

A STUDY of the CLINICAL FEATURES
and EPIDEMIOLOGY of so-called
MALAYAN TROPICAL or SCRUB TYPHUS ("K" form.)
and its relationship to other typhus-like fevers
in Malaya and elsewhere.

by

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INTRODUCTION.

The disease known as Tropical Typhus was first encountered in the Federated Malay States in 1924, when two cases of continued, undiagnosed fever, giving negative results with all other laboratory procedures, were found to yield positive results with the Weil-Felix reaction.

The disease was investigated by Fletcher and Lesslar, and by 1926 they had observed over one hundred further cases. They published an account of their investigations in 1925,¹ and again in 1926.^{2,3.}

They discovered that the disease existed in two forms, differing very little in their symptoms, and clinical course, but differing apparently in their epidemiology, and certainly in their serological reactions.

The first type which they called the urban form, they found to be almost exclusively confined in its incidence to towns, and while individuals in varying walks of life were attacked, a strikingly high proportion of these were engaged in various forms of trade, the number employed in the handling of foodstuffs being particularly great.

Examination of the blood sera of patients suffering from this form of the disease, demonstrated the presence of agglutinins for the ordinary indologenic strains of Bacillus proteus.X 19., such as No. 67, and the "Warsaw" strains of the national collection of type cultures, in high dilutions. At the same time it failed to agglutinate the anindologenic strain of Bacillus proteus.X 19., known as the "Kingsbury" strain. Since it was found that the most uniform results were obtained with the "Warsaw" strain they named this form of urban tropical typhus, the Warsaw or "W" form.

The second type of tropical typhus they called rural, or scrub typhus, since it was apparently confined entirely to districts outside the towns, and appeared further to be most prevalent in areas covered with a coarse grass or

lalang, abandoned mining, or agricultural lands which had been permitted to become overgrown, or in situations where low secondary jungle growth had sprung up.

The type of subject attacked differed also in great measure from that found in the urban form, the great majority of patients being outdoor workers of the cooly class. The few Europeans and better class Asiatic patients found to be suffering from this form of the disease were discovered to be individuals, who for some reason or another had recently resided in, or traversed areas of the type described, shortly before the onset of their illness.

The blood serum of such cases was found to give a positive reaction in high dilutions with the anindologenic, or Kingsbury strain of Bacillus proteus X.19. where-as negative, or in conclusive results were obtained with the "Warsaw" strain.

In consequence of this specific agglutination reaction, they named this type "Kingsbury," or "K" form of tropical typhus.

At this period little was known concerning the epidemiology of the disease, but in view of the large number of cases occurring among Punjabi bullock cart drivers, and milk vendors, and the occurrence of several cases amongst European soldiers encamped on waste land used for grazing purposes, they were inclined to agree with Megaw⁴ who had described a rather similar type of disease occurring in India, and had suggested ticks as the possible vectors.

In 1928, as a result of further investigations^{5,6} by Fletcher, Lewthwaite, and Lesslar, the distinction between the "W" and "K" forms was more clearly defined, and at the same time these two forms of tropical typhus were differentiated from tsutsugamushi disease, which has many points of resemblance, as well as some important ones of difference.

This investigation established the fact that

all these three diseases occurring in the Federated Malay States belong to the group of typhus like fevers.

The "W" form they considered resembled closely the endemic typhus, or Brill's disease of America, and the endemic typhus of Australia, in as much as it was an urban disease, appeared to attack principally the trading or shopkeeping class, had apparently a very similar clinical course, and gave a positive Weil-Felix reaction with the ordinary indologenic strains of B proteus X. 19.

On the other hand the "K" form they suggested might be closely allied to the disease described by Megaw in India. Its rural distribution was confirmed, and it was further observed that in several instances it occurred in association with tsutsugamushi disease, and both diseases appeared to have their greatest prevalence in the same type of country.

In addition to the differences already observed in the Weil-Felix reaction between the "W" and "K" forms, a further point of distinction was now noted. It was found that as in the case of Old World epidemic typhus exanthematicus, blood serum from "W" form cases was able to agglutinate Bacillus agglutinabilis U.2. described by Wilson in 1927,^{7.} albeit in rather lower dilutions than the "Warsaw strain of B. proteus X. 19.

Serum from "K" form cases on the other hand gave consistently negative results with B. agglutinabilis.

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Tsutsugamushi disease, in addition to having certain clinical differences, notably the presence of the initial ulcer and lymphadenitis, the more insidious onset, and the generally longer febrile period, less frequently gave a positive Weil-Felix reaction, and when present only in low dilutions.

When a reaction did occur it was invariably with the anindologenic or "Kingsbury" strain or B proteus X.19. thus

seeming to indicate a closer affinity to the "K" form than the "W" form, suggesting that scrub typhus, and tsutsugamushi disease are due to kindred viruses.

Work in the field had appeared to strongly incriminate a larval mite, Trombicula deliensis, as the vector of tsutsugamushi disease in the Federated Malay States, and the suggestion was now put forward, that since the epidemiology was so alike, it was very possible that the scrub typhus or "K" form was similarly carried by Trombiculae.

In the case of the "W" form of the disease no insect, or acarine vector had been discovered. Lice did not appear to play any important part in its dissemination.

in 1930 Lewthwaite⁹ published his observations of the clinical features and epidemiology of tropical typhus, based upon 164 cases occurring throughout the Federated Malay States during a period of a little over two years. He confirmed much of the previous work of Fletcher and others, and more clearly demonstrated the apparent close relationship of rats to the dissemination of the rural or "K" form, and its peculiarly focal distribution.

Later in the same year Lewthwaite¹⁰ recorded the results of experimental inoculation of various laboratory animals. Fletcher and Lesslar had attempted this previously with negative results, possibly because they were only able to obtain infective blood some considerable time after the onset of the disease.

Lewthwaite obtained blood between the fourth and eighth day of the disease. In the case of guinea-pigs his results were somewhat inconclusive. In only a small proportion of cases was he able to obtain any febrile reaction. Using brain emulsion from a rat which died eleven days after inoculation with infective human blood, he was able to infect

a guinea-pig, and with a subsequent brain emulsion from this guinea-pig he was successful in producing febrile reaction in four other guinea-pigs. A further attempt however to continue the strain failed.

The histological findings in the brain of one of these guinea-pigs appeared to resemble exactly those described in guinea-pigs infected with typhus exanthematicus. He was unable to find any scrotal swelling, or oedema or redness of the scrotum in any of the guinea-pigs inoculated and concluded that so far as tropical typhus was concerned, an animal more constantly susceptible must be found. His experiments further led him to conclude that no infection existed in a "forme inapparente" as described by Nicolle.

Further experiments were carried out with rats caught in the town of Kuala Lumpur, some distance from the endemic focus of the disease, with correspondingly inconclusive results. He concluded - "it is probable that the virus of tropical typhus is transmissible to rats by intra-peritoneal inoculation of human blood, but that successful infection is inconstant."

Of eleven rabbits inoculated with infective blood withdrawn from patients at the height of the fever two gave a positive Weil-Felix reaction with an alcoholised suspension of "K" proteus X.19 in a dilution of $\frac{1}{125}$ on the 31st and 32nd day after inoculation respectively, while the third gave a positive reaction in a dilution of $\frac{1}{50}$ with the "K" type on the 34th day. The "Warsaw" strain gave a negative result. All results were negative in the remaining eight rabbits. All these experiments were carried out with blood from patients suffering from the "K" form of tropical typhus. In view of the fact that the "W" form appears to resemble more closely serologically Brill's disease, Tabardillo, and typhus

exanthematicus, it is possible that more conclusive, and typical results would have been obtained had the blood from patients with the "W" form of the disease been used.

Anigstein^{11,12,} also in 1930, obtained very similar results. He found only 11% of inoculated guinea-pigs showing febrile reaction, and the temperature curves did not present the characteristics uniform curve of typhus exanthematicus.

Moreover he was unable to reproduce symptoms further than the fifth generation, using brain and blood emulsion. In a proportion of cases where no febrile reaction took place there was a marked loss of body weight.

In a few cases however he observed scrotal swellings similar to those described as occurring in Tabardillo^{13,} by Mooser in the endemic typhus of America by Maxcy,¹⁴ and typhus exanthematicus by Pinkerton.¹⁵

Using rats he only obtained a febrile reaction occasionally, but in a small number he observed the presence of redness and swelling of the scrotum.

The tunica vaginalis in the case of both guinea-pigs and rats with scrotal swelling was frequently found on post-mortem examination to be markedly injected, and microscopic examination of smears revealed micro-organisms in the form of slender spindle-shaped, gram negative bacilli or diplo bacilli situated extra -, or intra - cellularly. Minute coccal forms or bipolar staining cocco-bacilli were also seen within the protoplasm of the monocytes, the whole appearance being strikingly similar to that described by Mooser, Maxcy and Pinkerton. It was considered probable that these represented the etiological agent of the disease.

In a proportion of the inoculated rats he obtained positive Weil-Felix reactions against proteus X 19. "K" type

to titres of $\frac{1}{125}$ to $\frac{1}{250}$. In one instance he obtained a reaction to a titre of $\frac{1}{1000}$ 18 days after inoculation with brain emulsion from an infected guinea-pig, in a rat which had shown no febrile reaction, but had lost weight. In the case of two rats inoculated with a passage virus from an original "K" strain he obtained a positive reaction against the "W" strain to a titre of $\frac{1}{250}$.

He found that rabbits inoculated with either human or guinea-pig virus gave positive reactions with Proteus X 19 after two or three weeks, mostly of the "W" and "O" strains to titres of $\frac{1}{125}$ to $\frac{1}{150}$, but not so strongly as did the rats.

One observation of great significance was recorded. Blood from a human case of tropical typhus "K" type had been injected into a guinea-pig which reacted with fever. On the sixth day this animal was sacrificed, and the brain was emulsified and injected into a second guinea-pig. A brain emulsion from this latter animal, which had reacted with fever and some loss of weight, was injected into a rat. No febrile reaction eventuated but marked scrotal swelling developed, and large numbers of slender bacilli, and diplococci were demonstrated in smears from the tunica vaginalis. The serum of this rat agglutinated "W" and "O" strains of Proteus X 19, but failed to react with "K" strains. The brain of this rat was inoculated into another guinea-pig which reacted with scrotal swelling and typical microscopic findings were obtained.

Finally the brain of this guinea-pig was injected in to a human volunteer who developed mild fever lasting for ten days. The Weil-Felix reaction was positive with the "W" strain to a titre of $\frac{1}{500}$ and with "O" X 19 to $\frac{1}{125}$. After the lapse of a week the titre for the "W" strain had risen to

$\frac{I}{1000}$ but throughout no agglutination of the "K" strain was obtained.

This demonstrated that the fever was a result of the inoculation, and further strongly suggested that the serological variation of the virus which had already been observed experimentally, might take place in nature by passage through different animals. In this instance the transformation had apparently taken place in the rat and had been passed on in this form through the guinea-pig, to man.

Anigstein further isolated twenty three strains from the blood, six from the urine, and one from the brain of human tropical typhus cases, forty-four from experimental typhus in laboratory animals, and two from lice fed on patients. These were similar, and their most striking morphological characteristics was their pleomorphism. Three principal types were recognised, slender fusi-form bacilli, minute granular forms, and diphtheroid bacilli. Under certain circumstances a transformation of the bacilli into long wavy thread-like forms, which eventually broke down into minute cocci, or diplo-cocci was observed. All the cultures were gram negative.

Several of the culture proved to be serologically related to Proteus X 19. Some from rats, and guinea-pigs were agglutinated to $\frac{I}{16,000}$ against the Proteus X.19. rabbit immune sera. Among the human strains only one showed a serological relationship to Proteus X.19. namely its "smooth" variation.

Several of the human and rat strains were agglutinated by sera of the tropical typhus patients, as well as by the sera of infected rats to $\frac{I}{800}$.

Inoculation of guinea-pigs with human strains produced similar clinical and pathological conditions, as obtained by inoculation with human, or passage virus. Further X 19 agglutinins were produced in rabbits and rats, even when the culture used was not in itself agglutinable by the anti X 19 immune sera. From this evidence he concluded that there must be a close relationship between the cultivated strains, and the original virus of the tropical typhus from which it was obtained.

He prepared a prophylactic vaccine using cultures from experimentally infected rats which had given a strongly positive Weil-Felix reaction. One strain was isolated from a rat inoculated with blood from a tropical typhus patient, the other two were isolated from two rats inoculated with passage virus of different origin. Three hundred labourers in an endemic area received two inoculations at a week's interval of one hundred million, and four hundred million organisms respectively, seventy received one inoculation only, and three hundred acted as controls.

In studying the epidemiology of the disease lice (P.corporis) brought from Europe were fed on tropical typhus patients. Smears of the lice were made, and on examination Rickettsia-like micro-organisms of two forms, coccal, and bacillary were revealed, but in a low percentage and in small numbers only. Nevertheless the inoculation of an emulsion of these lice intra-peritoneally into guinea-pigs, though resulting in no febrile reaction, produced cachexia, and characteristic changes in the tunica vaginalis, while the brain lesions found on post-mortem examination corresponded to those of typhus exanthematicus.

The serum of a rat inoculated with an emulsion of lice which had fed upon a tropical typhus patient gave a Weil-Felix reaction, "K" form, to a titre of $\frac{1}{125}$, and a culture isolated from this rat was agglutinable by X 19 immune serum to a titre of $\frac{1}{800}$.

In later experiments many lice died during the second week of feeding, and smears of these showed masses of cocco-bacilli, so numerous as to resemble the appearance of culture. These could be likened morphologically to the organisms found in smears from the tunica vaginalis of infected guinea-pigs and rats.

The various morphological types of cultures were inoculated into lice. The fusi-form type were avirulent and did not multiply extensively. The coccal forms produced a heavy infection, and smears gave the appearance associated with Rickettsiae.

Lice were further inoculated with typical Proteus strains isolated from patients urine. A very heavy infection resulted, and the original bacillary proteus like culture appeared to have become transformed into bi-polar staining organisms, scarcely distinguishable from those found in lice which had fed on human patients, or had been inoculated with the Rickettsia-like cultures.

As these results were obtained under artificial laboratory conditions he did not consider it justifiable to draw conclusions there-from, as regards the transmission in nature or tropical typhus by the human louse.

In one case examination of smears of the gut of head lice from a tropical typhus patient revealed numerous Rickettsia-like bodies. A natural infection of the lice

could be inferred, but it is not likely that they function as carriers to any appreciable extent since their migratory habits are strictly limited.

In view of the possible role played by mites or ticks in the transmission of the disease, and the fact that the wild rat of Malaya harbours great numbers of larval Trombidid mites similar to those transmitting tsutsugamushi disease, systematic examinations of rats caught in the endemic area were carried out.

Out of eighty rats so examined, six were found to have scrotal swelling with haemorrhagic exudate, and injection of the tunica vaginalis. Smears from this tissue revealed micro-organisms, morphologically closely resembling those found in experimentally infected guinea pigs. In two rats the number of micro-organisms was so enormous as to give the appearance of a pure culture. The sera of these two rats agglutinated Proteus X 19 in dilutions up to $\frac{1}{250}$ and $\frac{1}{1000}$ respectively.

Further during the same year, 1930, Gater¹² carried out an examination of labourers on their return from work in the endemic area, and found a considerable number harbouring T.akumushi. This larval mite is the carrier of tsutsugamushi disease in Japan, but had rarely been found on the rat in Malaya. In view of the fact that there might be some other natural host for this mite, various wild animals were trapped in the neighbouring jungle. Examinations of these revealed the fact that T.deliensis is widely distributed, on squirrels, rats, "musang" and "plandok." This mite had already been strongly suspected of being the vector of tsutsugamushi disease in Malaya, and had been incriminated, in the apparently similar pseudo typhoid fever of Sumatra investigated by Walch¹⁶ in 1922.

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In 1931 further observations were made on tropical typhus, particularly the "K" form. It was noted that the endemic areas of the disease were spreading, and areas hitherto immune were now producing their quota of cases. This appeared to be coincident with a new form of cultivation adopted on rubber estates, whereby instead of "clean weeding" between the tree, leguminous cover crops were allowed to grow up to a depth of several inches, thus providing cover for rats and other rodents. The possibility of squirrels acting as reservoirs also attracted attention.

The disease still continued to be prevalent on oil palm estates in particular, and these were in every case found to be heavily infested with rats. Plentyful food supplies in the form of oil palm fruits attracting them in great numbers.

The results of the prophylactic vaccination carried out during 1930 were found to be disappointing. Out of 48 cases occurring since vaccination, 19 had been vaccinated, while 14 belonged to the unvaccinated control group. The death rate in each group was found to be the same, so that it could be concluded that any consequent immunity conferred was evanescent, and although the number of cases was small, the effect of vaccination on the case mortality rate was negligible.

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Lewthwaite using three guinea-pigs fed on a vitamin deficient diet, produced febrile reaction five to twelve days after inoculation with emulsions of brain, spleen and testicular washings from rats trapped in endemic tropical typhus areas. He was able to maintain passage strains for several generations, at the time of his report one having reached to the twelfth. In one hundred male guinea-pigs inoculated in the

course of these passages, 70% showed marked swelling, redness and oedema of the scrotum closely associated with febrile reaction. Testicular washings were found to be particularly virulent.

On reverting to guinea-pigs fed on ordinary diet, and using the same passage virus, the febrile reaction was more irregular, and in only a small proportion did scrotal swelling occur.

Post-mortem findings were in accordance with those reported by Anigstein,^{11, 12} "Mooser"¹³ Maxcy¹⁴ and Pinkerton¹⁵ ".

The typhus-like nature of the disease was further borne out by the effects of inoculation of passage virus from two guinea-pig strains, into thirty rabbits intra-peritoneally. In twelve cases agglutination titres ("O" type) varying from $\frac{1}{125}$ to $\frac{1}{825}$ were given using both "K" and "W" strains of Proteus X 19. In the case of one guinea-pig strain the significant agglutination was of the "K" type only. In the other guinea-pig strain, while four rabbits reacted with the "W" strains, in the case of a further two rabbits each inoculated at the same time with the same passage virus, agglutination was in one instance of the "K" strain, and in the other of the "W" strain. Reference has already been made to a similar occurrence observed by Anigstein in rats.

During the year under review (1931) further work has been done in connection with the Weil-Felix reaction. Experiments were carried out with a non-motile, non-spreading "O x K" strain forwarded to the Institute by Dr. Felix and as a result of these, it was introduced into the routine tests. The relative sensitivity of living and alcoholised emulsions was compared and the statement of Felix that cases of

tropical typhus may be missed by the non-inclusion of living emulsions, was confirmed.

A certain number of cases were reported in which the diagnosis of tropical typhus could be definitely excluded, but in which agglutination took place with living emulsions all of which were with one exception "K" or "O x K" strains. The maximum titre was $\frac{I}{220}$ while the majority were below $\frac{I}{150}$. In contrast to these, five cases were instanced where the diagnosis was undoubtedly one of tropical typhus on clinical grounds, but wherein the Weil-Felix reaction gave negative or low results.

Of six cases of tsutsugamushi disease investigated, four gave definitely positive Weil-Felix reactions with the "K" form of Proteus X.19. one to a titre of over $\frac{I}{2200}$, another to a titre of $\frac{I}{7000}$. Of the negative cases, one died before a further test could be performed, the titre of agglutination being $\frac{I}{85}$ "K" strain at the tenth day of the illness, whilst in the other case no serum could be obtained after the eleventh day.

These findings taken in conjunction with those of Nevin¹² who had reported in 1930, the presence of positive weil-Felix reactions with the "K" strain in two cases of tsutsugamushi disease to titres of $\frac{I}{1000}$ and $\frac{I}{500}$ respectively, would appear to modify the view advanced by Fletcher,⁶ and again by Lewthwaite,⁹ that the Weil-Felix reaction can be relied upon in the differential diagnosis between tsutsugamushi disease and the "K" form of tropical typhus.

