisen from direct infection with merozoites, as in therapeutic malaria in paralysis, is of a different character to malaria caused by infection with sporozoites, as in mosquito bites. In the former case a violent malaria arises which is very sensitive to therapy, however, and very rarely recurs. A malaria caused by mosquito bite is more benign on the other hand, but is inclined to relapse (James).

Before being ready to enter the erythrocytes the sporozoites have to pass through a stage of development in RES — this is thus considered proved.

Declassified in Part - Sanitized Copy Approved for Release @ 50-Yr 2013/07/16 : CIA-RDP83-00423R000500280002-4

Declassified in Part - Sanitized Copy Approved for Release @ 50-Yr 2013/07/16 : CIA-RDP83-00423R000500280002-4

Supported by this theory Kikuth considered himself able to explain a number of epidemiological phenomena. The prolonged time of incubation was due, *inter alia*, to plasmodia having remained in RES. The recurrences, which even in careful treatment of malaria, always occur in a certain percentage, would be due to our drugs only attacking the intra-erythrocytic forms and the gametocytes. For the same reason the drugs do not act during the incubation time, but, according to some authors, they may prolong it up to about a year (Kolle, Siebert). The plasmodia in the reticulo-endothelial system, would, in other words, form an infection reservoir which we have not been able to influence so far. Positive accounts of Kikuth's theories are found in German and English literature, but in France (Sergent) and Italy (Correlati, Missiroli) a certain opposition regarding his hypotheses has been aroused.

Schulemann considers that the plasmodium may penetrate into RES not only as sporozoites but also as merozoites.

The Author's own Investigations.

During Finland's second war against the Union of Soviet cases of malaria appeared in the army. The Russian troops were, without doubt, the source of infection, as some of them were recruited from areas where malaria is endemic. During the first summer no actual epidemic broke out, however, but solitary cases were reported at the end of summer 1941, in all 57 cases. Half the number of patients was from the Hangö frontier and a small number from the Carelian Isthmus and East Carelia. During the following years the malaria cases were decidedly more numerous:

1942 — 583 cases
1943 — 262 »
1944 — 892 »

The disease raged principally among the troops on the Carelian Isthmus but also to some extent in East Carelia. Men of the ranks were more pre-disposed to the disease and sickened proportionately twice as often as did officers. This is quite natural as soldiers have to serve for long periods in the open and at night in stationary warfare.

With soldiers on leave and disbanded soldiers the disease was carried to civilians in the home areas, fortunately in but few cases, and only to the south parts of the country (See map, Fig. 1).

Declassified in Part - Sanitized Copy Approved for Release @ 50-Yr 2013/07/16 : CIA-RDP83-00423R000500280002-4

Declassified in Part - Sanitized Copy Approved for Release @ 50-Yr 2013/07/16 : CIA-RDP83-00423R000500280002-4

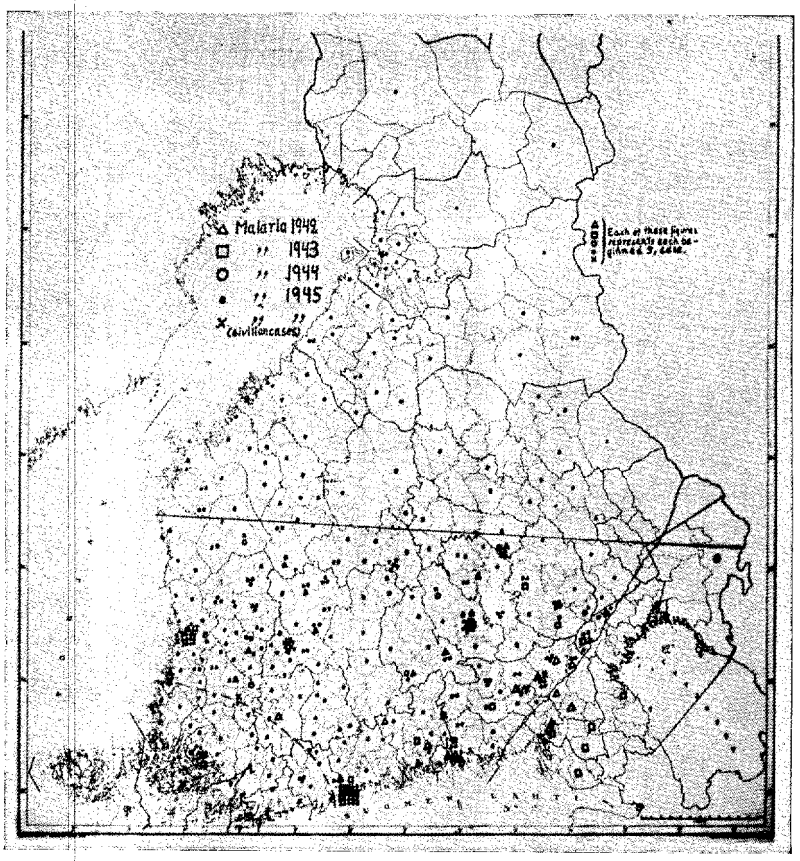

Fig. 1. On the map each point represents a group of five cases of malaria in 1945. The other figures denote groups of five cases during the years 1941—1945. The line across is the northern limit of civilian cases. The dotted line in the south-west corner denotes the border of the district within which no single case of malaria occurred among civilians in 1942 in the Hangö district.

According to the statistics published by the Medical Board we have the following civilian cases:

1941 — no cases
1942 — 75 cases, probably part of them disbanded soldiers
1943 — 53 cases, of these 40 from the Wiborg district
1944 — 17 cases.

The majority of military cases from 1944 originated from the Carelian Isthmus. Fortunately no leave was granted during the whole of the mosquito period, on account of heavy fighting, and

Declassified in Part - Sanitized Copy Approved for Release @ 50-Yr 2013/07/16 : CIA-RDP83-00423R000500280002-4

Declassified in Part - Sanitized Copy Approved for Release @ 50-Yr 2013/07/16 : CIA-RDP83-00423R000500280002-4

before the outbreak of the disease the entire civilian population on the Isthmus had been transferred. The spread of malaria from the Isthmus to other parts of Finland was very slight on that account.

However, after the end of the war, in 1945, a great number of malaria cases occurred among the civilians (Hernberg and Tuomala).

For the purpose of obtaining a fairly exact figure of the cases in 1945 the following sources were drawn upon:

1. Statistics published by the Medical Board, 869 cases. In the reports the name, age, address, and month of sickening was entered for more than half the number of cases, while in the remainder only time and place of sickening was noted.

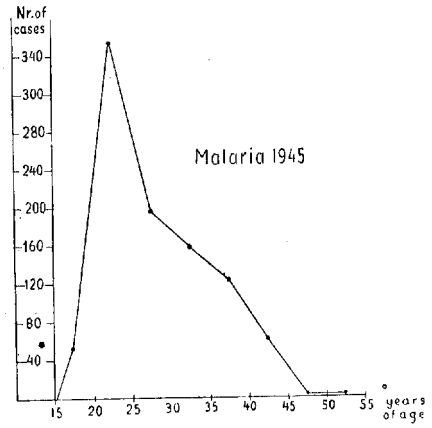

Fig. 2. Subdivision of cases in age-groups in 1945.

2. Cases of malaria collected from 25 hospitals in Finland, 597 cases. Thanks to the courtesy of the prefects I was able to study the case histories from 17 hospitals, which, of course, increased the value of my material greatly.

3. Military cases in 1945 from the peace-time army, 85 cases.

From the total figure, 1,551, cases occurring in two or more collections are subtracted. We then have 1,252 in all. This figure is about that of the total malaria morbidity in the year 1945. Relapses are not included in this figure. More or less complete personal information was obtained from 868 patients. This

Declassified in Part - Sanitized Copy Approved for Release @ 50-Yr 2013/07/16 : CIA-RDP83-00423R000500280002-4

Declassified in Part - Sanitized Copy Approved for Release @ 50-Yr 2013/07/16 : CIA-RDP83-00423R000500280002-4

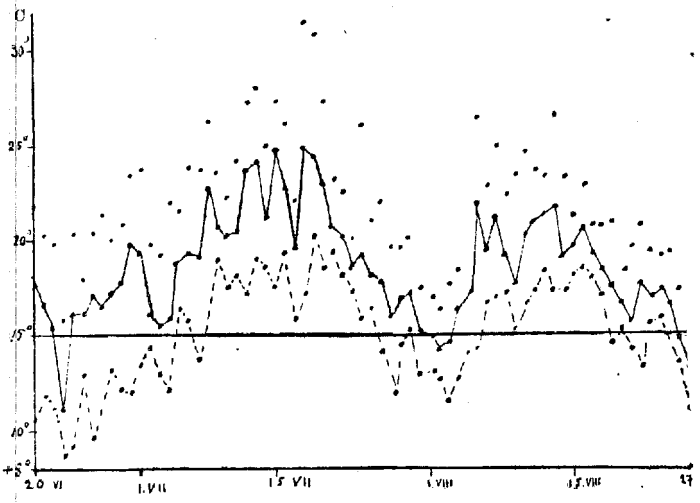

Fig. 3. Temperature curve for Helsingfors in summer 1945. The cross-line lies within temperature zone of 15° C.

material will suffice for the purpose of solving the present epidemiological problem.

To my great surprise there were 856 men and only 12 women among the 868 patients from whom personal information had been obtained.

The subdivision according to age is revealed in Fig. 2. As seen, no cases below 15 or above 53 were observed. This is all the more strange as malaria is more inclined to attack children than adults. Between 15 and 20 years of age there were only 45 cases. In the age-group 20—25 an enormous increase is observed — as many as 345 cases were noted. In the following 5-year-groups the number of cases decreased and above the age of 45 there were only 4 cases.