The foregoing is a brief resume of the work carried out on tropical typhus as it occurs in the Federated Malay States so far as it appears in published accounts. Several of the points touched upon will be dealt with more fully at a later stage.

Much of the work reviewed has been confined to the laboratory, and apart from the earlier account by Fletcher, and the more recent contribution by Lewthwaite, very little appears to have been published concerning the symptomatology and clinical course of the disease.

An account will follow of a series of cases of the "K" form, or scrub typhus as it occurred on a group of rubber and oil palm estates in the State of Selanger, Federated Malay States, during a period of approximately two years.

In Part I it is proposed to deal with the clinical features of this series. Part II will be devoted to a consideration of the Etiology and Epidemiology of the disease. In Part III the relationship of tropical typhus of the scrub or "K" form, to other typhus-like fevers occurring in Malaya and elsewhere, will be discussed.

PART I.

The tropical typhus of Malaya has been described by Fletcher⁶ as "an acute, specific fever which begins rather suddenly with headache and vomiting, terminates by crisis or rapid lysis on about the fourteenth day. It is clinically indistinguishable from mild typhus fever and is characterised by a typhus like rash which appears on about the fifth day of the disease."

This clinical account is based upon observations made upon forty seven cases of tropical typhus, admitted to the group hospital serving a number of rubber and oil palm estates, situated in the coastal district of Selangor, between the months of April 1931 and April 1933.

The forty seven patients were all Tamils, a race of Southern Indians brought over to Malaya in large numbers, and employed as labourers, chiefly in the rubber plantations in the country. The labour force throughout the whole group of estates whose needs the hospital serves belongs to this race, but with two exceptions all the cases here reviewed were admitted from one or other of two estates only. This is a point of considerable epidemiological importance and will be referred to in more detail in Part II.

Consideration of age and sex incidence will also be deferred to the section dealing with epidemiology. Suffice it to say that age varied from fifteen years to fifty two years while females predominated.

Appendix "A" I has been drawn up for ease of reference and shows the most prominent signs and symptoms, and the frequency of their occurrence in the various cases. An analysis of these signs and symptoms has been made, and is given below. Subsequently a more detailed account of individual cases will be shown in Appendix A II,

Incubation Period. This has not been determined, and in the absence of a definitely established vector is likely to remain unknown. In the present series of cases, it was frequently found to be a matter of considerable difficulty to elicit a clear history of the onset, since the intelligence of the average Tamil labourer is of a low grade, and he is generally rather vague with regard to dates. The possibility therefore of obtaining any information with regard to the mode and date of infection may be dismissed as being remote in the extreme.

Lewthwaite (1930)⁹ instances a case of a European who developed the disease eleven days after a tour in the jungle, so that in this case the incubation period was not less than eleven days. Another European developed the urban type fourteen days after returning from a sea voyage. The incubation period in this instance therefore being certainly not more than fourteen days. Fletcher 1925¹ recorded a case of a patient suffering from the rural type, who had slept in a camp for one night only, three weeks before the onset, and the probability is that he became infected on that occasion.

From these facts the incubation period would appear to be in the vicinity of eleven to twenty one days. The incubation period of tsutsugamushi disease is stated by Fletcher (1927)⁸ to be five to twenty one days, and it is possible that tropical typhus has very similar limits.

Mode of Onset. In thirty four of the cases (83%), the onset was abrupt. The most frequent history was of headache, often intense, and fever generally preceded by a rigor. In about half the cases bilious vomiting occurred at, or soon after the onset. Almost every case complained of "pains all over the body." Less frequently there was giddiness. In a few instances pains in the joints were present. Three cases appeared to have had prodromal symptoms, in one headache and malaise for two days, in another headache and aching of limbs for four

days, in a third headache and aching of body for one day followed in each case by a rigor and the abrupt onset of fever. It is possible that in the second of these cases (Case No. 32) there was some degree of fever at an earlier date than stated by the patient, who was of rather low intelligence. In four further cases the onset was stated to be gradual, while in two no very definite history could be obtained.

Initial lesion. In view of the possibility of tsutsugamushi disease occurring in this district, each case was carefully examined for the typical ulcer of that disease. Frequently scars and abrasions were found on the feet and legs of the patients who work barefooted and barelegged, but nothing of a suspicious nature was observed at any time, nor could the moderate degree of glandular enlargement present in a proportion of cases, be mistaken for the definitely inflamed and tender bubo of tsutsugamushi.

Fever. This varied considerably, even in the uncomplicated cases and comparatively few corresponded to the characteristic curve described by Lewthwaite. Of thirty seven uncomplicated cases only nine could be described as conforming in any degree to his description. In these cases the temperature was moderately raised for the first few days, during the later half of the first week it became more elevated, being in the vicinity of 103°F . By the end of the first week or the beginning of the second it had attained the fastigium, ranging between 104°F and 105°F occasionally, even higher. It remained elevated for a further four or five days, until about the twelfth or thirteenth day, when it fell by quick lysis, or occasionally by crisis, to reach the vicinity of normal by the thirteenth or fourteenth day. Frequently a terminal rise of a degree or two degrees occurred on the following day, repeated again for a further day in a proportion of cases before defervescence was finally completed. Wide variations from this typical picture

were observed. In only 4% of cases could the fever be described as continuous. In 49% it was moderately remittent, while in 26% there were marked remissions. In a further 21% the fever was markedly remittent and intermittent, intermissions occurring occasionally during the first week, and more often towards the end of the second.

One case (No. 7) shewed an altogether atypical temperature curve. The patient was admitted on the fifth day of the disease. During the first three days in hospital the temperature was only slightly elevated, and in the mornings of the eighth and ninth days actually reached normal. In the afternoon of the ninth day however the temperature shot up to 103° , and climbed steadily to reach 105.8° by the twelfth day. At the end of the second week bronchitis set in and defervescence was not completed until the twentysecond day.

In a proportion of patients the temperature remained at a low level throughout, never exceeding 102° or 103° during their stay in hospital. The majority of these cases were mild but that this is not consistently the rule is proved by case No. 4, wherein the temperature rarely exceeded 103° during the whole course of the illness, but in which broncho-pneumonia supervened with a fatal termination.

The duration of the fever also varied even in uncomplicated cases within fairly wide limits. The shortest period appeared to be nine or ten days, but in four at least out of six cases whose fever terminated within this period, some doubt may be cast upon the actual date of onset.

Of thirty seven uncomplicated cases the maximum period of high temperature was seventeen days in three cases. Of the remainder in fourteen cases (38%), the duration was fourteen or fifteen days, while in twenty five (68%), it lay between thirteen and sixteen days.

The fall of the temperature was by crisis in four cases (11%), by rapid lysis in twenty four (65%), and by lysis in

nine (24%). In the four fatal cases, and the six complicated cases of the series the character and duration of the fever were altered, the change usually being discernible from about the middle of the second week. Case No. 4 died on the thirty first day, the temperature during the third week being markedly intermittent, and occasionally subnormal. Case No. 19 died on the twentieth day, and again the temperature of this patient shewed marked intermissions during the last four days. Case No. 42 died on the twelfth day, the temperature shewing marked remissions after reaching 106° on the 7th day. Case No. 44 died on the 10th day the temperature suddenly dropping to normal on the morning of that day from 104° , only to rise again to 105° immediately prior to death.

In the other six complicated cases, the duration was twenty one, twenty two, twenty three, twenty four, and two of thirty days respectively. In all the temperature showed marked irregularity in the later stages, consistent with the bronchopneumonia or bronchitis with which it was associated.

Rash. A rash was observed in thirty two cases, or 79% of the whole series. In the majority it was ill defined, and in the dark skinned Tamil its characteristics could only be discerned with considerable difficulty.

Typically it consisted of dusky macules and papules, frequently irregular both in shape and size, varying from approximately two to five millimetres in diameter, though exceptionally, particularly on the face, larger elements were perceived. The papules were only slightly raised, and somewhat flattened. In some cases the rash was of a rather morbilliform character, but was never profuse and had no suggestion of the crescentic arrangement associated with measles. Occasionally on looking closely into the skin a fine subcuticular mottling could be discerned. In suspected cases where the subject was more than usually dark skinned, a hitherto unobserved rash could

sometimes be detected by looking along, rather than into the skin, more particularly when viewed with the light falling obliquely upon the surface, and reflected therefrom to the eye of the observer. The rash faded on pressure, in one case only widely scattered petechiae were observed (Case 37) which persisted for some considerable time. In a further case (No. 46) irregular purpuric macules were present, most readily observed on the chest where the patient had large areas of leucoderma.

The eruption was most frequently seen on the trunk, and was generally first recognised over the scapular region. It is very possible that this was due to the greater ease with which one could pick up the papular elements on the comparatively stretched skin of this area, when viewed by reflected light. In all but four of the cases with rash, it was detected early on the upper part of the chest. In twenty seven of the cases it appeared over the lumbar region soon after its initial appearance, and at about the same time it was observed on the abdomen in twenty six of the cases. The face was affected in a variable degree in twenty three cases, particularly over the malar prominences, and the forehead. In this situation the eruption tended to be of a more blotchy and irregular character. It was less frequently observed on the limbs. In eleven cases it appeared on the thighs two or three days after the initial appearance; in five cases it was faintly seen on the backs of the legs over the gastrocnemius muscles, while in three cases only it was observed faintly on the arms, chiefly in the vicinity of the shoulders. In no case was the rash perceived on the soles of the feet or the palms of the hands. Of the sixteen cases in which the initial appearance of the rash was first seen in hospital, in one it appeared on the fourth day, in four on the fifth, in three on the sixth, in five on the seventh, in three on the

eighth and in one on the ninth day. The late appearance in the last four cases may quite easily be due to faulty observation. Of the twenty cases admitted with rash already present, from a consideration of the date of onset, it must have appeared by the third day at the latest in two cases, by the fourth day in one case, by the fifth day in two cases, by the sixth day in eight cases, by the seventh day in six, and by the eighth day in one. The rash then most commonly appeared about the sixth day of the illness. The fifth day has been described as the usual day of appearance by both Fletcher and Lewthwaite and since some of their observations were made on Europeans, and comparatively light skinned Sikhs, theirs is probably a more accurate description.

The rash generally appeared quickly, and was fully developed in two or three days. Fading began about the third or fourth day after its initial appearance, and the average duration appeared to be between six and seven days. The rash disappeared on the eleventh to thirteenth day of the disease in twenty seven cases out of thirty seven cases in which a rash was observed (73%). In one case (No. 37) faint staining persisted until the twentieth day. In a few instances the rash after commencing to fade showed a tendency to reappear with its original intensity before disappearing ultimately.

Headache. This was a prominent symptom in all but three of the cases (94%). It was generally present at the onset, and was often severe throughout the first week. It persisted in the majority of cases until the commencement of defervescence.

Giddiness. Some degree of giddiness occurred in twenty eight cases (60%). It was generally most marked at the height of the fever. In cases with frequent cough, high temperature, headache and deafness, it was, on occasion, a distressing feature. It occurred at the onset in a proportion of cases.

Mental Signs. Definite mental disturbance was present in thirty one cases (66%). In the majority of cases it manifested itself as a definite dulling of the intellect. It tended to appear towards the end of the first week. The patient became apathetic and drowsy and appeared to lose all interest in his condition and neighbours. Questions were answered more or less intelligently, but cerebration appeared to be slow, and it became increasingly difficult to retain his attention. When this was associated with deafness as it occasionally was, communication with the patient became practically impossible. In a proportion of cases this condition passed almost imperceptibly into one of quiet delirium, more marked as a rule at night. It was of a low muttering type, and it was possible to recall the patient in certain instances, to a sense of his surroundings. Other cases again, developed a more noisy type of delirium; they became increasingly restless, talking and shouting, and attempting to get up out of bed. One patient indeed evaded the attendant, left the ward, and was found wandering aimlessly in the hospital compound. Altogether delirium of greater or less degree occurred in fifteen patients (32%), generally sometime during the second week.

Insomnia was a troublesome feature in 34% of the cases and in 19% a peculiarly irritable frame of mind developed. The patient became difficult to manage; he was querulous and fretful, and appeared to resent the attentions of the staff. His sole desire apparently was to be left alone. In two patients an exaggerated anxiety as to their welfare and progress manifested itself, and their facial expression was apprehensive and fearful, rather an unusual feature in the Tamil.

Knee jerks.— were normal in 70% of cases. They were exaggerated in one case, and absent in another. In the remaining 25.5% they were diminished.

Deafness. Present in thirty-five cases (76%) (excluding one case of congenital deafness) at one time or another, but most commonly in the second week, it exhibited remarkable variations and remissions. Thus a patient might be unaffected during the first week, rapidly develop almost total deafness for a day or two at the beginning of the second, regain normal hearing for a further day or two, only to relapse with partial deafness during the last few days of fever, recovering finally at the end of defervescence. Deafness was severe in 17% of cases, moderately severe in 24% and slight, and frequently evanescent in 35%.

Pain. This was present in practically every case at the onset (94%). In the great majority of cases this was described as being "all over the body". Severe backache was present in 13% of cases and in 15% there was a complaint of pain and stiffness at the back of the neck. Pain in the joints, usually knees and ankles, occasionally shoulders and wrists, were complained of in 20% of cases. Pain in the chest was present in 45% of cases, and was no doubt associated with the pulmonary congestion so frequently present.

A peculiar feature occurring in 62% of cases was tenderness on deep pressure of the calf muscles. This was severe in 28%, moderate in 23%, and slight, and only on deep pressure in 11%. It was generally bilateral, but occasionally occurred in one leg only, or first in one leg and then in the other. It was most commonly encountered towards the end of the first week, and generally passed off before defervescence was complete.

Eye Signs. In thirty three cases (70%), a suffusion of the conjunctivae was observed. It was rarely marked and the degree of injection was never extreme excepting in case No. 46. There was little or no increase in secretion, but this mild suffusion frequently proved a valuable aid in clinching the diagnosis in early cases. It was almost always accompanied

by a varying degree of photophobia. In one case (No. 13) dimness of vision was complained of from the twelfth to the sixteenth day. In another case (No. 17), severe pains in both eyes, increased by movement was complained of from the tenth to the sixteenth days.

Cough. In 81% of cases cough was present. As a rule it was short and dry, and particularly troublesome at night. It was rarely distressing except in the complicated cases. In one fatal case (No. 4) frequent paroxysms occasioned great discomfort and prostration during the later part of the illness.

Respiration. A notable feature was the acceleration of respiration, even in cases in which no lung signs could be discovered throughout. Thus in twenty such cases the respiration rate ranged between twenty and forty during the period of high temperature, and in five it occasionally became as frequent as fifty or even sixty.

Lung signs. These were present in twenty eight cases (60%). They were rarely sufficient to account for the increase in respiration rate, consisting for the most part of occasional scattered ronchi and moist rales, or fine crepitations, most frequently basal. They were in evidence generally during the second week. In seven cases (15%) broncho-pneumonia developed towards the end of the second week and in a further three cases (6%), bronchitis supervened about the same time.

Pulse. The most notable feature was a slowness relative to the degree of temperature. This occurred in thirty one cases (66%), and was well marked in twelve. Even in the cases with lung complications it was observed that the pulse rate was relatively slow until just about the period when defervescence would normally have taken place. The quickening of the pulse rate relative to the temperature immediately aroused the suspicion that complications had taken place. In four cases

only was the pulse rate rapid throughout. In the remaining cases the pulse-temperature ratio was normal.

The tension tended to be rather low towards the end of the first week, in some instances becoming definitely dirotic. In cases with broncho-pneumonia irregularity was observed at times, becoming marked towards the end in the four which terminated fatally.

Cardiac signs. In the uncomplicated cases there was little to remark. Occasionally during the second week, there was prolongation and muffling of the first sound. In the four cases which ended fatally, shortly before death indications of impending cardiac failure declared themselves, and signs of myocarditis with some degree of dilatation were observed. Irregularity, and occasional extra-systoles were present in several of the remaining severe cases.

Tongue. In the majority of cases (95%) the tongue was coated with a moist, brownish white fur. In the later stages in case 4, the tongue became dry and brown, sordes formed about the teeth and gums, the lips were dry and cracked, and there was severe thirst.

Vomiting. This was a feature in twenty cases (43%). It was most often present at the onset, was rarely troublesome, and generally bilious in character. On two occasions during the second week, in Case 21, an attack of bilious vomiting was followed by slight haematemesis.

Diarrhoea. This occurred in twenty one cases (45%) generally during the second week. It was usually moderate and rarely troublesome. In one fatal case (No. 19) it was severe and persistent for sometime before death.

Tympanites. This was present in seven cases (15%). It occurred generally in the second week at the height of the fever, and was accompanied in one or two cases by diffuse pain. It yielded readily to treatment as a rule.

Lymphatic glands. Enlargement of lymphatic glands was observed in thirty cases (64%). In five cases both inguinal and axillary glands were affected; in the remainder the inguinal glands only. In about half of the latter the affection was unilateral. In a few instances there was a definite complaint of pain, but in the majority there was a varying degree of tenderness only, usually slight. In no case did the degree of glandular enlargement approach that associated with tsutsugamushi disease, and bubo formation was never encountered.

Spleen. In twelve cases (26%) the spleen was palpable. Of these seven gave a history of one or more previous attacks of malaria, while one actually was suffering from malaria on admission. In view of these findings, splenic enlargement, to a degree at least which renders it palpable below the costal margin, cannot be considered as a notable feature of this disease. The high percentage with splenic enlargement reported by Lewthwaite (88%), can almost certainly be attributed to antecedent malaria. High spleen rates are at times encountered even in carefully supervised European estates in Malaya, while in the less well controlled areas, rates of 50% or over may prevail throughout the general population.

Urine. Albumen was present in twenty one cases (45%). In all but two of these it was never more than a trace. In one fatal case (No. 4), albumen was present as a heavy deposit. It was associated with oedema of the feet and legs and puffiness of the face, all of which were present on admission, and persistent until death. The other case (No. 5) developed a moderate albuminuria in the middle of the third week, with oedema of feet and legs. This all cleared up before discharge on the thirty fifth day.

Oedema. In addition to the foregoing, oedema of feet and legs appeared in four other cases. They were all anaemic (Haemoglobin rates of 55%, 45% and two of 25% respectively) and both the latter cases were suffering from ankylostomiasis.

Sore Throat. This was not a prominent symptom. In five cases (11%), there was a moderate degree of pharyngeal congestion with a certain amount of associated catarrh of the naso-pharynx, and a complaint of sore throat.

Degree of Toxaemia. In twelve cases (26%), this could be described as severe, and was generally well marked by the beginning of the second week. In one of these indeed (case No. 42) it was plague-like. In thirty three cases (70%), it was moderately severe. In the great majority of cases its disappearance was coincident with defervescence. In two cases it was slight throughout.

Weil-Felix Reaction. In every case blood serum was sent to the Institute for Medical Research, Kuala Lumpur for the Weil-Felix and Widal reactions. Owing to distance, and consequent difficulties in transport, it was not practicable to have these tests carried out as a routine measure more than once for each case, with the exception of a few in which the initial result was suggestive but not diagnostic. For this reason the blood was not generally taken until after the tenth day of disease, to ensure so far as possible a conclusive result. In view of this restriction it was impossible to study the agglutination curve in individual cases.