For the purpose of estimating possibilities of transmitting infection, conditioned by temperature, tables covering the temperature in 1944 and 1945 in 12 different places in Finland were obtained from Professor Keränen, Chief of the Meteorological Central Institute. With the view in mind that malaria plasmodium may develop in mosquitoes it would perhaps be more consistent to use only the minimum temperature as a norm, but, on the one hand it is probable that the temperature in the mosquitoes' nocturnal resting-places is above the minimum, and, on the other

Declassified in Part - Sanitized Copy Approved for Release @ 50-Yr 2013/07/16 : CIA-RDP83-00423R000500280002-4

Declassified in Part - Sanitized Copy Approved for Release @ 50-Yr 2013/07/16 : CIA-RDP83-00423R000500280002-4

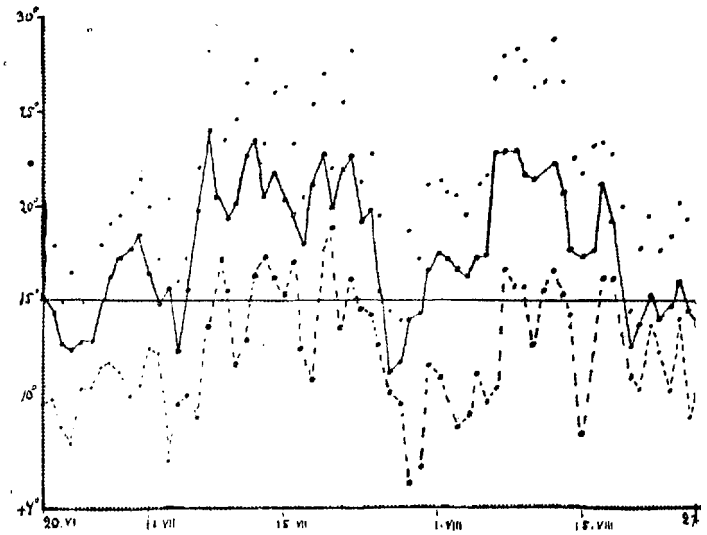

Fig. 4. Temperature curve for Uleåborg in summer 1945.

hand, the higher temperature during daytime must be of importance in the development of the plasmodium in the mosquito. On the basis of a study of temperature curves drawn for the 12 places in question the period of warmth may be considered sufficient for transmittance of malaria, with certainty in the latitude of Helsingfors (Fig. 3), possibly in that of Tammerfors, but in Uleåborg the temperature seems, on the other hand, to be less favourable for transmission of malaria infection (Fig. 4). The consecutive period of a mean temperature above 15° C is rather too short for the purpose.

It may seem somewhat audacious to draw a delimiting line regarding the possibility of conveying malaria, conditioned by temperature, as the malaria is dependent upon the vitality of the plasmodium, but an empiric border for the years in question may be obtained. During the years 1941—1945, those, who, with all probability, had been infected in their home districts, were stationed south of a line drawn from Vasa to Suojärvi in latitude 62.5°. This may be considered a northern line of demarcation regarding malaria in Finland during these years (Map, Fig. 1).

An accumulation of all the malaria cases during 1945 south of this line was expected, providing the plasmodium had hibernated in the mosquito.

Declassified in Part - Sanitized Copy Approved for Release @ 50-Yr 2013/07/16 : CIA-RDP83-00423R000500280002-4

Declassified in Part - Sanitized Copy Approved for Release @ 50-Yr 2013/07/16 : CIA-RDP83-00423R000500280002-4

However, what is the true geographical subdivison of malaria in relation to the one conditioned by temperature, the anticipated spread?

On the map (Fig. 1) the 1,252 malaria cases are marked thus: each point represents about 5 cases. As seen, malaria occurs in the most varied parts of the country, subdivided in about 250 communes, without large epidemical accumulations, and in approximate relation to the density of the population. The disease occurs more numerously in the large towns, and in Joutseno, north of the Carelian Isthmus. Malaria is also met with as far north as Uleåborg where the disease is not expected on account of the low temperature in these parts.

Several municipal doctors have informed me that the separate cases in the commune were often stated several miles apart although the patients had had no communication with one another.

In the preceding year the majority of the places had been free from malaria. The possibility of infection caused by hibernating mosquitoes should therefore not be taken into consideration.

Thus the geographical spread does not correspond to the calculated prevalence.

Fig. 5 represents the cases per month calculated according to the day of sickening. Already in February—April, the mosquito-free period, we have as many as 142 cases of malaria. The greatest number of cases accumulated in May, 440 cases, and in June, 352 cases. In July—August, the true mosquito months, the curve decreases steadily.

As 24—36 days must be assigned in Finland for full development of a complete picture of disease in transmission of infection from man to man via the mosquito, half the number of cases would have been infected already before the middle of April, *i. e.* before there were any mosquitoes at all, providing the infection had occurred in that year.

Thus the chronological subdivision of the cases does not either correspond to the one calculated.

I now consider fully evidenced that the majority of the malaria patients from 1945 had not been infected in the same year. I do so on account of the following facts:

1. It is impossible that malaria infection which has attacked only men of military age should have taken place in their respective home districts where both sexes and all ages are represented.

Declassified in Part - Sanitized Copy Approved for Release @ 50-Yr 2013/07/16 : CIA-RDP83-00423R000500280002-4

Declassified in Part - Sanitized Copy Approved for Release @ 50-Yr 2013/07/16 : CIA-RDP83-00423R000500280002-4

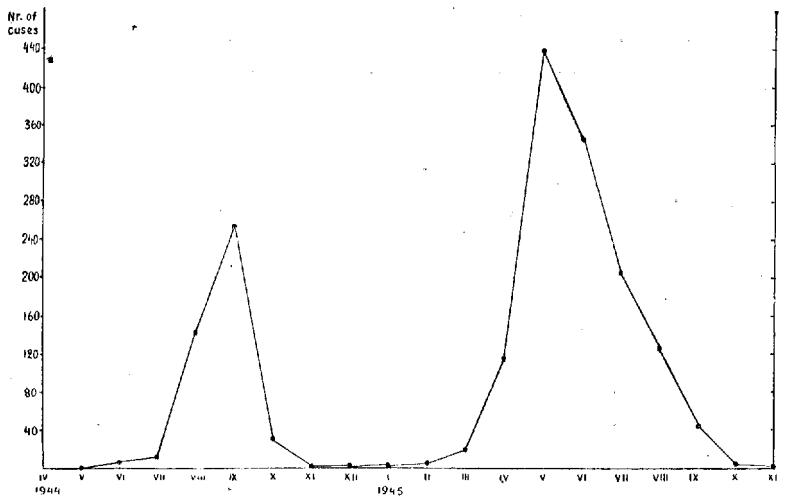

Fig. 5. The right part of the curve represents the malaria epidemic in 1945 subdivided according to month. The left part is that of cases with short incubation time during the epidemic on the Carelian Isthmus in 1944. The ratio between short and prolonged time of incubation during the same period of infection is clearly evidenced.

2. The separate cases are geographically too far apart for reciprocally transmitted infection being taken into account.

3. In some districts the temperature was too low during the summer months for infection transmitted via mosquitoes being probable.

4. The apex of the morbidity curve of infection by mosquitoes was reached too early in the year.

5. Infection by hibernating mosquitoes is not probable as the districts in question were free from malaria in the preceding year.

If the patients were not infected in summer 1945 a preceding mosquito period is the only explainable source of infection. Where were they in summer 1944? This question was put to them by letter. A reply was obtained from 596 patients out of 868.

It was revealed that almost every single patient had been in military service on the Carelian Isthmus. A great number of them had been in East Carelia in the beginning of the summer but had been transported to the Carelian Isthmus already before the middle of June. Only 13 had been in their respective homes.

In summer 1944 malaria occurred frequently on the Carelian Isthmus while the disease was very infrequent in other districts.

Declassified in Part - Sanitized Copy Approved for Release @ 50-Yr 2013/07/16 : CIA-RDP83-00423R000500280002-4

Declassified in Part - Sanitized Copy Approved for Release @ 50-Yr 2013/07/16 : CIA-RDP83-00423R000500280002-4

On that account I consider that the majority of the patients from 1945 had obtained their infection on the Carelian Isthmus in the summer of 1944, and that the disease had broken out after an incubation time of 6—14 months, or else were recurrent cases.

Among the questions put to the patients in the questionnaire may be mentioned: where did he sicken in malaria, for the first time; had he suffered earlier from some kind of fever? Evident relapses could be eliminated without further in this way; similarly, if clinical reports were obtained. Atypical slight cases of malaria with spontaneous healing thus remain. It seems improbable that such cases should appear, in any case not in such large numbers. Numerous closely observed cases are included in this material, such which had decidedly not showed any previous symptoms of infection. A soldier will not omit to report himself sick if he actually has a temperature — this with cognisance of soldier-psychology. Two military physicians, for example, had shared a room in a cottage on the Carelian Isthmus in summer 1944. Thirteen months later both of them sickened with an interval of four days only, each in his home, outside the malaria zone.

No malaria prophylaxis with antiplasmodica such as quinine, atabrine, or plasmochin was used in the Finnish army during the whole war. An extenuation of the incubation time by malaria prophylaxis is excluded.

My opinion is that the majority of the cases were due to prolonged time of incubation.

The cases of malaria, which, due to a prolonged incubation period, may be thought to originate from 1943 must be deducted from those on the Carelian Isthmus in summer 1944. If this is done in a manner which will be described later we have 554 cases, with short incubation. These 554 cases (from 1944) with short incubation thus correspond to 1,252 cases (from 1945) with prolonged incubation, related to the same period of incubation. This is graphically exposed in Fig. 5.

Thus, the malaria plasmodium may hibernate in man in a surprising degree. Does it hibernate in the mosquito at all? Common conception is, of course, that it may do so in the main. Also this question may be explained to be due to the exceptional conditions prevalent during the war. Let us return to 1941.

In the Hangö-sector 28 cases of malaria were reported in summer 1941. We take it that the Russians had a far greater number of cases. There must have been masses of malaria infected mos-

Declassified in Part - Sanitized Copy Approved for Release @ 50-Yr 2013/07/16 : CIA-RDP83-00423R000500280002-4

Declassified in Part - Sanitized Copy Approved for Release @ 50-Yr 2013/07/16 : CIA-RDP83-00423R000500280002-4

quitoes around the idyllic bays in the neighbourhood of Hangö in autumn 1941. In the winter the Russians left this district and the Finnish troops were transferred to more important sectors. The population was replaced by Finns from malaria-free districts. If the plasmodia had hibernated in the mosquito, malaria would have broken out among the inhabitants removed into this district in summer 1942. However, no cases of malaria occurred in the area of Hangö, not even within a radius of more than 100 km. (See map, Fig. 1.)