In thirty nine cases agglutination was obtained in dilutions of 1/200 or higher, thus conforming to the standard laid down by Fletcher³ as establishing a positive diagnosis on serological grounds. In four of the remaining cases agglutination was obtained in a titre of 1/125, which in the later techniques adopted by the Institute is given by Lewthwaite⁹ as a diagnostic titre in the presence of definite clinical signs. Of the four cases still remaining, one, No. 8, agglutinated in a titre of between 1/35 and 1/110 on the fifty third day after the onset, when the patient had actually been discharged. An unfortunate series of accidents, (tubes broken in transport, contaminated sera and lysed specimens), had

rendered it impossible to carry out the test at an earlier date. Clinically however this case was extremely typical, developed broncho-pneumonia as a complication, and was almost certainly tropical typhus. Case No. 5 with a Weil Felix reaction of 1/85 on the eighteenth day, and a negative reaction on the 30th day, conformed so closely to the clinical picture in every respect, with regard to symptoms, temperature curve, appearance of rash, and the development of bronchitis as a complication, that it has been retained in the series. Similar cases occurring elsewhere had been reported on, by the Institute for Medical Research.¹⁷ So far as the fatal case No. 42 was concerned the first serum taken was found to be contaminated and death supervened before a second specimen could be obtained. A further fatal case (No. 44) succumbed on the 10th day before a blood specimen had been withdrawn. Both these cases, however were almost certainly tropical typhus.

Widal Reaction. In twenty five cases this was negative, while in a further thirteen it was of low titre. In cases 42 and 44 no test was carried out. Of the remaining seven cases, in No. 20 the patient had had previous T.A.B. inoculations in India. Cases 21, 22 and 30 were suspected of being enteric carriers. Cultures of faeces and urine in each of these cases were negative. In view of the high titre of the Weil-Felix reaction in cases 3, 11, and 23, and the definite clinical picture, the accompanying high titre for Typhosus "H" agglutinins is most probably a heterologous reaction similar to that described by Wilson (1927)⁷, and Shattuck (1922)²⁰, in typhus exanthematicus. This is further borne out by the Typhosus "O" reduced titre reading, which in the few instances it was present invariably was higher in the first test than in the second; even in cases where the titre for "H" agglutinins was higher in the second than in the first. Cases No. 21, and 22 are good examples of this.

Blood Examination. The routine examination of blood revealed the presence of malarial parasites in five cases, viz. No. 23, 28, 37, 40, and 46. In the first of these benign tertian parasites were found, in the remainder sub-tertian. The three first cases received Sinton's modified alkaline quinine and Plasmoguin treatment for the first seven days in hospital, while the fourth and fifth cases received Atebrin and Plasmoguin for the first five days. There is no doubt that in these four cases the high range, and remittent or intermittent character of the temperature during the first two or three days in hospital was influenced to a great extent by the presence of malaria. In the case of No. 40, at least it is quite possible that the actual onset of tropical typhus was masked by the pre-existing malaria.

It was not possible to carry out blood counts in every case. In all but one of those examined leucocytes were found to be within normal limits, the lowest count being 5,000 and the highest 10,000 per cubic m.m. In certain of these cases a slight increase in lymphocytes was present. The exceptional case was No. 19, in which broncho-pneumonia supervened. A leucocyte count carried out on the seventeenth day showed a total leucocytes 15,000 with a slight increase both relative and absolute of polymorphoneuclears. It may be taken that nothing of any significance is revealed by a blood count.

Complications. These occurred in ten cases of the series (21%) In seven cases broncho-pneumonia developed about the middle or towards the end of the second week. In three cases, an acute bronchitis supervened about the same time. The febrile period was prolonged, and all the cases were for a time critically ill. Four cases of broncho-pneumonia had a fatal termination.

One case No. 17, in addition to broncho-pneumonia, also developed parotitis, the right parotid gland becoming swollen and tender on the twentieth day of illness. Suppuration did not take place and it subsided by the twenty sixth day. It was accompanied by pain in the right ear but examination of the external meatus and tympanic membrane revealed nothing abnormal and there was no discharge. The pain coincided exactly with the period of parotid involvement, and was ascribed to that cause. The patient was discharged thirty nine days after the onset of the illness. Two months later however, she was re-admitted with right-sided mastoiditis, which was relieved by operation. There seems to be a distinct possibility that this might well be a remote sequel of the original disease. This case was also remarkable for the intense pain on eye movements already mentioned under "eye signs".

Thrombosis,.- of the saphenous veins mentioned by Lewthwaite⁹ was not encountered in this series. However in 1929 it was observed in a European patient suffering from the "K" form of tropical typhus, who was admitted to the Government Hospital, Seremban, Federated Malay States, on the second day of disease. It appeared at the beginning of the third week of illness, the internal saphenous veins of both sides being affected. It was never severe and had commenced to subside before the patient's death on the seventeenth day. Tympanites was a distressing feature in this patient. Daily retention alternating with nocturnal incontinence of urine appeared in the second week. Insomnia and mental torpor with occasional quiet delirium were marked and broncho-pneumonia supervening about the middle of the second week finally brought about a fatal issue.

Clinical Course. During the first few days of the disease the patient, as a general rule, cannot be considered to be

very seriously ill. Apart from the sudden onset, the frequent headache, occasional vomiting perhaps, the presence of a short dry cough, mild suffusion of the conjunctivae, and slight enlargement of the lymphatic glands, all of which may not be present in every case, there is little to note.

Towards the end of the first week, however, more definite symptoms manifest themselves. There may be calf tenderness, possibly pain in the back or neck, while an indistinct rash can often be discerned, usually with difficulty in the case of the dark skinned Tamil, scattered sparsely over the scapular region, or indistinctly on the cheeks and forehead.

Soon after the appearance of this eruption the signs and symptoms become progressively more urgent, and by the beginning of the second week the patient has embarked upon the most critical period of the disease. Temperature is high, ranging between 103° and 105° ; stupor and apathy may be strongly in evidence; deafness is frequently a prominent feature; prostration of greater or less degree is commonly present, while giddiness may be an added embarrassment to the patient. Respirations, rather hurried from the onset tend to become still further accelerated; cough may be frequent and troublesome, and scattered rhonchi and moist rales can often be detected at both bases. Moderate diarrhoea and tympanites may contribute still further to the patient's distress. With the continuance of the fever mental signs become more pronounced, insomnia and irritability, or perhaps delirium of a muttering, or at times a violent type are manifest; the pulse relatively slow for the degree of the temperature, is of low tension, or definitely dicrotic, and grave doubt concerning the ultimate issue must often arise. Towards the end of the second week, however, a change takes place, often with dramatic suddenness. The temperature falls,

occasionally by crisis, more frequently by rapid lysis, and coincident with this decline of fever the urgency of the symptoms abates with remarkable rapidity. The mental condition improves, pulmonary congestion clears, appetite returns, refreshing sleep is obtained, and in a further week the patient is generally fit to be discharged.

The foregoing constitutes the very characteristic syndrome of the uncomplicated disease. In a proportion of cases the disease runs a milder course throughout, prostration is less extreme, mental signs are slight or absent, and defervescence is complete in ten or twelve days.

In still others toxæmia is an early and outstanding feature, defervescence is delayed until the sixteenth or seventeenth day, and some degree of mental dulness, prostration and occasionally deafness, persist for a day or two after the decline of fever, but even in these cases convalescence once established, is usually rapid. With the onset of serious lung involvement, towards the middle or end of the second week however a much more serious view must be taken of the probable outcome. Temperature tends to become markedly remittent or intermittent, and prostration may be extreme. The continuance of marked delirium, the onset of tremors and subsultus, incontinence of urine and faeces, and the appearance of signs of cardiac insufficiency are matters for grave concern. Even in such cases, once the disease has run its course, convalescence is generally uneventful, though delayed on occasion by a varying degree of asthenia.

Treatment. No attempt was made at isolation and the patients were treated in the general ward. This procedure appeared to be perfectly justified as there was no evidence that direct infection could take place, and no subsequent case was ever traced to contact with a hospital patient.

There was no specific treatment, but in view of the frequency with which signs of congestion of the lung, with

cough and pain in the chest were encountered, a stimulating expectorant mixture containing ammonium carbonate, vinum ipecachuana, and strychnine was administered from the onset. In some cases with distressing, frequent, short dry cough, with few or no lung signs, tincture camphor co. was added. Aspirin, phenacetin and caffenin powders were given for relief of the severe headache. Insomnia, and delirium were controlled with paraldehyde or chloral hydras.

In the second week with the onset of signs of cardiac insufficiency, digitalis was frequently resorted to, and in the cases with marked cardiac irregularity and low tension pulse, camphor, strophanthin, and adrenalin injections were given.

Diarrhoea was rarely sufficiently severe to require special measures. Tympanites was generally relieved by an injection of pituitrin on one or two occasions, the application of turpentine stupes, and the administration of turpentine enemata.

Injections of "Omnadin" 2 c.c. daily were tried in several patients, but it is doubtful if they had any effect upon the course of the disease.

Cases with high fever, insomnia, restlessness and headache, were often afforded considerable relief by tepid sponging. The impression gained was that more intensive hydrotherapy would be beneficial, but in an estate hospital of this type, with limited facilities, this was not practicable.

The injection of convalescent serum would appear to be a rational procedure. It was not attempted in this series apart from the last two cases, as it was first taken into consideration only when the cases were occurring at rather wide intervals of time, so that direct inoculation from convalescent to patient would rarely have been practicable. Moreover a considerable number of Tamils are anaemic to a

greater or less degree, and it is doubtful whether the withdrawal of any considerable quantity of blood from such subjects, convalescing from a severe illness would be justifiable or not. It is always advisable to have a preliminary Wasserman Reaction carried out before transferring serum from one patient to another, and more particularly so where the Asiatic is concerned. The lack of a suitable laboratory wherein this might be effected, with facilities for the sterilising and preserving of sera was an additional handicap. The risk from a latent malaria infection is also considerable.

Case No. 45 proved to be a young unmarried female of 15 years of age, with no signs of congenital disease, of healthy appearance, and with no history of previous malaria. Her blood serum gave a positive Weil Felix reaction to a titre of 1/420 on the sixteenth day from the onset of the disease.

Thirty days after the onset in this patient, a further case (No.46) of suspected tropical typhus was admitted to hospital. It was considered in view of the foregoing facts that this was a favourable opportunity to utilise serum obtained directly from the convalescent on the fresh case.

The patient, a male aged 28 years, had a moderately severe attack. There was a blotchy, irregular, purpura-like rash, well marked on the upper part of the chest where he had an extensive area of leucoderma, and he had an intense injection of both conjunctivae, giving the appearance of an actual subconjunctival haemorrhage, spreading in a flame-shaped fashion from the outer canthi of both eyes. Insomnia was a prominent feature, and on the seventh and eighth days of the disease, he developed a noisy delirium, alternating with a low muttering type. The signs and symptoms all seemed to indicate that he would be critically ill during the second week.

On the morning of the ninth day 10 c.c. of fresh convalescent serum from case No. 45, made up with a 1 in 40 solution of phenol to form a .5% solution of phenol, was injected deeply into the gluteal muscles. The effect appeared to be encouraging. The temperature, which during the previous afternoon had risen to 103°, was only slightly in excess of 100° on the afternoon following the injection. On the next day it never exceeded 100° and on two subsequent days it was just over 99°. Thereafter it was normal. The febrile period lasted altogether twelve days, but only for the first eight of these could the temperature be described as high. At the same time the patient's general condition improved considerably. No further delirium occurred, headache and general muscular pain became much less urgent, and the patient slept well. Recovery was rapid and uneventful. A second injection was impossible, as the convalescent girl was removed by her parents. The diagnosis of tropical typhus was confirmed serologically, a blood specimen taken on the fifteenth day after the onset giving a positive Weil-Felix reaction to a titre of 1/560.

Case No. 47 was admitted twenty-two days after the onset of the disease in the previous patient. There was a history of three days illness with abrupt onset, headache, and aching of the body. A rash was present on admission. Deafness and headache were severe. Insomnia was troublesome, and on the fifth day slight delirium developed. This increased on the sixth day, the patient became noisy, truculent, and persisted in attempting to leave the ward. On the morning of the seventh day 10.c.c. of convalescent serum obtained from Case No. 46, prepared with phenol as on the previous occasion, were injected intra-muscularly. The patient was delirious again that evening, and the temperature was 102°. On the following morning a further 10.c.c. were injected. In the afternoon the temperature rose to 102.4°, but that evening

the patient was rational, had less headache and deafness, and obtained a good night's sleep. The next day the temperature rose to only slightly over 100°, and on the following day, (the tenth from the onset,) was never above 99°. Subsequently it remained normal. The patient improved rapidly, and made an uneventful recovery. The diagnosis was confirmed serologically on the eleventh day, a positive Weil-Felix reaction being obtained to a titre of 1/400.

It might be legitimately contended that since the febrile period was apparently only nine days in two cases, and ten days in three cases, none of which had received serum treatment, little significance can be attached to the fact that in these two cases the period of pyrexia was only twelve and ten days respectively. However the five earlier cases had less urgent signs and symptoms, and in none were mental signs apparent. Experience seems to demonstrate that delirium occurring about the end of the first week is an indication that the illness will be severe, and that pyrexia will be present for at least fourteen or fifteen days.

While then it is impossible to be dogmatic on the slender data provided by two cases, the results would seem to be encouraging, and to invite further investigation along the same lines. Cautiously increased doses, and earlier administration may yield more positive results. In a larger hospital, treating a greater number of cases, and with laboratory facilities easily available, sera might well be collected from convalescents, when the Weil Felix reaction in each case was at the peak of the agglutination curve, tested for the Wasserman reaction, pooled, filtered, preserved, and stored ready for immediate use should the occasion arise.

Convalescence. In the great majority of uncomplicated cases this was often remarkably rapid. Patients who only a week or ten days previously had been gravely ill, stuporose, and

profoundly toxæmic, were frequently found to be fit for discharge. Numbers of these cases were discharged from hospital between the twentieth and thirtieth day after the onset. Of the uncomplicated cases only three had a lengthy convalescence. In one of these (case 28) there was a moderate degree of asthenia following defervescence. In this instance however, a history was given of a considerable amount of malaria in the past, while on admission parasites were found in the blood, and the haemoglobin rate was barely 55%.

Another case (No. 39) was in poor physical condition, gave a history strongly suggestive of previous dysentery, and during convalescence actually developed an attack of amoebic dysentery, necessitating a twelve day course of emetin. The remaining case (No. 40) was admitted with subtertian malaria and had a haemoglobin rate of 25%. She was found to be suffering from ankylostomiasis, and during convalescence was given treatment for this condition, and for the anaemia.

Mortality Rate. In this series of cases there were four deaths, giving a case mortality of 8.5%. This figure is somewhat higher than that given by Fletcher (1929)⁶. In the series of cases reported upon by Lewthwaite⁹ out of one hundred and sixty four patients there were eleven deaths, giving a case mortality rate of 6.7%. He is inclined to think that in one of the focal areas described by him the virulence is increasing, the death rates being in three successive years 4%, 11% and 14% respectively, but he admits that the figures of incidence are rather low to permit one to be dogmatic on this point.

It will be seen therefore that the death rate approximates fairly closely to that of typhus exanthematicus in inter-epidemic periods, or even in the milder epidemics such as the Russian epidemic of 1919-1922, when according to Maxcy⁸ the death rate was between 5% and 7%.

Of the four fatal cases, one was a male aged thirty eight years, two were females aged twenty five years and the fourth was a female aged twenty years. Since this disease almost invariably attacks workers, and since the Tamil labourer generally returns to India before old age, it is difficult to come to any conclusion as to the relative morbidity in differing age groups. In Lewthwaite's series of cases, out of twenty to twenty five patients below the age of eighteen there were two deaths, while out of ten to fifteen patients over forty years, two died.

Morbid Anatomy. Post mortem examinations of the four fatal cases were not obtained.

Lewthwaite (1930)⁹ however, carried out examinations of seven fatal cases, and his findings are summarised below:-

Naked eye examination gave no one constant feature that could be regarded as peculiar to tropical typhus.

Lungs. In all seven cases bi-lateral congestion and oedema of the lungs were found. These findings were marked in six cases. In all small punctiform, subpleural haemorrhages were present, and in two there were signs of broncho-pneumonia.

Trachea. Blood stained mucus covered the mucous membrane in three cases.

Spleen. This was small in one case, enlarged in all the others. Most of them had probably suffered from one or more attacks of malaria. In four cases the spleen was diffluent, as in an acute septic spleen. Subcapsular haemorrhages were present in one case.

Lymphatic Glands. Enlargement was insignificant in three, considerable in two, and marked in two cases. The glands principally affected were, those along the course of the iliac arteries, the para-vertebral in the lumbar region, and the mediastinal.

Liver. In four subjects there was some enlargement, in three fatty change, and in two punctiform haemorrhages on the surface.

Kidney. Minute haemorrhages occurred on the surface of the renal pelvis, in one case. Apart from occasional cloudy swelling and congestion there was nothing note-worthy in the others.

Testis. In one case only there was injection.

Intestinal Tract. No morbid changes were observed.

Heart. In one case minute haemorrhages were visible beneath the epicardium, and on the papillary muscles in another. Nothing else noteworthy was observed.

Brain. Injection of the surface vessels was noted in five cases, a glazed appearance of the surface in two, and a marked increase of cerebro-spinal fluid in two.

The most noteworthy histological changes which he observed in sections of the cerebral cortex were:-

(1) A slight but definite perivascular infiltration of the smaller pre-capillaries of the brain, with mononeuclear cells.

(2) The presence within the walls of these vessels of minute diplococcal forms, usually within swollen endothelial cells, but occasionally extra-cellularly. In many instances they were arranged in clumps. With Giemsa they stained dark blue, though exceptionally there was a purplish tinge.

(3) The occurrence of coarse greenish-blue pigment in the walls of these vessels.

(4) The occurrence of diplococcal forms similar to those noted in the walls of the infiltrated vessels, in the large pyramidal cells of the cerebral cortex.

These findings correspond very closely with those described by Stevenson and Balfour 1921¹⁹, in tissues from cases of typhus exanthematicas examined by them.

They stress the point that typhus is fundamentally a systematic disease of the smaller arterioles and capillaries, and that the vessel changes are not limited to the skin, but occur in all viscera. The vessels of the brain and upper spinal cord appear to be specially liable to affection, and they have been described as a particularly striking and constant feature, a single layer of mononuclear leucocytes entirely surrounding the smaller brain vessels. The changes are vascular and perivascular, with swollen endothelial cells, and the presence of diplococcal forms, staining dark blue with Giemsa, and often occurring in clumps in the so called typhus nodule.

This arteriolitis with resulting irritation, stenosis and thrombosis can account for all the principal symptoms - the nature of the rash, gangrene, and the profound nervous manifestations.

That similar morbid changes take place in tropical typhus, though probably to a lesser degree, would appear to be the case on a consideration of Lewthwaite's findings. It is possible that the slowness of the pulse, and the quickening of the respiration rate in the absence of urgent lung signs, which occurs in a large proportion of cases is a manifestation of nervous irritation of central origin.

Prognosis. In the absence of complications this would appear to be reasonable good. The majority of patients in the series described were not of a particularly robust type, but nevertheless no uncomplicated case had a fatal termination.

The onset of acute bronchitis, or broncho-pneumonia however, must be looked upon as of grave prognostic import. Of ten such cases four or 40% died. Profound nervous symptoms and delirium with marked prostration and the occurrence of incontinence of urine and faeces, would also engender a very guarded prognosis. In patients with any marked degree of cardiac insufficiency, or those suffering from chronic diseases

of the chest, the ultimate issue must necessarily be in doubt from the onset, and such cases can only be viewed with grave concern.

Differential Diagnosis. The diseases in Malaya which in their early stages may be confused with tropical typhus are four in number - viz:- Measles, leptospirosis, the enteric group of fevers, and tsutsugamushi disease.