The case was similar on the Carelian Isthmus in autumn 1944, although the extent was greater. In agreement with Armistice stipulations the Finnish troops were withdrawn from the Isthmus in the autumn and stationed north of the Finnish-Russian border line of 1940, and the majority of the Russian troops were transported as they were considered superfluous in this district. In the following year civilians from Russia settled on the Carelian Isthmus. Had they come from malaria-free districts an epidemic among them would indicate that the plasmodium had hibernated in the mosquito. It is not known, however, whether these people had come from non-infected districts, but as malaria is greatly prevalent in Russia, it is hardly possible. Yet, I have learnt that no epidemic broke out on the Isthmus. Information regarding sporadic cases is lacking. The Carelian Isthmus would, thus, be a parallel to the Hangö district.

Consequently, it seems probable that the malaria plasmodium had not hibernated in the mosquito after the summers of 1941 and 1942.

If we adhere to the theory that the malaria plasmodium may be lodged for long periods of time in RES, one might explain, in my opinon, why the time of incubation is just about 9 months. I consider that the vitality of the malaria plasmodium in man augments with increasing light, but hardly with rising temperature. In an isothermal organism, as that of man, the outside temperature is said to play a subordinate part as regards the plasmodium. The temperature plays a great part, on the other hand, regarding the perpetuation of the plasmodium in the poikilothermal mosquito. Thence the potential malaria period in Finland would be the light months of the year. If a person becomes infected with malaria in the autumn the plasmodium is more inclined to lie quiescent in RES, and to awaken to life not earlier than the following spring.

Declassified in Part - Sanitized Copy Approved for Release @ 50-Yr 2013/07/16 : CIA-RDP83-00423R000500280002-4

Declassified in Part - Sanitized Copy Approved for Release @ 50-Yr 2013/07/16 : CIA-RDP83-00423R000500280002-4

The summer in Finland is short and thus also the virulent time of the plasmodium. The spring malaria curve and that of late summer will on that account fall within one another and give rise to a resultant curve in common, the apex being reached some time during the summer. In countries with longer summers the curves become separated, and it may also be expected that the prolonged incubation time will occur percentually less frequently in those countries than in Finland, and, possibly, be totally lacking in the tropics. The disinclination of investigators in subtropic countries to accept the prolonged incubation time as a mass occurrence would thereby be elucidated in a natural way.

For the same reason the malaria becomes more benign the higher up in the north it appears.

A larger number of cases with prolonged incubation might be expected, percentually, if the malaria epidemic occurs towards autumn, and a shift for the benefit of a short incubation time if the epidemic occurs in early summer. I was able to observe this occurrence during the former epidemics in the army. My thanks are due to the administration of the Army and the Archives for War Wounded for permitting me to study clinical reports regarding malaria during the duration of the war.

Due to the outbreak of war on June 25, 1941, the soldiers were sent to the fronts in that month, and were thus exposed to a potential malaria infection. The first cases appeared one month later, *i. e.* in July, as anticipated (Fig. 6, lowest curve.) In August the curve rose furthermore but did not reach the maximum until September. In the following months the curve declined slowly. It is a non-composed curve constituted only of cases with short incubation. The slight slant in the curve might denote that more people had become infected but that the disease had not broken out. It is also difficult to understand that the cases could have been located at such distances from one another among closely packed troops. Three-fifths of the cases were apportioned to September and later. This was distinctly a late summer epidemic.

In the subsequent year 583 cases, excluding the recurrences, were noted (Fig. 6, second curve from lower edge). The apex of the epidemic was reached in June. The curve should, however, be a resultant curve and solvable in two components. One of the components comprises cases from 1941 with prolonged incubation, the second one cases with short incubation from 1942.

How should the curve be decomposed?

Declassified in Part - Sanitized Copy Approved for Release @ 50-Yr 2013/07/16 : CIA-RDP83-00423R000500280002-4

Declassified in Part - Sanitized Copy Approved for Release @ 50-Yr 2013/07/16 : CIA-RDP83-00423R000500280002-4

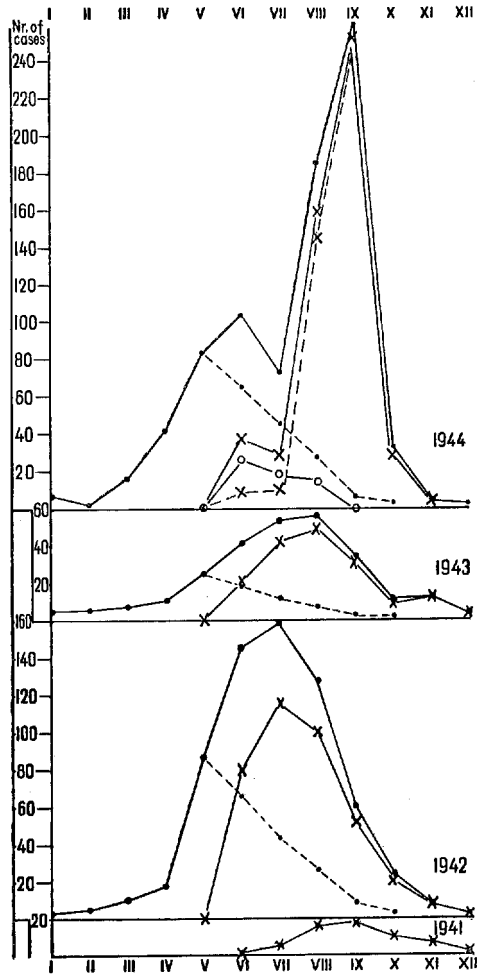

Fig. 6. In the same diagram, but with different abscissa lines, the epidemic in 1941—9144 is graphically reproduced. The morbidity curves are solved in their two components, of which ------ denotes short incubation cases and x——x prolonged incubation cases. The small epidemic in East Carelia is broken out from the curve for 1944.

As we cannot calculate with SI-cases[1] in May, on account of what has been said above, we have the right to consider the entire left side of the curve as PI-cases[1] until the end of May. The right

[1] SI — short incubation, PI — prolonged incubation.

Declassified in Part - Sanitized Copy Approved for Release @ 50-Yr 2013/07/16 : CIA-RDP83-00423R000500280002-4

Declassified in Part - Sanitized Copy Approved for Release @ 50-Yr 2013/07/16 : CIA-RDP83-00423R000500280002-4

side of the PI-component is hypothetic. It is highly probable that it will follow along the resultant curve as malaria infected mosquitoes do not appear in Finland until the end of June. But, as we should not follow the most advantageous interpretation of our reasoning. I have consistently given the right side of the curve, in this and the following cases, the same general course as that of cases with malaria in the year 1945 (Fig. 5), which were proved PI-cases. The mean value of the error should not be particularly great, notwithstanding possible variations in the right side of the PI-component curve from year to year. If the hypothetical right side of the curve is traced into the curve for 1942, the dotted curve in Fig. 6 is obtained for PI-cases from 1941. If the dotted curve is subtracted from the total curve the second component curve, the curve for SI-cases in 1942 is obtained. It is characterized by an increase in June, with an apex in July, followed by a fairly rapid decrease of the curve in the following months. In September and later we find only one-fifth of the SI-cases, *i. e.*, relatively, only one-third of autumnal cases as compared with the preceeding year. This was thus a typical early summer epidemic. The curves reveal that there were 210 PI-cases in 1941 and 373 SI-cases in 1942. As mentioned, there where 57 SI-cases in 1941. The ratio short : prolonged time of incubation is $57 : 210 = 0.27$.

The early summer epidemic in 1942, the curve described above, might have been expected to be followed by a relatively smaller number of PI-cases, and this was actually what occurred. The epidemic in 1943, 262 cases, is graphically illustrated in Fig. 6 and solved in its separate components similarly as in the preceding curve. The curves show 86 PI-cases and 172 SI-cases. In the preceding curve the number of SI-cases in 1942 is 373. The ratio short : prolonged time of incubation in 1942 is $373 : 86 = 4.36$ *i. e.* sixteen times that of the previous year. Cases belonging to the same infection period are graphically reproduced in Fig. 7. *The sensibility of the ratio to chronological shift of the SI-curve is surprisingly great.*

As the apex of the component curve for SI-cases in 1943 is reached in August, as revealed in Fig. 6, the ratio for that year might be expected to be found somewhere between the two preceding figures and such is also the case. The ratio $172 : 220 = 0.78$ is obtained from the decomposed curve of the epidemic in 1944. (Fig. 6.)

The resultant curve for 1944 is somewhat more composed than

Declassified in Part - Sanitized Copy Approved for Release @ 50-Yr 2013/07/16 : CIA-RDP83-00423R000500280002-4

Declassified in Part - Sanitized Copy Approved for Release @ 50-Yr 2013/07/16 : CIA-RDP83-00423R000500280002-4

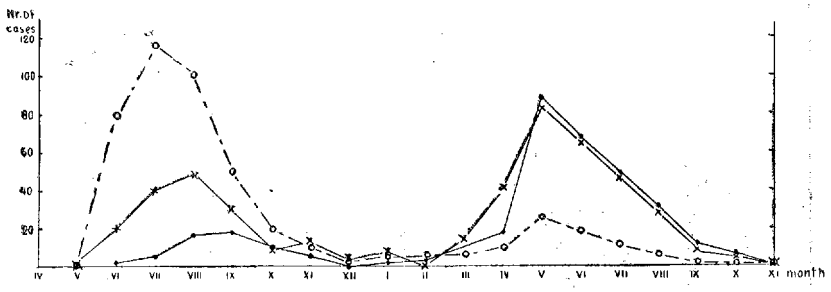

Fig. 7. The total number of cases from the same infection period are collected in one diagram. Observe that the right part is dependent on whether the apex of the left curve is reached early or late in summer.

the preceding curves. The chronology of the previous curves was similar in all sectors and the total malaria material could be treated as a totality. In summer 1944 a great move in the action of the troops took place and the possibilities for soldiers to become infected was different. The principle habitat of the infection was the Carelian Isthmus. During the hard fights in the summer the troops were reinforced. The new troops were thus not exposed to infection until about July. It seems, principally, as if the stationary warfare at the end of the summer would have furthered the transmission of infection as the frontier ran through the swampy districts around Äyräpää, the Vuoksen Valley, and the long Bay of Wiborg. The malaria epidemic on the Carelian Isthmus broke out in full force in August—September. It was thus a typical late summer epidemic.