Measles. Difficulty might arise in the early stages of both diseases particularly in the type of patient under review, who so often cannot give a very clear history of onset, and frequently only presents himself for treatment when the disease is well established. Thus a patient admitted on or about the third day of either disease might quite easily show very similar symptoms, viz:- headache, conjunctival injection, cough, and a moderate degree of temperature. The rash also might appear on or about the same day of illness, and further difficulty may arise in the case of a patient presenting himself with a rash already developed, as in so many cases of this series. However on careful consideration of the various points, these difficulties are more apparent than real. Thus the conjunctivae suffusion of tropical typhus is seldom so marked as the conjunctivitis of measles, and while there may be some catarrh, there is never the definite coryza of the former disease. The rash of tropical typhus while at times of a somewhat morbilliform character, is never so profuse, is much more discrete, shows no tendency to coalesce, does not have the crescentic appearance, is never seen in the mouth, has macular as well as papular elements, in a proportion of cases indeed, macules preponderating, may be associated with subcuticular mottling, and is confined chiefly to the trunk, whilst finally nothing resembling "Koplik's spots" is to be observed. At the end of the first week in uncomplicated cases the difficulty is over, the measles case is embarking upon convalescence, the

tropical typhus case is entering the period of greatest prostration. There might conceivably be some difficulty with regard to measles complicated by broncho-pneumonia, but in such a case the Weil-Felix reaction from the tenth day of the disease onward should prove of great diagnostic value.

Leptospirosis. There might be considerable difficulty in the early stages - calf tenderness and pain in the neck muscles are present in tropical typhus with sufficient frequency to render them of doubtful diagnostic value, though the calf tenderness is rarely so severe as in leptospirosis. In the latter disease also conjunctivitis is generally much more marked than in tropical typhus. The appearance of jaundice on the third day and the presence of bile pigments in the urine in leptospirosis, are valuable aids to diagnosis. Rash in the latter disease is frequently absent, but when it appears it is generally brighter in colour than that of tropical typhus, more regular, and more profuse. The febrile period terminates earlier the temperature usually falling by lysis by about the tenth day.

The experimental reproduction of the disease in guinea pigs by intra peritoneal inoculation of a patient's blood taken in the first few days, or of his urine after the tenth day will definitely establish the diagnosis.

Enteric Fever. The more insidious onset, and the less rapid development should serve to differentiate this disease. Fletcher defined the difference admirably when he wrote that in tropical typhus - "by the seventh or eighth day the patient's condition is more like that of a man in the third week of typhoid than in the first."

Tsutsugamushi disease. This closely allied disease may give rise to considerable difficulty. Clinically the one may simulate the other with remarkable fidelity. In tsutsugamushi disease the onset is generally taken to be more gradual with

one or two days prodromal symptoms, but this can also occur in tropical typhus, and in the present series a definite history of abrupt onset was not always obtained. On the other hand the onset in tsutsugamushi disease may occasionally be abrupt. Such a case was reported by Nevin¹² in 1930.

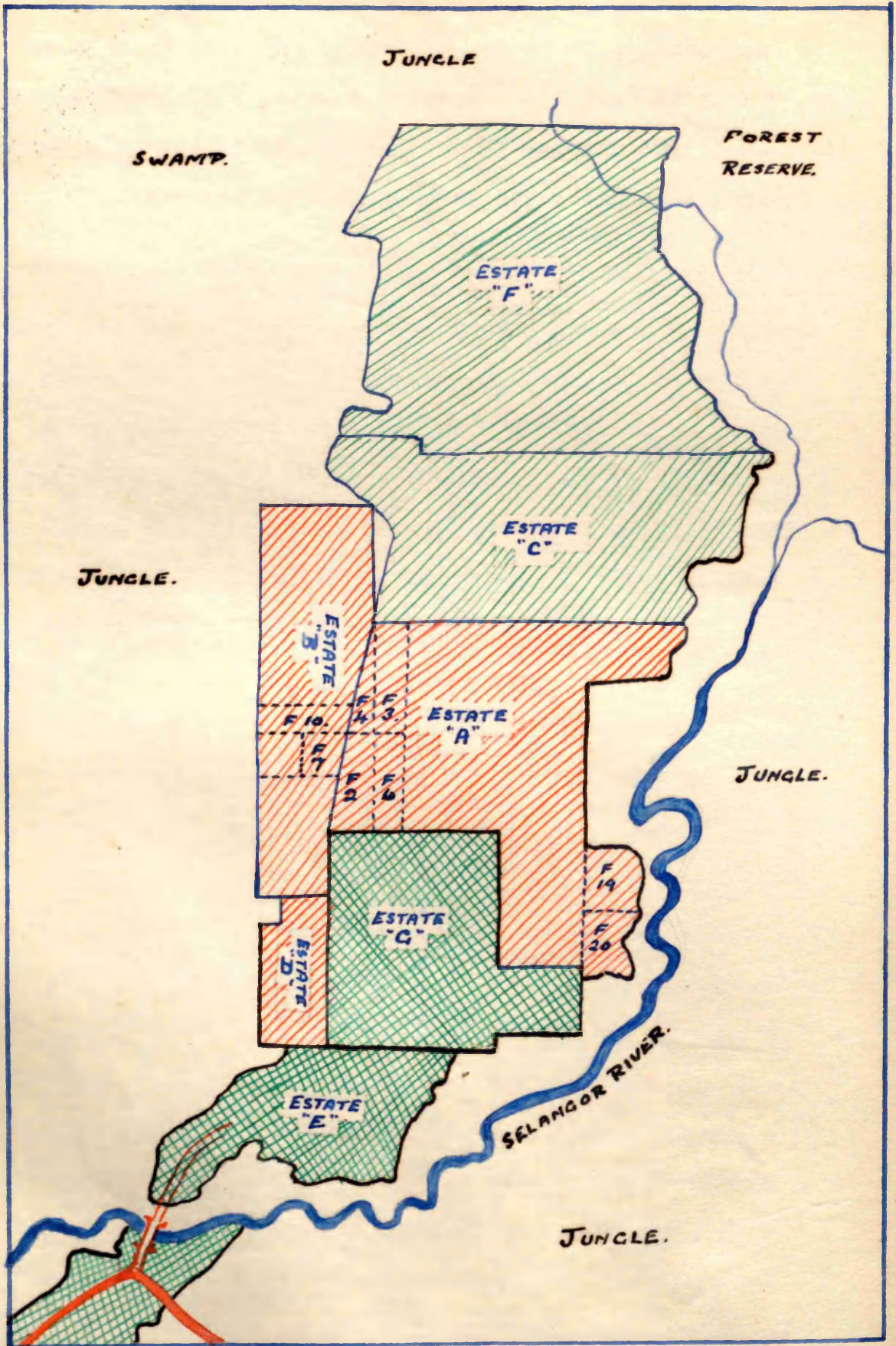
The pyrexial period in tsutsugamushi disease is also considered to be longer than in tropical typhus, extending to the third, fourth, and even fifth week, but shorter periods do occur, as in the case already mentioned above and reported by Nevin, in which after an abrupt onset, the pyrexial period lasted for eighteen days only, while in a proportion of tropical typhus cases, particularly if there is affection of the lungs, it may well be prolonged beyond the fifteenth day.






Lewthwaite⁹ has stated that the low titre of the Weil-Felix reaction, assists in making the differential diagnosis easier, and Fletcher⁶ had previously stressed this point. In both 1930¹² and 1931¹⁷, however, as already mentioned in the introduction, the Institute for Medical Research had reported eight cases of tsutsugamushi disease wherein the Weil-Felix reaction with Proteus X.19 "K" form, was positive to high titres in six, being over 1/1000 in five. Wolff²¹ (1931) also mentions thirty cases out of forty five seen by him in the Dutch East Indies which agglutinated Proteus X.19 "K" form to high titres. As a result of his experiences with both tsutsugamushi disease and scrub typhus, he concluded that the single constant feature of value in making a differential diagnosis between these two closely related diseases is the presence or absence of the initial ulcer, and the associated bubo. In the light of recent facts, this appears to be a very rational view.

Prophylaxis. This can be better discussed when the

epidemiology is being considered and will be referred to more fully in Part II. Suffice to say, that there appears to be no danger arising from direct contact, and as a consequence isolation has never been considered necessary.

SKETCH MAP.



-  ESTATE ROAD AND PRIVATE BRIDGE.
-  GOVERNMENT ROAD.
-  OIL PALM ESTATES.
-  IMMATURE RUBBER ESTATES (HEAVY COVER CROP.)
-  MATURE RUBBER ESTATES (CLEAN WEEDED.)

PART II

ETIOLOGY AND EPIDEMIOLOGY.

Etiology. The causal organism of tropical typhus is still undetermined. In the introduction the work of Anigstein,^{11,12,} and Lewthwaite^{10,17,} has been mentioned. The former had succeeded in isolating seventy six strains from the blood, brains and urine of patients, from infected experimental animals, and from lice fed on infected human beings.

These displayed a marked pleomorphism, but certain morphological types could be differentiated. In particular certain minute coccal, and diplococcal forms very similar in appearance to the classical Rickettsiae. It was further found that the different types varied greatly in their virulence when inoculated into experimental animals. The fusiform type was the least virulent when injected intraperitoneally, but inoculated into the scrotum there was fall in body weight, and examination of smears from the tunica vaginalis revealed the presence of large numbers of slender bacilli, and intra- and extra-cellular coccal and diplococcal forms.

The diphtheroid type of culture produced loss of weight and scrotal reaction in guinea-pigs, and on post-mortem examination haemorrhagic foci were found to be in the lung, perivascular infiltration of the capillaries was present, and "nodes" were demonstrated in the brain.

The most virulent type of all proved to be the minute coccal form. Inoculation into guinea-pigs caused high fever and marked testicular reaction, and numerous intra-cellular minute coccal bodies very similar in appearance to the typical Rickettsiae bodies, could be demonstrated in smears from the tunica vaginalis.

In human volunteers the fusiform type of culture proved to be avirulent. On the other hand inoculation with the minute cocco-bacillary form, produced a positive Weil-Felix reaction in the specific "O" form after the lapse of four weeks despite the fact that none of these strains had any serological relationship to B.proteus X.19.

Twenty seven of the strains isolated were similar in bio-chemical characteristics to B.proteus. Fifteen of these were found to be agglutinable by Proteus X.19 immune sera, either "W" or "K" form. It was also found that in twenty five rats inoculated with sixteen different strains, a positive Weil-Felix reaction developed in 48%, compared with 35% when passage virus was used, and 28% in rats inoculated with original human virus.

22

In 1917, Neill had observed scrotal lesions in guinea-pigs inoculated with the virus of Tabardillo or Mexican typhus fever, and had observed similar results with the virus of Rocky Mountain spotted fever. They consisted of subperitoneal haemorrhages, and pronounced vascular changes, consisting of perivascular infiltration chiefly with mononuclear leucocytes, and proliferation of the endothelial lining of the vessels. These changes were chiefly in evidence in the smaller vessels. In early lesions thrombosis was occasionally present. These findings were common to both diseases, but were more severe in Rocky Mountain spotted fever than in Mexican typhus.

13

In 1928 Mooser confirmed Neill's work in so far as it related to Mexican typhus, and reported the presence of minute diplo-bacilli in the endothelial cells lining the tunical vaginalis of infected guinea-pigs, as well as in those of the blood vessels. He obtained these endothelial cells free in oedematous fluid taken from infected guinea-pigs, and observed that the diplo-bacilli multiplied rapidly, finally rupturing the cell, the appearance then being very similar to that

observed in the epithelial cells in the stomach of infected lice.

15

Pinkerton confirmed the work of Mooser on Mexican typhus, and also demonstrated that scrotal reaction occurred in guinea-pigs infected with a European strain obtained by Wolbach, Todd and Palfrey in 1920. The reaction, however, was not so severe, and was rarely demonstrable during life. Almost invariably at the end of the incubation period a gelatinous exudate was found on both visceral, and parietal layers of the tunica vaginalis, and smears of this material revealed Rickettsia-like bodies similar to those described by Mooser in his investigation of Mexican typhus. He considered them probably identical morphologically, and indistinguishable in staining reactions to those seen in smears from the gut of lice infected with European typhus virus.

He established cross immunity between the Mexican and European strains, but discovered that cross immunity between European typhus and Rocky Mountain spotted fever was almost negligible.

He concluded that the organisms described as occurring in the tunica vaginalis subsequent to inoculation with these two strains, were in all probability the cause of the disease with which they were associated, and that the Mexican and European forms were in all likelihood only slightly different strains of the same disease.

23

Castaneda in 1930, carried out further work on Mexican typhus, from which he concluded that the scrotal swelling found in guinea-pigs inoculated with the virus, was an integral part of the disease, and that the Rickettsia-like organisms described by Mooser as occurring in the tunica vaginalis were of etiological significance.

Later in the same year Zinsser and Casteneda^{24,25} found that by injecting rats with benzol, phagocytosis was inhibited, and that subsequent inoculation of a rat so treated, resulted in a much greater concentration of extracellular Rickettsia-like bodies free in the peritoneal cavity. By repeated washings and centrifuging, they were able to isolate these bodies freed from all cell debris. Subsequent inoculation of these washed Rickettsiae produced the typical picture of Mexican typhus in guinea-pigs, corresponding exactly to that found as a result of the injection of scrapings from tunica vaginalis, blood or other virulent material. Moreover they discovered that such animals were rendered immune, or highly resistant to later inoculation with infective material derived from European typhus strains. As a result of these experiments they concluded that the disease produced in guinea pigs by inoculation of washed Rickettsiae represents the whole picture of Mexican typhus as illustrated by these animals, and that it is unnecessary to postulate the co-existence of some virus, other than these Rickettsiae in infective blood, organs or scrapings from the tunica vaginalis. Further that since washed Rickettsiae of Mexican typhus confer immunity upon guinea-pigs for subsequent inoculations of European typhus virus, the etiological factor in the latter disease is probably a Rickettsia organism closely allied to that of Mexican typhus, but differing slightly in some of its minor biological characteristics, particularly in its capacity for selective localisation in the bodies of guinea-pigs, as demonstrated by scrotal changes.

In 1929 Maxcy¹⁴ while investigating the endemic typhus of the south-eastern States of the U.S.A., had demonstrated scrotal swelling, and the presence of Rickettsia - like bodies in the endothelium of the tunica vaginalis of infected guinea-

pigs, and had further shown that inoculation with anyone of the strains of Tabardillo (Mexican typhus), endemic typhus of the U.S.A., or European typhus conferred immunity for the other two. He also considered that Mexican typhus and endemic typhus, were more closely related to each other, since both produced marked scrotal reaction in guinea-pigs, while the brain lesions were constant, and easily identified.

All this has a direct bearing upon the etiology of Malayan tropical typhus, since it has already been shown that in a proportion of cases infected guinea-pigs react with scrotal swellings, and organisms similar to those described by these American workers have been demonstrated in the tunica vaginalis, and in the brain lesions.

All the factors appear to incriminate Rickettsiae as the causal organisms of these varying types of typhus, including the Malayan variety, though there are probably minor biological differences.

The relationship of the numerous pleomorphic organisms isolated from infective blood, urine, and organs is more difficult to explain. According to Wilson⁷, Weigl maintained that the Bacillus of Plotz (Microbian typhi exanthematici) and the As bacillus were variants of the typhus virus, of which Rickettsia prowazeki was the virulent form. Wilson further refers to the work of Fejgin who claimed that by acting upon the "H" variant of B proteus X.19 with a specific bacteriophage, he was able to produce a lysed culture, which on inoculation into guinea-pigs produced a reaction analagous to the malady of Nicolle, and he claimed further to have carried out successful passage experiments through a number of animals, by the inoculation of organs of guinea-pigs which had been

infected with filtrates of lysed cultures. He maintained also that guinea-pigs previously inoculated with a typhus virus were refractory to subsequent infection with the bacteriophage, and conversely that bacteriophage anti "H" Proteus X.19 conferred in over 50% of guinea-pigs, complete immunity to typhus passage virus.

Confirmation of these remarkable findings would seem to establish the specificity of Proteus X.19 strains, and thus explain the Weil-Felix reaction with its waxing and waning titres, as one of ordinary immunity. It would not however appear to afford any explanation of the presence of other agglutinins in typhus sera, as for instance those for Bacillus typhosus, Bacillus coli, Bacillus agglutinabilis U2²⁶ and Bacillus pyocyaneus. Topley and Wilson (1929), in mentioning this work, stated that it had never been confirmed by any other worker, and were inclined to be sceptical with regard to its ultimate value.

They did not consider that Proteus X.19 had any direct relationship to Rickettsia prowazeki since inoculation of guinea-pigs with Proteus X.19 did not confer any immunity for subsequent typhus virus inoculation, while at the same time guinea-pigs recovered from the effects of inoculation with typhus virus, were susceptible to lethal doses of Proteus X.19. in no less a degree than control animals.

As a possible explanation for the agglutination by patients serum of Proteus X.19 to high titres, they suggested that this organism might play a role very similar to that of Bacillus suispestifer in swine fever.

This view is not new, and secondary invasion had been advanced to account for the presence of Proteus X.2, the Bacillus of Plotz and the many other organisms found in the

blood, urine and tissues of infected subjects. It had been suggested that typhus fever by greatly lowering resistance to bacterial infection permitted these various organisms to establish themselves.

While in the case of B. Proteus X.19 it would appear to give an adequate explanation for the almost constant presence of agglutinins for this strain, it fails to account for the comparatively small number of cases in which this organism has been isolated from actual cases of typhus.

Weil and Felix²⁷ have always inclined towards the view that Proteus X.19. and Rickettsia are related to each other in some manner yet to be discovered. Variations in agglutinins have received a considerable amount of attention, but little is known regarding variations in virulence, and it is possible that further work in this direction may reveal the role played by Proteus X.19 in typhus fever, affording at the same time, a rational explanation of the Weil-Felix reaction, and possibly providing some corroboration of Fejgin's earlier work.

While many factors in the etiology of typhus fever require further elucidation, the evidence which has steadily accumulated during the last few years would appear to strongly incriminate Rickettsiae as the causal organisms. In view of their somewhat protean characteristics, it is possible that many of the remarkable pleomorphic organisms isolated from the blood of infected human beings and animals, are variants of the causal organism, differing morphological characteristics already observed in vivo, being still further accentuated by cultivation in vitro. That these Rickettsiae may differ slightly in their minor biological characteristics has already been pointed out by Zinsser and Castaneda in their work on Mexican typhus and

European typhus, and this in all probability applies to the other typhus like fevers, including the Malayan, in greater or less degree. Before the exact relationship of all these fevers to each other can be determined, it will be necessary to adopt a definite standard for the Weil-Felix reaction, and to employ a variety of strains of Proteus X.19 (without the "K" strain of Proteus X.19 the diagnosis of rural typhus in Malaya would have failed to obtain laboratory confirmation); cross immunity will require thorough investigation; and improved methods for the isolation and cultivation of Rickettsiae in pure culture free from cellular elements must be devised.

Epidemiology. Reference has already been made in the introduction, to the views expressed by Fletcher and others^{2,3,} in connection with the epidemiology of the "W" and "K" forms of tropical typhus encountered in Malaya. The more detailed account of the epidemiology of the "K" form given later by Lewthwaite⁹ has also been mentioned. An account will now be given of epidemiological observations made in the endemic area, in which the series of cases described in Part I occurred.

Influence of Climate and Season. British Malaya lies between one degree and six degrees North latitude. The climate is typical of the equatorial belt, with a daily temperature ranging approximately between ninety five and seventy degrees throughout the year, with no sudden changes in temperature, though the nights are comparatively cool. There are no well marked seasons, but on the West Coast, where these estates are situated at least, there are two periods, one generally short, in the early part of the year, the other of longer duration, in the latter half of the year, when rainfall tends to be higher. These periods are by no means constant, and the appellation, wet, or dry season, is only a comparative one.

TABLE I.

	<u>1931.</u>		<u>1932.</u>	
	<u>Rainfall.</u>	<u>Cases.</u>	<u>Rainfall.</u>	<u>Cases.</u>
January	15.12"	?	5.74"	5
February	6.61"	?	5.75"	1
March	9.29"	?	8.63"	2
April	9.77"	1	13.38"	2
May	9.99"	1	7.83"	2
June	5.40"	2	4.05"	2
July	6.75"	1	2.45"	-
August	2.79"	2	7.83"	1
September	7.42"	2	5.51"	1
October	4.92"	8	15.75"	-
November	10.89"	2	15.37"	1
December	17.47"	3	10.63"	1

In table I the monthly rainfall is given, and alongside, the number of cases of tropical typhus admitted during the month. A consideration of this table shews that cases were distributed more or less evenly throughout the period. The greatest number occurring in one month was eight in October 1931, a month of low rainfall preceded by one of moderate rainfall, the next highest number, five, occurred in January 1932, a month of low rainfall, preceded by one of high rainfall. Rainfall, therefore, appeared to have little or no influence in determining the incidence of the disease.