A small independent epidemic occurred simultaneously in East Carelia in the early summer. The total morbidity curve is thus composed of both the SI- and the PI-components and, besides, of the epidemic curve from East Carelia. In the figure it has been broken out from the total morbidity curve. The SI-curve for the epidemic in the Carelian Isthmus only, comprises 554 cases. Following this typical late summer epidemic the above described great spring malaria epidemic followed in 1945, with, as mentioned, at least 1,252 cases. The ratio is thus 554 : 1,252 = 0.44 (Fig. 6).

The East Carelian epidemic in 1944 did not cause an accumulation of PI-cases in 1945, partly as the epidemic was very small, partly as it occurred relatively early in the summer.

The surprising homogeneousness of the epidemic with the calculated course supports the accuracy of my reasoning.

Declassified in Part - Sanitized Copy Approved for Release @ 50-Yr 2013/07/16 : CIA-RDP83-00423R000500280002-4

Declassified in Part - Sanitized Copy Approved for Release @ 50-Yr 2013/07/16 : CIA-RDP83-00423R000500280002-4

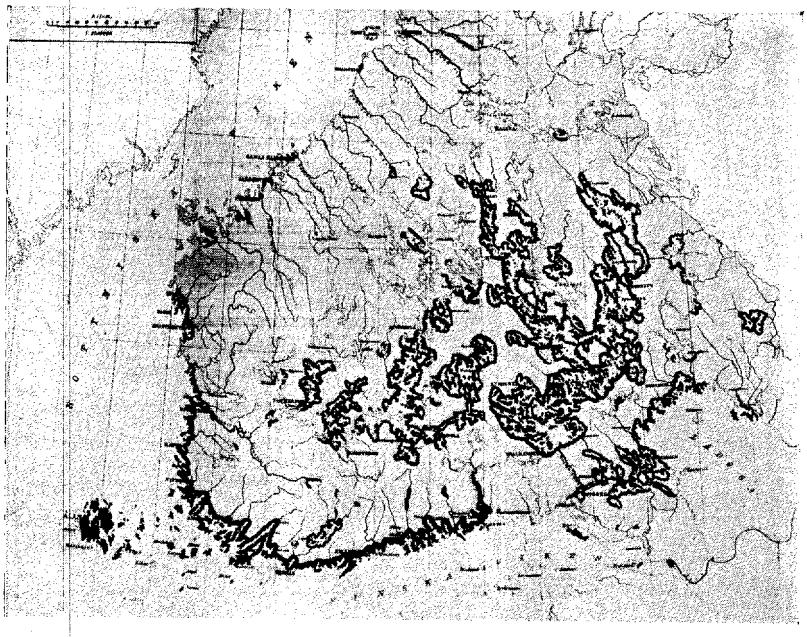

Fig. 8. Map showing malaria in Finland in 1853—1862 according to R. Sievers. Note the extensive spread of the disease northward, and its affinity to water.

The sensitivity of the malaria plasmodium to a chronological shift in the time of infection is remarkable. A change of only one month to the left of the apex of the epidemical curve reduces the number of prolonged incubation cases to a minimum. This also elucidates the rare occurrence of long incubation in the tropics.

The virulence of the malaria plasmodium was evidently fairly small in Finland during the war-years, and the disease very benign. Among the total cases of malaria, about 4,000, relapses included, no single death was noted, notwithstanding the disease being new in this country and treatment not always sufficiently intense or instituted early enough. Nor was the morbidity with regard to exposure to infection within the army particularly marked. The plasmodium was not able to hibernate in the mosquito. The disease occurred principally in the south parts of Finland and the spread among civilians was surprisingly small.

The character of malaria not always being similar to the one described is evidenced in R. Sievers' reports. The map (Fig. 8) illustrating the disease in 1853—1862 reveals the enormous

Declassified in Part - Sanitized Copy Approved for Release @ 50-Yr 2013/07/16 : CIA-RDP83-00423R000500280002-4

Declassified in Part - Sanitized Copy Approved for Release @ 50-Yr 2013/07/16 : CIA-RDP83-00423R000500280002-4

spread of the disease notwithstanding the density of the population then being about half of the present one. The northern limit of the disease was much farther north than at present, and the mortality was considerable. It is possible of course that the epidemiology of those days differed to that of to-day.

Summary.

In 1945 an epidemic of malaria was observed in Finland. It attacked almost exclusively men of military age who had been in service in malaria infected districts in the preceding summer. It is considered evidenced that the disease broke out following an incubation time of about nine months. The possibility of these cases having been relapses is excluded.