Racial Incidence. All the patients in this series were Tamil labourers, but since the labour force in this group of estates consists almost entirely of Tamils, no particular inference can be drawn from this fact. There was no occurrence of the disease among the ten Europeans engaged in the supervision of the estates, and none of the Asiatic clerical staff were affected. Fletcher (1925)¹, and later Lewthwaite (1930)⁹, had observed the

preponderance of Tamils in cases occurring throughout the Federated Malay States, and came to the conclusion that this uneven racial distribution depended primarily upon the occupation pursued by the great majority of these people.

Sex Incidence. Of the forty seven patients, thirty five were females, and twelve were males; whereas the actual proportion of males to females in the population of the affected area was four to three. Lewthwaite had found that males preponderated, but considered this to be of no significance since he believed occupation to be the determining factor. The apparently contradictory sex ratio obtained in this series of cases, in reality corroborates this view, since as will be shewn later, it is dependent, more upon the precise nature of the work, than upon any other known factor.

Age Incidence. The age of the youngest patient was twelve years; that of the oldest, fifty two years. So far as age groups were concerned, no cases occurred in the first decade, thirteen patients were between eleven and twenty years of age, twenty two between twenty one and thirty, eleven between thirty one and forty, and only one over the age of forty years. All were workers, and as Tamils are immigrant labourers, who tend to return to India after a varying period of residence in Malaya, it can be taken that the ages of the majority in active employment lie between twenty and forty years, little significance therefore can be attached to the fact that the ages of so many of the patients were found to be within these limits. The significant feature which arises from consideration of the age incidence, is that neither the very young, nor the old are attacked, in other words those who are compelled by the nature of their work to go out into the field are especially prone to infection.

Influence of Environment on Incidence. Typhus exanthematicus of the old world, in its epidemic form is a disease long associated with war, famine, destitution, over crowding, and filth, and its close relationship to infestation with lice has repeatedly been demonstrated since Nicolle in 1909 drew attention to this important point. Even during inter-epidemic periods the endemic typhus present in Eastern Europe has always been chiefly confined to the destitute, the hungry, and the filthy. It is a disease primarily of the slum, where the poor and needy huddled together for warmth, in vermin infested rags, have proved ready victims. The general belief has been that without lice there could be no typhus fever.

This view is based upon the following data which have been considered sufficient to explain the mode of dissemination both in epidemic and inter-epidemic periods.

- (a) In nature the virus exists only in :-
 - (i) the blood and tissues of infected human beings
 - (ii) the bodies of lice feeding on such persons
- (b) That man is only infective from onset until defervescence, that is to say two to three weeks.
- (c) That an attack in man confers a high and lasting immunity.
- (d) That six days after feeding upon an infected subject, the louse is infective for man, and that this infectivity lasts throughout its life, a matter of two to three months.
- (e) That all attempts to demonstrate the inheritants of infection from one louse generation to the next have failed.

If the foregoing data comprised all the facts essential to explain the propagation of the disease it must be pre-

/presupposed that there are sufficient lice in the community to ensure the occurrence of at least one fresh case of human infection for every case recovered from or dead of the disease, and it must be further assumed that this condition could only be fulfilled were the majority of the population lice infested; unless this were the case, within the strict limits imposed, typhus could not continue in endemic form. In European typhus, no doubt, an adequate explanation of its occurrence, whether in epidemic, or endemic form can always be found along these lines, but so far as the endemic typhus of the tropics is concerned some further factor must be sought.

The Tamil labouring class, from which the patients in this series of cases were drawn, are not a particularly robust race. They are probably more prone to infection than any other race living in Malaya, and in particular, owing to faulty diet, and insanitary habits are more than usually susceptible to bowel infections. On European owned estates in Malaya, however, the welfare of the employees receives considerable attention from the management, and certain standards for housing, sanitation, medical, and when necessary hospital treatment, have been laid down by the Health Branch of the Malayan Medical Service. On well managed estates therefore destitution is unknown, and the labourer is adequately housed and fed.

In the Malayan climate the clothing of the Tamil labourer is generally scanty, a loin cloth, or loose cotton skirt in the case of the man, and very little more in the case of the women. Frequent bathing is practised, and the body louse is unknown. Probably about 50% harbour the head louse, but it is doubtful whether this parasite can play any important part in the transmission of typhus, either of the

old world type, or the tropical, owing to its very limited powers of migration.

In any case these conditions apply more or less to all the Tamils employed throughout the country, whereas the disease itself is strictly limited to certain definite areas.

The sketch map at the beginning of Part II shows the group of estates served by the hospital in which the cases in this series were treated. The whole area is roughly twenty thousand acres, and has a population of approximately three thousand, the great majority being Tamil labourers employed by the estates.

It will be seen that the area on three sides is surrounded by jungle, which extends for many miles beyond. On the fourth side the boundary is a river, spanned by a bridge, the private property of the Company. The traffic over this bridge is directly under control, and unauthorised persons, particularly vagrants, are prohibited from entering the property. It is true of course that a considerable number of food hawkers and people of a like category may enter from the neighbouring village, but no case of tropical typhus is known to have occurred among these people, at least during the period of this investigation, and no other cases have been reported from neighbouring estates outside the group.

All the cases, with one exception, were admitted from the estates shown in red on the map (Estates "A", "B" & "D"). The remaining case was admitted from Estate "C". That the general health conditions prevailing on these estates compared favourably with the standard of health throughout the group is shown by the vital statistics given in Table II below. Statistics have not been given for Estate "D" as it is a small private property employing a few labourers only.

TABLE II.

<u>1931.</u>	<u>Estate</u> <u>"A"</u>	<u>Estate</u> <u>"B"</u>	<u>Estate</u> <u>"C"</u>	<u>Estate</u> <u>"D"</u>	<u>Whole Group</u>
Population	497	289	278	No figures available	3419
Percentage of dependents in population	41.2%	38.1%	44.2%		35.4%
Death Rate per Mille	32.2	27.7	32.4		34.2
Birth Rate per Mille	34.2	48.4	46.8		44.8
Hospital admission) Rate (per cent of) population))	36.0%	39.8%	72.7%		40.2%
Cases of Tropical Typhus	15	7	N 1 1	N 1 1	22

<u>1932.</u>					
Population	546	222	220	No figures available	2888
Percentage of dependents in population	42.5%	39.6%	45.9%		38.5%
Death Rate per Mille	32.9	22.5	63.6		33.6
Birth Rate per Mille	38.5	45.0	27.2		41.9
Hospital admission) Rate (per cent of) population))	37.7%	20.7%	78.2%		34.5%
Cases of Tropical Typhus	14	2	1	1	18

It will be seen from these figures that Estate "C" is distinctly below the average of the group in every respect, more especially in the year 1932, with a high death rate, low birth rate, and high hospital admission rate. This estate gave rise to considerable anxiety, on account of the prevalence of malaria, bowel diseases, and consequent generalised debility. Nevertheless only one case of tropical typhus occurred during the period under review.



COOLY LINES. ESTATE "A"



COOLY LINE. ESTATE "A"
Shewing latrine on right. Oil palms beyond.

A further point of some significance may be derived from a consideration of these figures. The percentage of dependents in the population is higher on Estate "A" from which the greater number of cases were admitted, than the average for the group. These dependents comprised the children too young to work, the decrepit, and the aged, but no individual in this category contracted the disease.

In a further effort to elucidate the source of infection, an inquiry was instituted with a view to discovering whether direct infection, or house infection were possible. The labourers in both estates "A" and "B" live in so called "cooly-lines", provided for them by the company. These are situated more or less centrally on each estate, in a cleared and clean weeded area. They consist in Estate "A" of ten rows of raised wooden hutments, each row containing some fourteen rooms arranged in pairs, back to back. The distance between rows is a matter of some seventy paces. On estate "B" the arrangement is very similar, there being six hutments containing approximately the same number of rooms.

As a result of this inquiry it was found that in only one instance did infection occur in two persons occupying the same room, the interval between each being twenty-six days. Further, near relatives developed the disease, in one instance only, a mother and daughter, but in this case the interval was over one year. This taken in conjunction with the previously recorded observation that no dependents living in the lines had ever contracted the disease, appears conclusive proof that direct contagion plays no part in the dissemination of the disease, and that the role of the head louse harboured by quite a considerable number of the labourers may be considered negligible.



*MATURE RUBBER ESTATE.
Clean-weeding between rows of trees.*



*OIL PALM ESTATE.
Panorama of part of Estate "A."*

So far then no factor has been disclosed which would explain the occurrence of the disease on certain of the estates of the group, while providing at the same time, an adequate reason to account for its absence from the others. The significant feature serving to distinguish the estates affected by the disease, from those enjoying immunity, is the nature of the cultivation, and this appears to be a matter of supreme epidemiological importance. Two very different types of tropical produce are cultivated on this group. Rubber trees are grown on those estates coloured green on the map; the African oil palm on those coloured red.

In the areas planted with rubber which has become mature, the trees stand some fifteen paces apart, they are well grown and their branches come off at a considerable distance above the ground. The intervening space between the trees is kept absolutely free from weeds, and grasses, a system of rubber cultivation known as "clean weeding". No protection is thus afforded for rats, and they are rarely seen in such areas. Squirrels, however, are comparatively common.

On the oil palm estates different conditions prevail. The palms have wide spreading fronds, so that when the trees are young these sweep down and touch the ground, enclosing a fairly wide circle in which coarse grasses and weeds luxuriate, and which becomes littered with debris and decaying matter fallen from the tree.

⁹
Lewthwaite in his investigation into the epidemiology of tropical typhus, observed that the incidence of the disease suddenly increased on the oil palm estate concerned, when the trees, all of which had been undisturbed for four or five years, were first pruned, prior to the initial harvesting of the fruit.



IMMATURE OIL PALM.

Sweeping lower fronds and thick cover-crop.

This procedure entailed a considerable amount of strenuous work on the part of the labourers who had to hack off the lower fronds of the palms, and clear away the decaying rubbish around the base of the tree, in order to provide easy access for the harvesters who followed at a later period to cut out the ripened fruit situated higher up the tree. It was found in his series of cases, that the greatest incidence was among the pruners, though as the same labourer might be pruning at one time, and harvesting at another, he included both pruners and harvesters in one group.

The next group to be attacked in order of frequency was the "weeders". Their duties consisted of keeping an area of roughly six feet around each palm, free from noxious weeds, and in maintaining paths from tree to tree, in a clean weeded condition. During the four years in which the palms were maturing, the weeders were unable to approach closely to the tree, since the lower fronds sweeping down to the ground prevented their access. Few cases occurred throughout this period, and those that did were amongst the weeders. The number of these workers affected however rose sharply coincident with the onset of pruning.

Lewthwaite advanced two alternative theories to account for the sudden rise in incidence, closely associated apparently with the operation of pruning. In the first he assumed that the unknown vector is intimately associated with the decaying products of the palm, and that the manipulation of this material by the pruners rendered them peculiarly liable to infection. At the same time these products tended to be scattered more widely from the tree, and thus were responsible in conveying infection to the weeders working in the vicinity.

In the second theory he suggested that possibly infection



YOUNG OIL PALM.

immediately after initial heavy pruning.

did not depend wholly, or even at all, on the process of pruning, but that this operation might be an indirect cause by exposing the undergrowth which hitherto had been permitted to grow undisturbed beneath the shade of the branches, and had provided possibly an ideal shelter for the unknown vector. Close contact with this undergrowth on the part of both pruners and weeders exposed them to a greater danger of infection than had hitherto been possible. If this theory were correct it would account for the fall of incidence which followed soon after the cessation of pruning, since clean weeding was extended right up to the base of the tree, and the constant passage to and fro of harvesters and weeders would serve still further to keep the scrub in check and to broaden and extend the paths between and around the trees, thus creating still more unfavourable conditions for the vector.

The high incidence among males in his series, he attributed to the fact that the strenuous and apparently hazardous labour of pruning could only be undertaken by them.

In the present series of cases rather a different set of circumstances prevailed. At the time of investigation, the majority of the palms were considerably older than those seen by Lewthwaite, and the lower branches came off from the trunk some feet above the ground. The period of excessive pruning to prepare the tree for harvesting, was past in all but a small section of the estates, and had apparently, so far as could be ascertained, been unaccompanied by any serious outbreak of the disease. The light pruning necessary to keep the tree in good condition, could easily be carried out by the harvester whilst gathering the ripened fruit, and so far as his labour was concerned, there was no necessity for him to handle any material which might be lying on the ground.



TEN YEAR OLD OIL PALM.

Fronds well above ground, light grass cover.



TEN YEAR OLD OIL PALM.

showing ripefruit and decaying flowers.

TABLE III.

Harvesters. All Males.	Weeders.			Factory Coolies.			Drain cutters and Fruit sorters.		
	Male.	Female.	Total.	Male.	Female.	Total.	Male.	Female.	Total.
8	2	35	37	1	-	1	1	-	1

TABLE III indicates the type of work in which the forty-seven individuals who contracted the disease were engaged. The most notable feature is the comparatively large numbers of weeders - 79%.

It would appear therefore that while the nature of this work is still apparently the factor which determines the highest incidence, the type of worker called upon to face the greatest risk varies according to the stage of maturity to which the trees have attained. Pruners and harvesters initially most prone to infection, become comparatively safe, their work being confined to the higher parts of the trees. Weeders whose task continues to bring them into close contact with the soil and undergrowth at its base, are constantly exposed to the hazard of infection.

The discrepancy in sex incidence as shown by a comparison of this series with that of Lewthwaite, is thus accounted for, since weeders in distinction to pruners and harvesters, are almost invariably women with a small number of working children, and an occasional male less robust than his fellows.

So far these findings support the second hypothesis of Lewthwaite, rather than his first, and are in accordance with the earlier observations of Fletcher²⁸, who had associated the vector with coarse and rank undergrowth, a number of his earlier cases being cowherds who tended their cattle on abandoned and overgrown agricultural land on the one hand, and European soldiers who were encamped on very similar ground on the other.

In October 1931, eight cases were admitted to hospital within a few days of each other, seven from Estate "A", and one from Estate "B". A consideration of the histories indicated that the date of onset in all the patients had been during some part of the same week. This suggested that the source of infection might be concentrated in some restricted area of the estate, since the weeding gangs tasks are so arranged that every portion of the estate is covered in regular monthly rounds. The incubation period was assumed to be most probably between eight and fifteen days, and in view of this, the area wherein each labourer had been employed between the fifteenth and eighth day prior to onset was ascertained. For administrative purposes the estates are divided up into rectangular blocks known as fields, and while it was discovered that in the case of Estate "A" work had been carried out in various fields by different gangs, all those infected had worked in fields 1, 2, 3 and 4 sometime during the period in which infection was presumed to have taken place. This area as will be seen in the sketch map, adjoined the boundary of Estate "B", and it was discovered that the single patient admitted from Estate "B" had been working from the fifteenth to the eighth day before the onset of the disease, in fields 10, and 7 of that estate, an area lying alongside the suspected area in Estate "A".

In pursuing this line of investigation further, the fact was revealed that on Estate "A" these fields had until quite recently been thickly covered with undergrowth. It had been decided by the management that this was deleterious to the trees, and the whole area had been very thoroughly cleared by a gang of Chinese contracted labourers only a short time before the occurrence of the seven cases. Chinese coolies are generally reluctant to seek the aid of Western medicine in

times of sickness. It was impossible, therefore, to discover whether any cases had occurred amongst this itinerant gang or not.

It appears reasonable to suppose that the disturbance caused by this thorough cleaning up of the area, was a potent factor in bringing about the subsequent increase of infection among the Tamil weeders, who later had to traverse the ground and maintain it in a cleaned condition.

Explanation of this in the absence of direct evidence incriminating any particular vector, can only be conjecture. However, in view of the probable role played by rats as reservoir hosts of the virus, the theory is advanced that work which involves widespread disturbance of their normal habitat, is the dominating influence in determining increased incidence of the disease. If the vector is an ecto-parasite of the rat, and much of the evidence points in that direction, then it may be expected to flourish in much greater concentration in, and around the nests of the rats, than elsewhere.

During the first few years while the palms are left to mature undisturbed, the area immediately contiguous with the base of the tree with its security, abundant food supply, and thick cover, might be expected to attract rats in large numbers, while the long coarse grass permitted to spring up between adjacent trees would provide shelter only a little less favourable. If however the rats are suddenly disturbed and dispersed, and their nests broken up and scattered, whether it be by pruners at the base of the palms or by major clearing operations between the trees, large numbers of rat parasites will be disseminated throughout the surrounding area. Unable to attach themselves again to their host of choice, they attach themselves to man, and an outbreak of

tropical typhus is the result. Once the disturbed area has had time to settle down, the concentration of vectors becomes considerably lessened, and only an occasional sporadic case is liable to occur.

In support of this hypothesis, further investigation on Estate "A" showed that all the patients admitted prior to October were labourers, who with the exception of the first case only, had worked in these particular fields sometime between the fifteenth and the eighth day preceding the onset, but never more than two cases occurred in one month. Further it was ascertained that patients from Estate "B", with one exception only, had worked during the period appropriate for infection, in fields seven and ten which adjoined the affected area of Estate "A". On Estate "B" no intensive clearing was carried out, and the cases occurred sporadically only. After the admission of one case in October 1931, only two further cases occurred on this Estate during the whole of 1932.

During November and December of 1931 four further cases were admitted from Estate "A", all of whom had worked in the suspected fields during the period of possible infection. Four harvesters had been affected up till January 1932, and from a consideration of their time table, they also apparently had become infected whilst working in these fields.

Throughout 1932 however, no further case occurred, traceable to these fields, and it appears rational to assume that the area in its now cleared, and clean-weeded state, affording little protection for rats, and no inducement for them to build their nests, had ceased to be a potentially dangerous locality.

In January 1932 a definite shift in focal incidence took place. Five fresh cases were admitted, all weeders, and enquiry revealed that during the period of possible infection, four of these had been working in Fields 19 and 20. Reference



*THICK COVER CROP.
Oil Palm area, Field 19. Estate "A".*

to the sketch map will show that these fields are situated on the boundary of the estate, at the opposite extreme to those previously involved. This area was planted with younger trees than the other and immediately prior to the occurrence of these cases, had been brought into bearing, involving as already indicated, extensive pruning and clearing away of decaying debris.

The interesting feature, and one which is inconsistent with either of Lewthwaites theories, is that none of the pruners or harvesters were initially affected, the brunt of infection falling upon the weeders. The hypothesis advanced to explain the occurrence of cases in the other section of the estate, would serve in equal cogency in this, that a widespread disturbance and dispersal of the rat population had disseminated the vector broadcast throughout the area. Unlike the previous fields, cases continued to occur sporadically in this area throughout the year, all but two cases occurring between January 1932, and April 1933 being traced to this locality, and this can be accounted for most probably, by the presence of a thick leguminous cover crop, grown for the purpose of preventing soil wash, and to promote aeration and enrichment of the soil, but providing at the same time unfortunately, protection and shelter for rats.

Although the two focal areas lie widely separated from each other, they have one feature in common which may be of considerable epidemiological significance. Both are low lying, and both are subject to flooding during the wet seasons, particularly the locality embracing fields 19 and 20, which adjoins a large river draining a wide area. This constitutes a further similarity between scrub typhus and tsutsugamushi disease, known also as Japanese river fever, the association of which with recently flooded areas has long been recognised.



*IMMATURE RUBBER ESTATE.
Heavy Centrosema Cover-crop between trees.*

It has already been mentioned that a single case came from Estate "C", where the oil palm is not cultivated. From the map it will be seen that it adjoins Estate "A", whence the majority of cases came, and that moreover, fields 1, and 3 of the latter estate are contiguous with its lower boundary.

This estate is planted with young immature rubber trees, and unlike the older, more mature estates under rubber cultivation, it is not clean-weeded. The intervening ground between the trees is overgrown with dense cover crop. That this provides a suitable habitat for rats has already been indicated, though food supplies are not so abundant as in the oil palm areas. Occasional sporadic cases are to be expected when such an area adjoins an endemic focus.

Beyond Estate "C" lies a second immature estate of large acreage, employing approximately one thousand labourers, and as this is also thickly grown up in cover crop, the disease may eventually make its appearance there, as a result of rat migration.

Rat catching is encouraged among the labourers in their spare time, a small monetary reward being given for every dead rat brought in, and in this respect it is rather a striking fact, that of the considerable number of men engaged in this work which theoretically would appear to be particularly hazardous, only one contracted tropical typhus, and in any case he had worked at the same time as a harvester in one of the focal areas. This apparent anomaly can be explained if the vector should prove to be the larva of a Trombicula since, as has been shown by Nagayo (1924), cited by Fletcher and others⁵ in the case of tsutsugamushi disease the larval mites only feed once, and having fed on an infected host, do not directly carry infection to a fresh animal as the rat flea carries plague. They remain infective however, as nymphs and egg-laying adults,

as was proved by injecting their crushed bodies into monkeys. The adult Thrombiculae do not feed on animals, but those already infected in their larval stage are capable of transmitting the virus through their eggs, to the next generation of larvae, and thus a fresh host may become infected.

Rumreich and others²⁹ in investigating the endemic typhus of the South Eastern states of the U.S.A., concluded that the rat flea Xenopsylla cheopis was the vector, and along with a considerable amount of experimental evidence to support this view, they mentioned the number of patients in whom direct contact with rats could be demonstrated, either by trapping, shooting, or sleeping in rat infested houses.

This latter observation in conjunction with that of Nagayo, lends support to the view that a larval mite, probably a Trombicula is the vector of tropical typhus, at least of the "K" form, as it is of tsutsugamushi disease, since if rat fleas or ticks were the responsible vectors, a greater incidence would be expected in rat catchers.

Dove and Shel mire (1931)³⁰ claimed to have transmitted endemic typhus in Texas by means of a tropical rat mite (Liponyssus bacoti, Hirst) in which both adult and larva are parasitic, and with which many of the rats in the district were found to be naturally infested, though Maxcy was not satisfied with their criteria of successful infection. They claimed that the larvae were capable of inheriting the virus from the previous generation, and suggested that passage through this mite brought about a "step up" in virulence. A phenomenon observed by them, which seems to afford some corroboration for the hypothesis already advanced, that the rise in incidence in the present series was a sequel to the breaking up of the nesting places and dispersal of rats, was

the increase in the number of cases of human infection with endemic typhus occurring, subsequent to an intensive rat poisoning campaign.

Prophylaxis. In view of the epidemiology, and the important part which a knowledge of this must play in devising effective prophylactic measures, only passing mention was made to this subject in Part I, a fuller consideration seeming to be more appropriate at this later stage. Nevertheless, until more knowledge is possessed concerning the virus, the vector, and the animal reservoir suggestions can only be tentative.

12,17

Vaccination with the vaccine prepared by Anigstein has proved disappointing both in preventing infection, and in mitigating the severity of the disease in those infected, and in any case the cost of treating large labour forces, with the object of preventing a comparatively small number from contracting the disease, militates against its widespread adoption. Before the commercial firms interested in the development of the endemic areas, can be induced to employ such a measure, they must first be convinced of its efficacy.

The view that the rat, and possibly the squirrel or other rodents, are the reservoir hosts, is steadily gaining ground. Mention has already been made of the finding by Anigstein^{II}, of a natural infection in over six per cent of wild rats trapped in an endemic area, indicated by swelling and inflammation of the testicles, and the presence of agglutinins for Proteus X.19. It is more than probable that the infection exists in a "forme inapparente" in a much larger proportion of cases. Extermination of rats in the endemic foci would therefore appear to be an eminently rational prophylactic measure. In practise however this is a matter of considerable difficulty. On Estate "A" between two hundred and three

hundred rats are killed daily, making an average of over six thousand monthly, without making any appreciable difference to the rat population. So fast as they are destroyed others press in from an apparently inexhaustible reservoir in the surrounding jungle, attracted by the abundant, and appetising food supply in the form of the succulent palm fruit. Some method of wholesale rat destruction will require to be devised, which will at the same time be free from risk to labourers, their children and domestic animals, and moreover will not have any deleterious effect upon the trees.

Measures directed primarily against the vector itself might prove a further valuable line of attack, but until it is definitely known, little can be achieved in this direction. Assuming that the vector proves to be a Trombicula, the fact that the adult forms are free living and apparently feed on the juices of plants and seeds, may indicate the means whereby they can be exterminated. It is possible that in oil palm areas, as the trees become taller, and providing that the surroundings are maintained in a scrupulously clean-weeded and well drained state, no lurking places suitable for these adult Trombiculae will remain, and thus indirectly the infectivity of rat for man will be reduced. Admittedly this does not take into account the fact that other ecto-parasites of the rat may be equally capable of transmitting the disease, but so far as the most likely of these others is concerned, the tropical rat flea Xenospsylla cheopis, it has been frequently observed in the investigation of plague, that it is only when the rat population is markedly diminished as a result of the epizootic, that this parasite will forsake its host of choice to attack itself to man.

The suggestion has been made, that as an attack of tropical typhus probably confers immunity, tasks involving

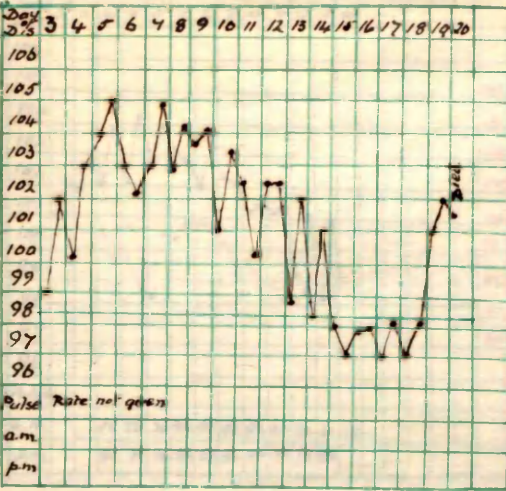
increased risks of infection, such as opening up an area for harvesting, clearing undergrowth, and weeding in endemic foci, might be given to labourers who had recovered from the disease. This is a perfectly rational proposal, though it is based upon an assumption that has scarcely had time for absolute confirmation. The allied condition tsutsugamushi disease is known not to confer lasting immunity, so that further observations of tropical typhus may prove this measure to be of no prophylactic value.

Much of all this is, and must of necessity in the light of our present knowledge, be speculation. Before the epidemiology of Malayan scrub typhus can be put on firm ground, still further work is necessary, both in the field, and in the laboratory.

TEMPERATURE CHARTS OF VARIOUS
TYPHUS-LIKE FEVERS.

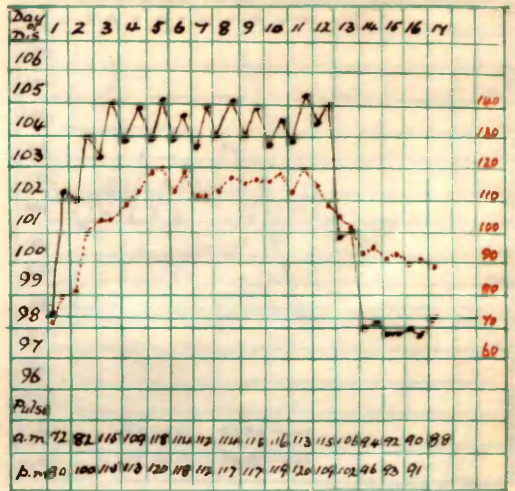
vide PART. III.

CHART. 1.



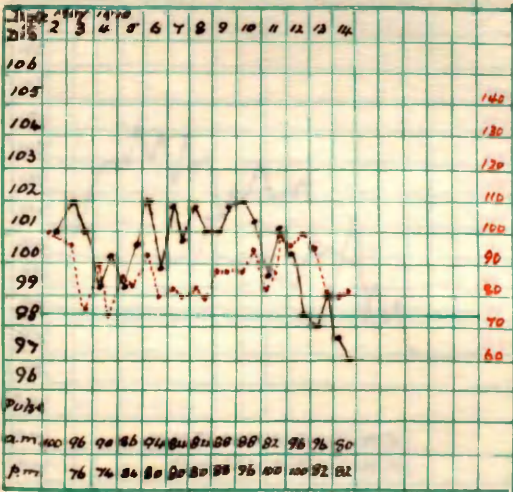
TYPHUS EXANTHEMATICUS.
CASTELLANI AND CHALMERS.

CHART. 2.



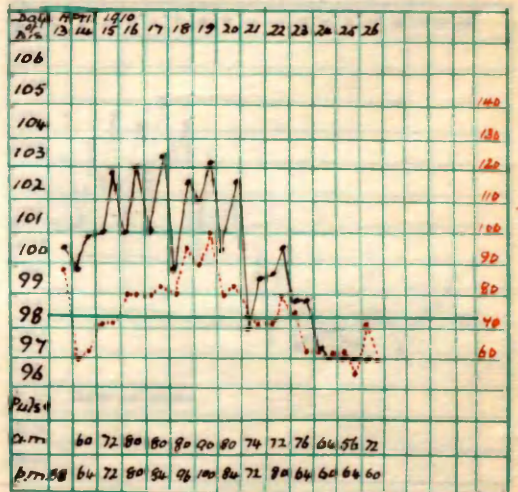
TYPHUS EXANTHEMATICUS.
STITT.

CHART. 3.



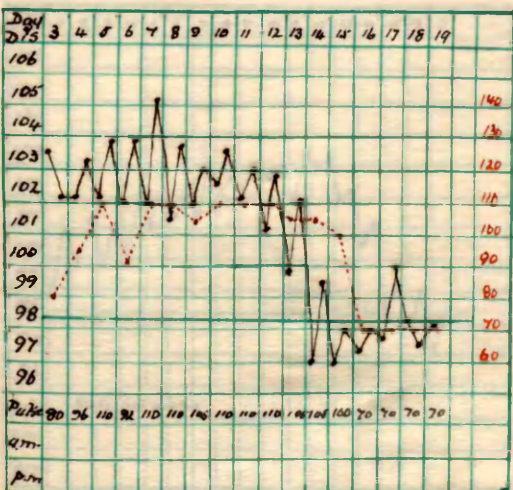
MOSSMAN FEVER.
SMITHSON.

CHART. 4.



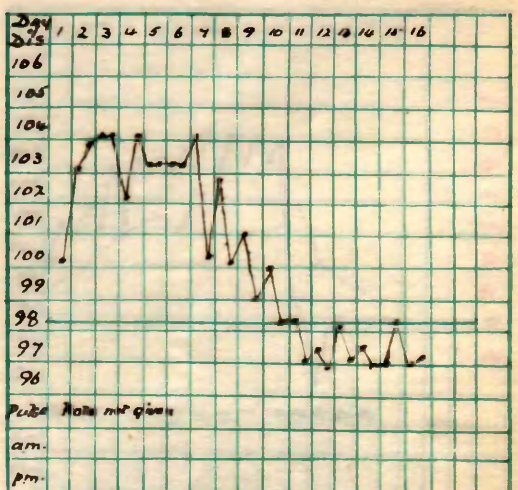
MOSSMAN FEVER.
SMITHSON.

CHART. 5.



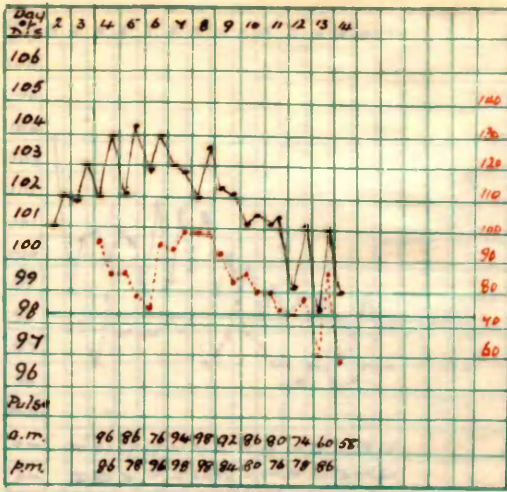
ENDEMIC TYPHUS, S.E. STATES, U.S.A.
MAXCY.

CHART. 6.



FIEVRE BOUTONNEUSE.
CONSEIL (JEWELL)

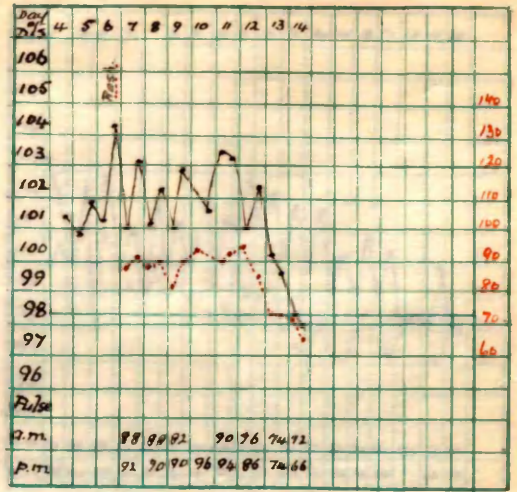
CHART. 7.



NIGERIAN FEVER.

DAVIES AND JOHNSON.

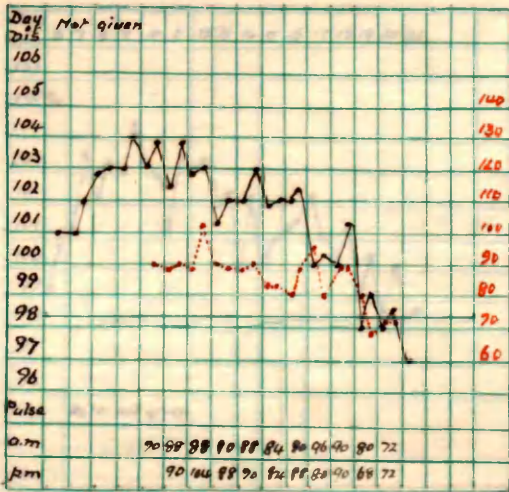
CHART. 8.



NIGERIAN FEVER.

DAVIES AND JOHNSON.

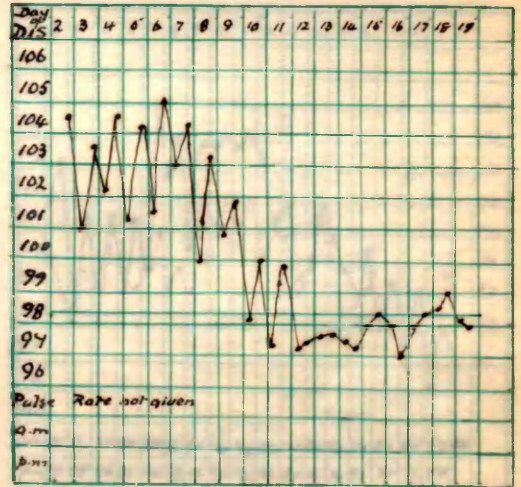
CHART. 9.



KENYA FEVER.

JEWELL.

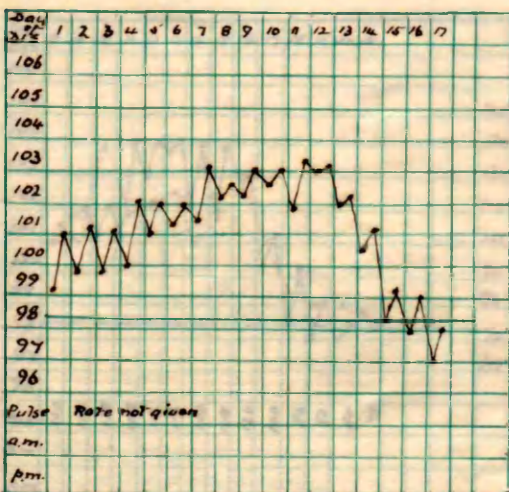
CHART. 10.



INDO-CHINA FEVER.

YERSIN AND VASSAL.

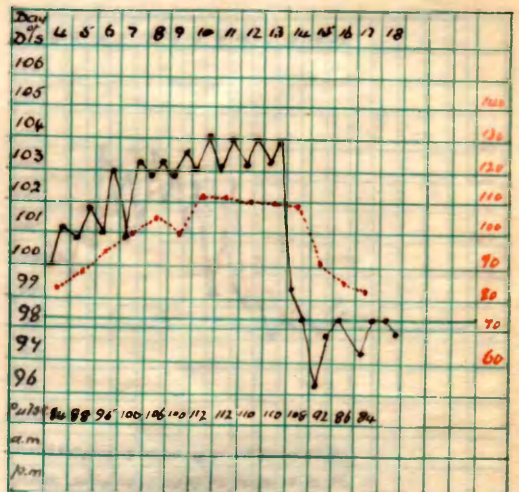
CHART. 11.



BHIM TAL FEVER. (INDIA.)

MEGAW.

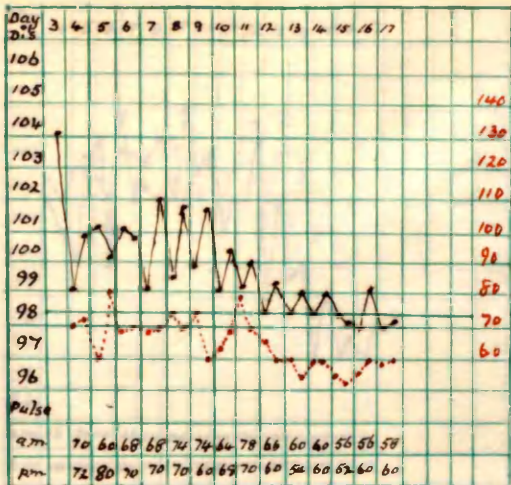
CHART. 12.



SAT TAL FEVER. (INDIA.)

MEGAW.

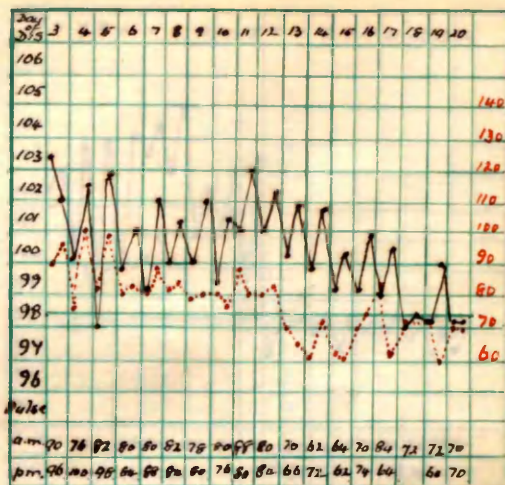
CHART. 13.



BANGALORE FEVER. (INDIA.)

BIGGAM.

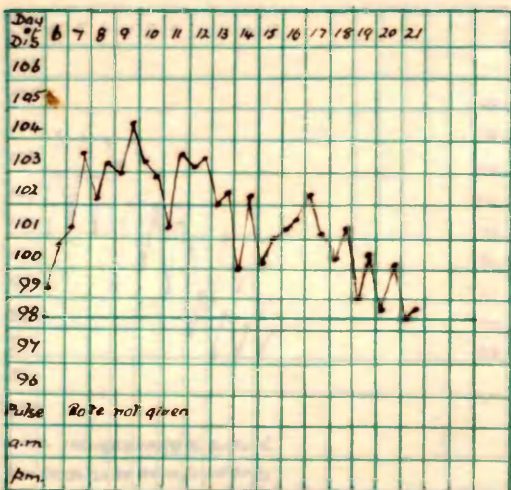
CHART. 14.