A further study of the malaria epidemics in Finland's army during the years 1941—1944 revealed the following characteristics of the prolonged time of incubation:

Prolonged incubation was observed subsequent to each epidemic of malaria. The ratio short time of incubation : prolonged time of incubation varied between 0.27 and 4.34.

The prolonged incubation was *extremely sensitive to chronological shifts in the time of infection.* An early summer epidemic supplied less numerous cases with prolonged incubation time than did an autumnal epidemic.

Prolonged incubation being dependent on light is considered evident.

Hibernation of malaria plasmodium did not take place in the mosquito with all probability — but in man.

The malaria was benign. No deaths occurred among about 4,000 cases including relapses. The disease differed in this respect from other epidemics of malaria in Finland in the nineteenth century.

The theory of the probable correlation between the plasmodium and the reticulo-endothelial system is described.

Literature.

Craig, Charles F.:The malarial fevers p. 510 in The malarial Departm. of the United states army in the world war Vol. IX 1938. — Craig, Charles F.: in Oxford medicine Vol. II p. 741. — Menck, W.: D. Tropenmed. Zschr. 1942: 46: 329. — Coggeshall, L. T.: Malaria in. Cecil, R.:

Declassified in Part - Sanitized Copy Approved for Release @ 50-Yr 2013/07/16 : CIA-RDP83-00423R000500280002-4

Declassified in Part - Sanitized Copy Approved for Release @ 50-Yr 2013/07/16 : CIA-RDP83-00423R000500280002-4

Textbook of Medicine. 1944. — Abramow, S.: Münch. med. Wschr. 1941: 88: 42 p. 1156. — Korteweg, P. C.: Z. Hyg. 110: 724—731. 1929. — Missirolli, A.: Riv. malariol. 11: 1—24. 1932. Ref. Kongresszbl. f. inn. Med. 67. — Sergent: Presse médical 1942. — Berkesy, L. v.: Wien. klin. Wschr. 1931, II: 1110—1112. — Sivén, V. O.: F. L. H. 49. 1907 and 54. 1912. — Palmén, J. A.: Duodecim 1900. — Renkonen, K. O.: Acta med. scand. 119: 261—275. 1944. — Schulemann, W.: D. med. Wschr. 1940: 66: nr 10 p. 253 and cited lit. — Schüpfer, W.: D. med. Wschr. 1941: 67: 1251. — Kikuth, W.: Zschr. f. Immunität u. exper. Ther. N. 104: 148—57. 1943. — Kikuth, W. & Mudrow, Lilly: D. med. Wschr. 1941: 67: 85, and 1942: 68: 42 p. 1024. — Reichenow, E. & Mudrow, Lilly: D. trop. Zschr. 1943. Bd 47, 288—99. — Raffaele: Riv. malariol 1934 and 1936 cit. Kikuth, D. med. Wschr. 1941. — Huff, C. G. & Coulston, F.: Trop. J. of infect. dis. v. 75. 231—49. 1944. — Wasiliewski, Th. W.: in Handbuch der ärztlichen Ehrfahrungen im Weltkriege. 1922. — Wilcken, H.: Klin. Wschr. 417—18. 24/25. 1943. — Moberg, Erik: Nord. med. 1939 p. 1727. — Shute, P. G.: Ref. Kongr. Zbl. f. inn. Med. 1942. — Sade, Georg: Arch. Schiffs- u. Tropenheilk. 42. 503—506. 1938. ref. Kongr. Zbl. inn. Med. — Tillich, Alfred: Münch. med Wschr. 1936. — Bradild, R. A.: Dtsch. med. Wschr. 1938. 787—788. Ref. Kongr. Zbl. 97. — Martini: E: Arch. Schiffs- und Tropenheilkunde 351. 577—583. 1931. Ref Kongr. Zbl. inn. Med. 1932. — Kolle, W. & Hetsch, H.: Die experimentelle Bakteriologie und die Infektionskrankheiten. Berlin & Wien 1929. — Schenz, T. D.: Arch. f. exper. Path. u. Pharm. v. 201. 1943. 502—19. — Siebert, H. B.: D. Tropenmed. Zschr. 1941: H 5. Ref. Nord. Med. 14. — Schilling, Claus: J. k. ärzt. Fortb. 21. H. 10. 47—53. Ref. Kongr. Zbl. inn. Med. — Correlati, A.: D. Tropenmed. Ztschr. Häft 19. Ref. Nord. med. Bd 14. — Sergent, E.: La presse médicale 1941: 49, 52, p. 649. — Sievers, R.: F. L. H. Bd 33, 1891, p. 563. — Hernberg, C. A. & Tuomala, A.: Acta med. scand. XX scand. kongr. int. med. 1947.

Stockholm 1947. Kungl. Boktr. P. A. Norstedt & Söner

Declassified in Part - Sanitized Copy Approved for Release @ 50-Yr 2013/07/16 : CIA-RDP83-00423R000500280002-4

Declassified in Part - Sanitized Copy Approved for Release @ 50-Yr 2013/07/16 : CIA-RDP83-00423R000500280002-4

Page Denied

Declassified in Part - Sanitized Copy Approved for Release @ 50-Yr 2013/07/16 : CIA-RDP83-00423R000500280002-4