BANGALORE FEVER. (INDIA.)

BIGGAM.

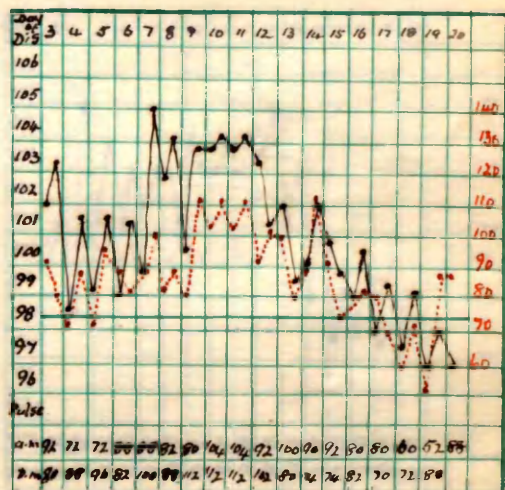
CHART. 15.



MALAYAN TSUTSUCAMUSHI.

FLETCHER AND FIELD.

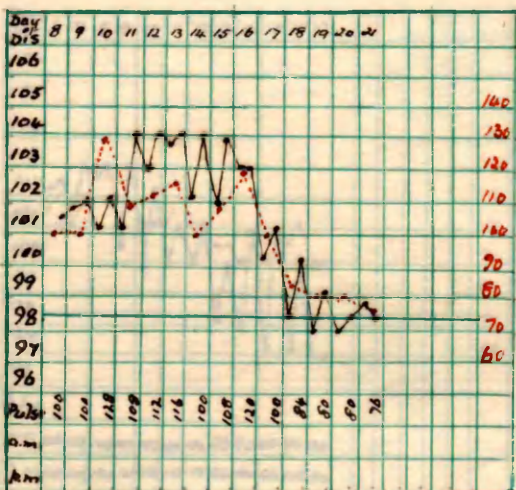
CHART. 16.



MALAYAN TROPICAL TYPHUS "W."

LEWTHWAITE.

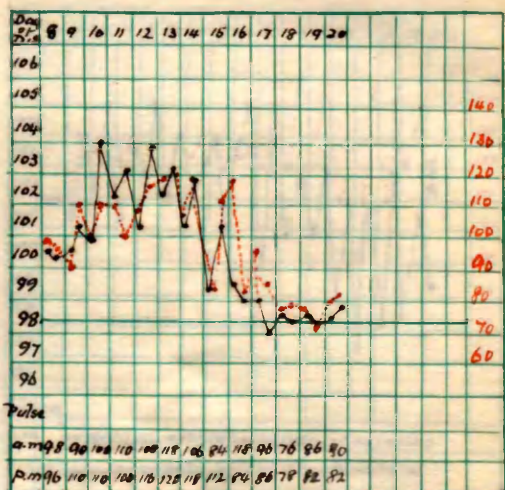
CHART. 17.



MALAYAN TSUTSUCAMUSHI.

FLETCHER AND FIELD.

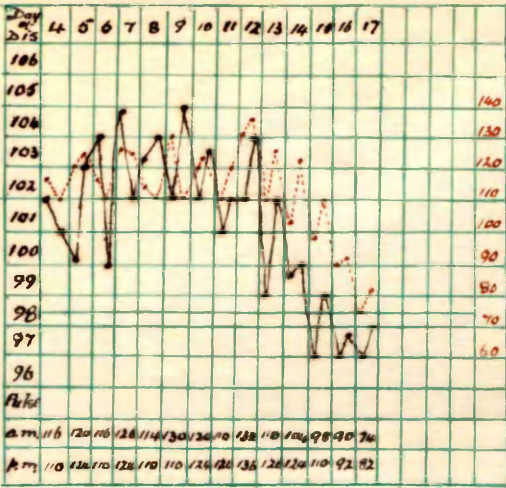
CHART. 18.



MALAYAN TROPICAL TYPHUS "K."

LEWTHWAITE.

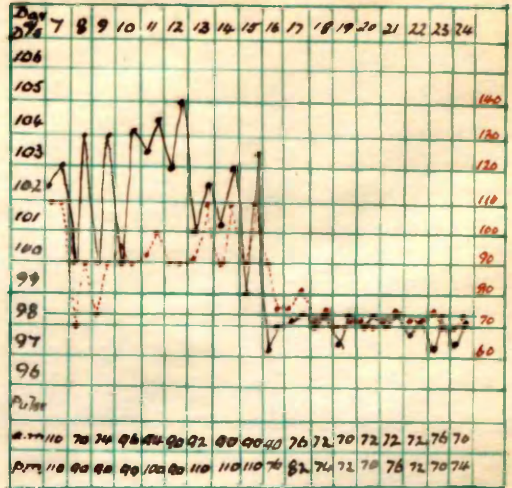
CHART. 19.



MALAYAN TROPICAL TYPHUS "K."

CASE No. 11. PRESENT SERIES.

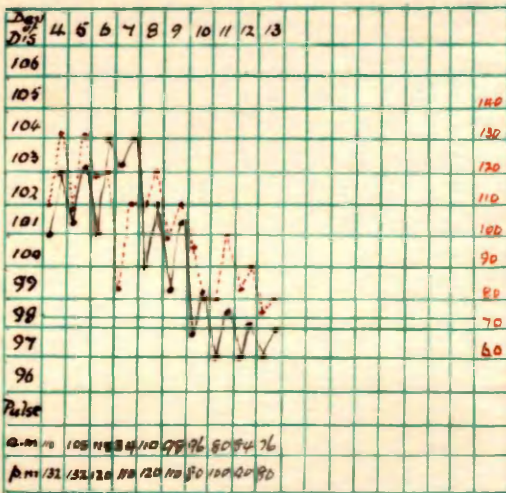
CHART. 20.



MALAYAN TROPICAL TYPHUS "K."

CASE No. 20. PRESENT SERIES.

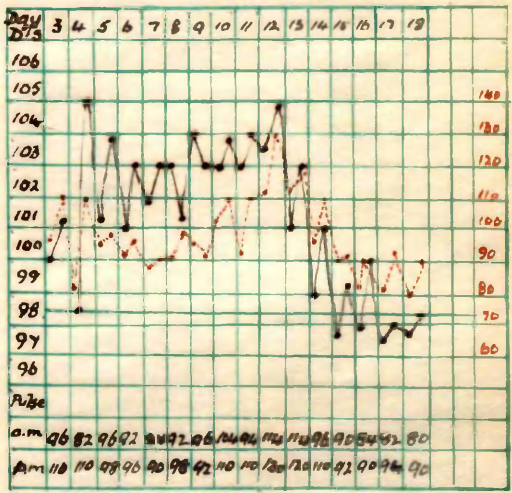
CHART. 21.



MALAYAN TROPICAL TYPHUS "K."

CASE No. 24. PRESENT SERIES.

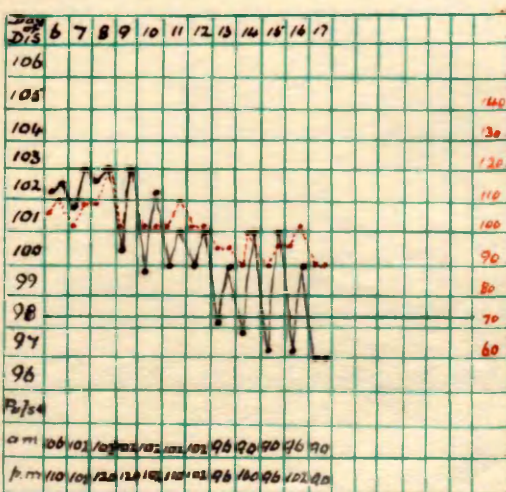
CHART. 22.



MALAYAN TROPICAL TYPHUS "K."

CASE No. 40. PRESENT SERIES.

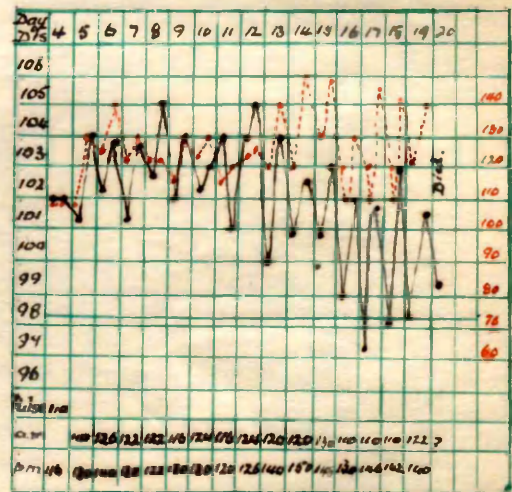
CHART. 23.



MALAYAN TROPICAL TYPHUS "K."

CASE No. 39. PRESENT SERIES.

CHART. 24.



MALAYAN TROPICAL TYPHUS "K."

CASE No. 19. PRESENT SERIES.

PART III.

The relationship of Tropical Typhus (K" form)
to other typhus-like fevers in Malaya and
elsewhere.

For many years fevers similar to a greater or less degree in their salient features, to the classical typhus exanthematicus commonly found in certain European countries, have been recognised in various parts of the world. In Mexico Tabardillo has been long known, but as it occurred in epidemics, had frequently a high mortality rate, and was associated in its transmission with the body louse, it was considered to be precisely the same as Old World typhus and was believed to have been imported to that country by the Spanish.

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When Brill in 1898 and again in 1910 described mild cases of typhus-like fever occurring in New York, in which contagion appeared to play little part, which were of sporadic occurrence, seldom associated with lice, and most prevalent in the summer months, it was generally held that he was dealing merely with a mild, endemic form of European typhus.

The first two distinct diseases to be recognised as having many-typhus-like features, while at the same time having important points of difference clinically, and more particularly epidemiologically, were Rocky Mountain spotted fever, and tsutsugamushi disease, or Japanese river fever.

Within recent years, however, a considerable number of observers in various parts of the world have reported fevers with certain clearly defined typhus-like characteristics, and it is becoming more clearly recognised that typhus fever

has a wider distribution than had hitherto been believed, though at times inconstant and protean in its manifestations.

In the Far East tsutsugamushi disease has been known for a considerable time. Fletcher³ in his resume of its distribution, mentioned that for many years, it was looked upon as a local form of typhus, until Bälz and Kawakami in 1879 recognised it as a separate disease and gave it the name of "Flood Fever" because it was most prevalent after floods, in the valleys of certain Japanese rivers. The disease is endemic in Japan and Formosa, and although it is supposed not to occur in China today, ancient Chinese writings mention a sand mite which burrowed under the skin and occasionally, according to ancient belief, caused death by reaching the heart of the victim. Faust (1923)³² described two doubtful cases occurring at Wuchang in the central Yangtse Valley.

In 1908 Ashburn and Craig³³ investigated tsutsugamushi disease with special reference to its relationship with Rocky Mountain spotted fever. They found that both had many clinical features in common, such as conjunctival injection and photophobia, moist coated tongue, cough and oedema of the lungs. In both deafness might be present, but was more frequent in tsutsugamushi disease, and a moderate degree of splenic enlargement might be present in each. The differences were principally of degree rather than kind; thus the rash appeared in both about the same time, but tended to be haemorrhagic and petchial in Rocky Mountain spotted fever, and to persist longer, while gangrene of the skin might be a sequel. An important point of difference was the distribution of the rash which in spotted fever was first abundant on the wrists and ankles, later spreading over the whole body, while in tsutsugamushi disease it first appeared on the face, spreading later to the chest, trunk and legs. An outstanding point of distinction was the presence of an initial ulcer, and accompanying lymphadenitis in tsutsugamushi disease.

Further this disease did not confer immunity against subsequent infection, though successive attacks were less severe, while apparently Rocky Mountain spotted fever was followed by lasting immunity. In both the death rate was high (15% - 70% with an average of about 27% in tsutsugamushi disease, and over 70% in spotted fever). It must be remembered however that they were comparing tsutsugamushi disease with the Montana variety of Rocky Mountain spotted fever and not the Idaho variety which is much milder, and has a death rate in the vicinity of 5%. Tsutsugamushi disease would appear to occupy a position intermediate between these two varieties, with regard to the severity of the symptoms, and the mortality rate. Finally they suggested that certain obscure fevers in the Phillipines might prove to be tsutsugamushi disease.

Ashburn and Craig had likened Rocky Mountain spotted fever to typhus clinically; tsutsugamushi disease they thought more closely resembled typhoid, though displaying at times characteristics associated with plague, pneumonia, and typhus. This latter observation is of special interest since Schüffner³⁴ in 1915 under the title "Pseudo Typhoid of Deli" described a series of cases occurring in Sumatra which closely resembled the tsutsugamushi disease of Japan. The symptoms of this disease were very similar to the Japanese variety, but on the whole were less severe, and the mortality rate was only 3%. The rash which consisted of roseolar raised spots varying in size from a hempseed to a three penny piece, was very similar to a secondary syphilide, and made its appearance on the second or third day. It was thickest on the trunk, particularly the flanks, and usually persisted for seven or eight days. On fading it frequently left brown stains, a feature which Ashburn and Craig had noted in spotted fever of the Rocky Mountains, but had failed to find in tsutsugamushi disease in Japan. This

Sumatran disease shewed many of the signs and symptoms associated with tropical typhus; intense headache, drowsiness, in severe cases the typhoid state, or continuous delirium.

Nocturnal restlessness was common, and nervous signs tended to become more evident late in the disease, and to persist into the apyrexial period. Bronchitis and broncho-pneumonia occurred as complications, and rheumatoid pains were occasionally present in the small joints. In addition there was an easily observed initial ulcer, rather indolent with clear cut edges and black necrotic centre, accompanied by moderate lymphadenitis. The temperature curve in typical cases resembled more closely that of typhoid than typhus the fastigium not being attained until the fourth or fifth day, while the fall was by lysis.

About the same time Dowden³⁵ (1915) in the Federated Malay States described a case which he believed to be identical with tsutsugamushi disease of Japan. The initial ulcer was present, with necrotic centre, and a rash consisting of papules varying in size from a pinhead to that of a pea. Dowden also like Schüffner was struck by the resemblance of the rash to a secondary syphilide. The fever in this case lasted for twenty seven days, and bronchitis and broncho-pneumonia were present as complications.

Kitashima and Miyajima (1918)³⁶ gave a full statistical account of tsutsugamushi disease as it occurred in Japan. They gave the average death rate over a period of years as 28% but mention that in one year in one district it was as high as 62.5%. The rash, according to them, may appear within fairly wide limits - 5th to 9th day, and they noted that the pulse was generally full and bounding, and relatively slow.

In 1919 Hatori³⁷ described a form of tsutsugamushi occurring in Formosa. It differed in certain details from the typical Japanese variety. Thus the mortality rate was in the vicinity of 10% as compared with approximately 30%. A bigger proportion

of the cases in Formosa had no rash, and on the whole the disease tended to run a milder course. The epidemiology also was rather different. In Japan the endemic areas appeared to be confined to river valleys subject to flooding, whereas in Formosa cultivated fields and forest lands, lying at the base of mountains, and not subject to inundation, appeared to harbour the vector. Moreover in Formosa Trombicula akamushi was not restricted to field mice to the same extent as in Japan but was a common parasite of other rodents, and of chickens, pheasants, and dogs.

Hayashi (1920)³⁸ gave an account of his work on the etiology of tsutsugamushi from 1906 onward. He described various rod, spheroid, and ring shaped bodies which he considered to be forms of a protozoan and named tentatively Theileria tsutsugamushi.

In 1931 Ogata³⁹ observed gram-negative, pleomorphic non-filter passing organisms to which he gave the name Rickettsia tsutsugamushi. During the same year Kawamura⁴⁰ claimed to have demonstrated Rickettsia-like bodies in the body cavity of Trombicula akamushi, and suggested that these should be named Rickettsia akamushi. This claim was questioned by Hayashi (1931)⁴¹, who pointed out that there are various mites closely allied to Trombicula akamushi, and that all contain Rickettsia-like bodies. He considered that the organism associated with tsutsugamushi disease should be named Rickettsia tsutsugamushi. On the other hand Nishibe and others (1931)^{42,43}, in describing their work with tissue cultures had called the organism found in the tissues of experimentally infected animals, Rickettsia orientalis,

Despite a certain confusion in nomenclature sufficient evidence appears to have been brought forward by these various workers to strongly incriminate a Rickettsia as the causative organism of classical tsutsugamushi disease.

The possibility of tsutsugamushi disease occurring in the

Phillipine Islands has already been referred to in the review of the work of Ashburn and Craig.³³ Sinclair (1930)⁴⁴ gave an account of what appeared to be an indisputable case of the disease occurring in a European woman so far removed from the generally accepted endemic focus of the disease as New Guinea. Rash, ischar, pyrexial period and general signs and symptoms were typical, and although the Weil-Felix reaction was twice negative no mention is made as to whether the "Kingsbury" strain of Proteus X.19. was used or not.

Reference has already been made to the work carried out by Walch¹⁶ (1922) in Sumatra, and his conclusions that most probably the vector of the so called pseudo typhoid of Deli was not Trombicula akamushi as in Japan, but the closely allied T.deliensis, an acarine commonly found in Malaya also, as an ecto-parasite of the rat.

The work of Fletcher and others^{5,6,8}, on tsutsugamushi disease in Malaya has been mentioned, and the differences which according to them existed between this disease and tropical typhus have been indicated; in particular the more gradual onset, the presence of the initial ulcer, the longer pyrexial period, the more gradual fall of temperature, and the absence, or presence to very low titres of the Weil-Felix reaction.

While certain very typical and clear cut instances of each disease may readily be distinguished by these criteria, in a considerable number of cases differentiation may be a matter of no little difficulty. Wolff²¹ from his experience of both diseases in the Dutch East Indies, has asserted that the only constant distinguishing feature is the presence or absence of the initial ulcer. He described the case of a native admitted with fever which showed the typical curve of tropical typhus, and in which he obtained a positive Weil-Felix reaction to a titre of $\frac{1}{1000}$ with the "K" strain of Proteus X19. The patient was discharged, but was re-admitted six months later

with high fever and a typical tsutsugamushi scrotal ulcer. His blood serum again agglutinated the "K" strain of Proteus X.19 to a titre of $\frac{1}{1000}$, but only after the lapse of twelve days. It was obvious therefore that agglutinins arising from the first attack of fever had disappeared, and that the second positive reaction was a direct result of the disease with which it was associated. He made the significant statement that tropical typhus, or possibly tsutsugamushi disease without ulcer, does not confer immunity from tsutugamushi disease with ulcer. Further he was of the opinion that it was still an open question whether the two diseases were caused by different viruses, or whether, rather they were transmitted by different vectors, the presence or absence of the local ulcer being dependant upon the particular vector involved.

With the Weil-Felix reaction to a titre as high as $\frac{1}{1000}$, it would in practice be impossible to differentiate between a great number of cases of tsutsugamushi disease without ulcer, and tropical typhus of the "K" form, either on clinical, or, in our present state of knowledge at least, etiological and epidemiological grounds.

The problem of the degree of relationship existing between typhus-like fever in Malaya is rendered more complex when the urban or "W" form is taken into consideration. Attention has already been drawn to the observation made by Anigstein^{11, 12} of a transformation from the "K" to the "W" form during passage through laboratory animals, the rat in particular being in his opinion the causative agent, and there appears to be no reason why this should not occur in nature. It would not however explain the almost entire absence of the "W" form in human cases from rural areas, and the peculiar rarity of the "K" form in urban centres.

With no clear knowledge concerning the vector, or vectors

it may be considered venturesome to embark upon even a hypothetical explanation for this. It is possible, however, that tsutsugamushi disease may be the original form in which typhus-like disease existed in Malaya, brought thither from a distant endemic area by migrant birds, a possibility suggested by Walch¹⁶ who found mites on Acrocephalus orientalis, a bird which migrates southward from Japan during the winter months. It is possible that the adaptation of the virus previously carried by Trombicula akamushi to a vector of a different though closely allied species, Trombicula deliensis, may modify its virulence to a varying degree, so that while clinical tsutsugamushi disease may still appear in a small number of cases, it is of a milder type, and is associated with a lower mortality rate than the original Japanese form. In a growing number of cases, however, the resulting disease is clinically tropical typhus, varying from cases which, were it not for the absence of the initial ulcer, would from a consideration of the mode of onset, length of pyrexial period, and mode of defervescence, be diagnosed as tsutsugamushi disease, to the more typical type with abrupt onset, comparatively short pyrexial period, and rapid fall of temperature.

So far as the urban form of tropical typhus is concerned it would seem that T. deliensis suspected in rural areas, can play little part as a vector, since Fletcher⁵ has stated that of fifty four rats trapped in the bazaar of Kuala Lumpur town, not one was found to harbour Trombicula deliensis. Fortyone however, were found to be infested with the more common Trombicula muris. It is suggested therefore that the vector of the urban form of tropical typhus differs from that of the "K" form, and may not indeed be a Trombicula, but possibly a rat flea, as has been suggested by Dyer^{29,45}, in connection with certain cases of endemic typhus in the U.S.A. and by Kodama and others (1932)⁴⁶, in the endemic typhus of Manchuria.

That the transformation from the "K" to the "W" form is a result of the passage from rat to rat by some vector other than the rural Trombicula, is put forward as a suggestion only. That the "K" form is the dominant, probably original type, appears to be shown by the comparatively few occasions upon which the transformation from "K" strain to "W" strain takes place, and the absence of any laboratory record of a transformation in reverse direction having occurred. The clinical record moreover tends to support this view, since of one hundred and sixty four cases of tropical typhus reviewed in Lewthwaite's series,⁹ comprising the great majority of cases occurring throughout the Federated Malay States during a period of two years and four months, only ten were suffering from the "W" form.

All this is admittedly of a speculative and highly controversial nature but the relationship of these three Malayan typhus-like fevers to each other can only be established on unassailable grounds when more intimate and detailed knowledge has been gained concerning vectors and reservoir hosts.

So far as other far Eastern countries are concerned, typhus-like fevers do not appear to be of common occurrence. In 1908 Yersin and Vassal⁴⁷ described an outbreak of a typhus like fever in Annam in French Indo-China, amongst a gang of imported Tonquinese labourers. These men had lately arrived by steamer, and apparently no case had occurred on board. They were engaged in work on a railway embankment, and though this is not specifically mentioned, it no doubt involved close contact with coarse undergrowth. The first case occurred fourteen days after arrival and the symptoms were very similar to the Malayan tropical typhus; sudden onset, suffused conjunctivae, severe headache, lung involvement, prostration and marked nervous signs. The temperature curve was of very much the same type and the fall was by rapid lysis. (See Chart No.10) Five cases occurred, in all of which no rash could be observed.

Convalescence was remarkably rapid. As inoculation of guinea-pigs rats and rabbits with patients blood failed to produce any results they decided to adopt the somewhat drastic measure of inoculating human volunteers. The first case, a Tonquinese labourer, was inoculated with .5 gm of blood taken from a naturally infected patient on the second day of his disease. After an incubation period of fourteen days, the volunteer developed a severe attack of fever, with marked prostration, lung signs, and nervous manifestations. The second volunteer, also a Tonquinese of the same gang, convalescent from malaria, received .5 gm blood taken from the first experimental case on the fifth day of the disease, and after an incubation period of twenty-one days, developed a very severe attack, with sudden onset, continued and remittent fever lasting eleven days, plague like delirium, conjunctival injection, insomnia, and marked prostration. In both cases the temperature fell by rapid lysis, and convalescence was rapid.

Yersin and Vassal considered this to be an example of typhus fever of the Old World type, and suggested that it was probably transmitted by the bite of some insect. This was before Nicolle's incrimination of the louse as the vector of European typhus, and no reference is made to the presence or absence of lice on these patients. On consideration of all the facts as given by them, it seems more likely that this was a form of tropical typhus, and the failure to infect guinea-pigs with patients blood supports this view.

Bablet and Mesnard (1927)⁴⁸ described a fever occurring in Tonquin, which would appear to be a form of typhus-like fever. The death rate was in the vicinity of 3%. In a series of forty-two examinations the Weil-Felix reaction was positive with an indologenic strain of Proteus X.19 in twenty-three cases; in five cases it was positive with the anindologenic "Kingsbury" strain; while in five cases positive results were obtained with both strains.

An interesting situation appears to exist in Manchuria. According to Kodama and others (1932)^{46,49,50}, two distinct types of typhus apparently exist side by side, one the classical louse-borne typhus exanthematicus occurring in epidemic form, the other, which they call Manchurian typhus, persisting in endemic form, and transmitted in their opinion, by the rat flea Xenopsylla cheopis. They claim to have demonstrated Rickettsia-like bodies in the body cavities of fleas belonging to this species, and also in rat lice of the species Polyplax spinulosus, taken from the bodies of rats trapped in endemic areas. They asserted that these Rickettsia like bodies, which they named Rickettsia manchuriae were not identical with Rickettsia prowazeki, though probably of a common origin, and in support of their view referred to a series of animal experiments carried out by them. They found that guinea-pigs inoculated with virus containing material obtained from the endemic form, reacted with marked scrotal swelling, redness, and oedema, while at the same time brain lesions were not constant nor well marked. Moreover abundant Rickettsiae could always be demonstrated in smears taken from the surface of the tunica vaginalis, and from the exudation in the sac. Transmission of the disease through the albino rat also was a matter of comparative ease. All these features were in marked contrast to those obtained by using infective material derived from true typhus. They suggested that the reservoir host of Manchurian typhus was the common house rat, with rat fleas as vectors. They sought to explain the different reactions obtained with the two strains, by suggesting that the one, Rickettsia manchuriae, by passage through animal host primarily, had developed an affinity for the tunica endothelial system, while the other, Rickettsia prowazeki, by constant human heart blood passage had developed an affinity for the vascular endothelial system.

Hoshizaki (1932)⁵¹ claimed to have successfully propagated Rickettsia manchuriae in tissue cultures, and to have demonstrated an increase in virulence one hundred fold after culturing for eleven days. He further stated that no direct relationship appeared to exist between the number of Rickettsiae and the degree of virulence.

Kundu (1932)⁵² described a case occurring in Rangoon. The patient was a Hindoo, a city clerk living in fairly sanitary surroundings, and free from lice. He had not been out of the town for some time before the onset of the disease, which commenced abruptly with fever and headache. The rash appeared on the seventh day, and consisted of indistinct macules on the back and extensor surfaces of the limbs. It was indistinct and faded on the eleventh day of the disease. The patient was very ill, with delirium, alternating incontinence and retention of urine, distended abdomen, conjunctival injection, transient pain in the knee joints, and bronchitis during the second week. The temperature dropped on the seventeenth day, and remained normal after the twenty second day. The Weil-Felix reaction was positive to a titre of $\frac{1}{2000}$, but the strain used was not mentioned. It was suggested that this typhus-like fever might be of Malayan origin, but in view of the peculiarly focal distribution in Malaya, there would appear to be little justification for this opinion, though it is admitted that Rangoon is only a matter of three or four days steamer journey from Penang, and infection might possibly have been carried by a ship's rat. This isolated case of typhus-like fever occurring in Burmah appears to be identical with the urban form of Malayan tropical typhus, and it would be a matter of interest to discover whether a rural form occurs endemically in Burmah or not.

Typhus-like fevers have been known to occur in India for some considerable time. Megaw⁵³ in 1917 described a case which

he compared to Brill's disease, owing to its relative mildness. The patient gave a history of having been bitten by a tick while in the hill country, twenty one days before the onset of the fever.

Megaw suggested that typhus exanthematicus and the Montana type of Rocky Mountain spotted fever, both characterised by a high mortality rate should be placed in one class, and all the other typhus-like fevers with low mortality which he called "Macular fevers" should be classified together under the name of Brill's disease. He objected to the name "paratyphus" as there was no proof that these fevers stood in the same relationship to typhus as did paratyphoid to typhoid. On the other hand he considered that to baldly call these fevers typhus would give rise to a considerable amount of unjustifiable alarm amongst the general public who have grown to look upon this term with dread.

in 1921 Megaw⁴ gave a fuller account of this typhus-like disease as it occurred in Indian hill stations. According to his account the disease tended to run a somewhat milder clinical course than is generally the case in Malaya. The temperature curve however, is reminiscent of Malayan tropical typhus (See Charts Nos. 11 & 12). The disease described was characterised by abrupt onset, rapid rise of temperature, a pyrexial period of about thirteen days, and termination by lysis. A rash appeared about the fifth day, and became conspicuous on the seventh. It consisted of rose red spots and flat red blotches. Bronchial congestion and rapid respiration were frequently present. In many cases the patients were Europeans with no trace of lice, though in several cases a history of tick bite was obtained. Megaw himself contracted the disease twenty one days after being bitten by a tick. In his case the onset was gradual, the fever lasted twelve days, and the temperature fell by lysis. There were no marked nervous symptoms. He suggested that from the evidence available this

fever of the Indian hills was most probably transmitted by a tick with some jungle animals, possibly rodents, as reservoir hosts.

In 1924 and 1925 Megaw^{54,55,56,} again discussed the typhus-like fevers and suggested that in the past these had been wrongly diagnosed, because typhus was considered to be rare in the tropics, and the rash was frequently not observed on dark skinned subjects. Moreover it was usually regarded as occurring in severe and fatal epidemics, and in consequence sporadic cases had been thought to belong to some other disease group. These typhus-like fevers often resemble fevers on the enteric group, and not uncommonly a positive Widal reaction was present in low dilutions, so that their true nature might easily have been overlooked. It had been supposed that typhus was characterised by sudden onset and sudden termination, whereas this was not always the case in the typhus-like fevers of the tropics. Perhaps the most fruitful cause of error in diagnosis, however, was the belief that it was impossible for people living clean, healthy, out-door lives to contract a disease so frequently associated with filth, destitution, and misery.

He elaborated a more comprehensive scheme for classification than he had originally suggested in 1917, using the vectors where known as a basis. Thus typhus exanthematicus was shown as "louse typhus," spotted fever of the Rocky Mountains as "tick-typhus," and tsutsugamushi disease as "mite-typhus." The fever described by him as occurring in the Kumaon hills in India, he included under the heading of "typhus of unknown origin" and in the same category he placed typhus-like fever of South Africa, twelve day dengue of Nigeria, Mossman fever, Adelaide fever, and pseudo typhoid of Sumatra.

In 1928 Megaw and Rao⁵⁷ gave a further interesting account of the sporadic forms of typhus-like fever occurring in various parts of the world and they enlarged Megaw's previous

classification to include under "typhus-like fevers of unknown origin", Brill's disease, endemic typhus of the south-eastern states of U.S.A., Fievre Boutonneuse, pseudo or paratyphus of Kenya, and Malayan tropical typhus.

They described the occurrence of further Indian cases, and stated that in eight instances a tick was implicated, while in other cases tick bite was strongly suspected. The incubation period in the cases with a definite history of tick bite was six to fourteen days. In the majority the Weil-Felix was negative with all strains, but in one European patient a positive reaction was obtained on the twenty first day after the onset, to a titre of $\frac{1}{160}$, with strain No.67 Kuala Lumpur, and incomplete agglutination with the "Kingsbury" strain to a titre of $\frac{1}{40}$.

From the time when attention was first drawn to the occurrence of sporadic cases of typhus-like fever in India by Megaw, cases have been reported from time to time from widely separated localities of the sub-continent. Williamson⁵⁸ reported a case in 1924 occurring in a European soldier. The fever was not very severe, the temperature ranging between 99° and 102°; the pyrexial period lasting for seventeen days. Defervescence was by lysis. There was no definite history of tick bite, but ticks were present in the camp. The patient had been occupying a tent with other comrades but none of these were affected. He was admitted to hospital on the sixth day of illness, and a rash consisting of macules was present on the face, soles of the feet and palms of the hands, papules were to be found on the trunk, and both macules and papules on the limbs, some of which were petechial. Sore throat and conjunctival injection were present. The Widal reaction corresponded with that of an inoculated subject, and there was no rise in agglutination on a subsequent test, so that typhoid could be excluded.

De⁵⁹ in 1930, and Pai in 1931⁶⁰, each described a case corresponding closely with those already described by Megaw. In both the Weil-Felix reaction was negative, but how many strains of Proteus X.19 were used is not mentioned. In one case the patient, a railway guard, gave a history of having been out shooting a short time before the onset of his illness. The other patient, a native cavalryman had a small insect bite on the finger and it was suggested that this might have been caused by a tick whilst he was engaged in grazing horses.

In 1932 Biggam⁶¹ reported cases occurring in European soldiers stationed at Bangalore. In all three cases the temperature fell by lysis on the eighteenth or nineteenth day of the disease (See Charts Nos. 13 & 14.) Again as in Megaw's cases the course of the fever did not appear to be so severe as in the typical Malayan case. Headache and pains in the muscles were marked, particularly in the early stages. The rash appeared on the third or fourth day of the disease, first appearing as macules, later papules, and finally petechiae. In all cases it was of a dusky colour. It appeared all over the body and was observed on the palms of the hands and soles of the feet. There was no conjunctival injection, and apparently no lung involvement. Insomnia was marked in one case and slowness of the pulse for the degree of temperature was present in all three. An interesting feature was the presence in two cases of agglutinins for Proteus X.19 "Kingsbury" strain, to titres of $\frac{I}{150}$ and $\frac{I}{250}$ respectively.

Consideration of the foregoing renders it clear that in India typhus-like fevers with many points in common with the Malayan tropical typhus are occurring. In some of the higher hill stations it may be impossible to altogether rule out the louse as a vector, but on the plains such a possibility is remote. Many of the cases described have been Europeans living a healthy,

open air life, in clean and hygienic surroundings, and some other vector must undoubtedly be involved. Megaw strongly suspects some species of tick, and has brought forward clinical evidence to support that view. So far as can be gathered no actual experimental work has been done to prove its infectivity, and the possibility of more than one vector transmitting the disease must not be overlooked.

The differing results of the Weil-Felix reaction, and the variation in length of the pyrexial periods, suggest that there may be more than one form of typhus-like fever occurring in India. That such a large proportion of the reported cases have been Europeans is a significant feature when it is remembered how comparatively few in number they are. In the more remote districts typhus-like fevers probably occur undiagnosed, and further investigation may reveal their presence with much greater frequency among the native population than would be gathered from statistics. The occurrence of tsutsugamushi-like diseases in India does not appear to have been recorded, but the possibility of its unrecognised existence among the illiterate and ignorant rural population cannot be lightly dismissed.

The presence of typhus-like fevers in Australia is extremely interesting since so far as can be ascertained, typhus exanthematicus has never occurred there, and consequently such fevers cannot be considered as merely mild variations of that disease, such as are sometimes recognised during inter-epidemic periods in Europe.

Under the name of "Mossman Fever" Smithson (1910)⁶² described a continued fever occurring in the Mossman district of North Queensland. The onset was abrupt with headache and fever. The pyrexial period was ten to fourteen days, and the temperature ranged between 102° and 105°F, with morning remissions of some two degrees. The fall of temperature was generally by

rapid lysis. The subscapular and posterior axillary groups of lymphatic glands were enlarged. The patients were dull and lethargic, and occasionally passed into the typhoid state; actual delirium however was not noted (See Charts Nos. 3 & 4.)

The epidemiology is of particular interest. Sugar cane is grown in the district, and only persons actually engaged in the cuttings of the canes were affected; the farmers and millers escaping infection. In his opinion direct contact played no part in the transmission of the disease, and he did not think that mosquitoes could be held responsible. It was noticed that cases from certain farms were more severe than from others. No vector was definitely implicated but Smithson considered that it was probably transmitted by some insect harboured by the sugar canes.

Hone in 1922⁶³ and again in 1923^{64, 65}, described a fever occurring in the city of Adelaide, which had originally been mistaken for typhoid because of headache, pyrexia, relatively slow pulse rate, and the absence of any signs of local disease, apart from some degree of splenic enlargement. On more careful observation however the onset was found to be more abrupt than in typhoid, and the accompanying headache more severe. The rash appeared rather earlier, generally from the fifth to the seventh day, and though at first it might be mistaken for the typhoid rash, it tended later to become more diffuse. Cases with marked rash gave an appearance very similar to that of measles, and this was accentuated by the reddened conjunctivae. Coryza, however, was absent. In severe cases delirium was marked, and the patient looked desperately ill. Nevertheless toxæmia cleared rapidly with defervescence which occurred generally on the twelfth to the fourteenth day of the disease, by crisis, or rapid lysis. In the four cases that died no bowel changes were observed, and in the other organs, save for the signs of severe

toxaemia, nothing significant was observed. The Widal reaction was invariably negative, but after the eighth to the tenth day of illness, B. Proteus, X.19 was agglutinated to titres of $\frac{I}{80}$ to $\frac{I}{1000}$. The reaction was absent in the early stages, firmly established with the approach of defervescence, and most marked in the early stages of convalescence. A fuller account of the serological findings in this series was given by Bull (1923) ⁶⁶.

In the cases investigated body lice were never found, and head lice in one instance only. Many of the patients came from clean homes and there rarely appeared to be any connection between patients, though one group of five came from two adjoining houses. Where groups did occur, no regular period intervened between cases, so that the possibility of direct contagion could almost certainly be dismissed. One striking characteristic brought out by the earlier cases was the existence of occupational foci of infection, so that people living in widely separated districts of the city, but who worked near the one centre, contracted the disease. In many of these cases there was association with the handling of wheat, in which at times weevils were present. Another outstanding feature was the frequency with which housewives, bakers, grain merchants and shopkeepers were attacked. This had already been observed by Fletcher in his studies of the urban type of Malayan tropical typhus, and as will be shown later similar observations were made in connection with endemic typhus of the South Eastern States of the U.S.A.

Wheatland ⁶⁷ in 1926 gave an account of a typhus-like fever occurring in Queensland among farm workers. It was not unlike the fever already described by Hone: the pyrexial period lasted from twelve to fourteen days, and was terminated by crisis or rapid lysis. Severe headache was a prominent symptom, and there was a macular rash, rather similar to that of typhoid, but more

profuse. The Weil-Felix reaction was invariably positive. The mortality rate was only 2%. There was no evidence of contagion, and lice as transmitting agents were definitely excluded. It has been observed that prior to the outbreak a plague of mice had occurred in the district, and coincident with the advent of human cases, mice were found dying in large numbers. The people of the district associated the disease with these sick mice, and called it "mouse disease". It was noted that human cases were almost entirely confined to individuals occupying mouse-infested farms, or handling grain, which had been contaminated by mice. Wheatland was of the opinion that the vector was an ecto-parasite of this animal.

Moore (1927)⁶⁸ described a series consisting of seventeen cases, occurring in Perth and Freemantle, Western Australia. They were characterised by abrupt onset, though in one case there was prodromal malaise. Initial rigor was present in two cases, and in three the onset was followed by epistaxis. Headache was severe and the eyes were congested. A rash was present in all cases on the trunk and limbs, but the face was unaffected. The date of appearance was only noted in one case, the eruption being in evidence on the sixth day. The fever terminated by rapid lysis on the 11th or 12th day. All cases gave a positive Weil-Felix reaction, but there appeared to be two groups, one agglutinating to high titres, the other to considerably lower. In one case broncho-pneumonia was present as a complication. The majority of cases were associated with grocery or grain shops, and these were found to be infested with rats and mice. The commonest ecto-parasite of these rodents was found to be Ctenopsylla musculi which does not affect man, but in a proportion Xenopsylla cheopis was present, and also the rat louse Polyplax spinulosus.

In 1927 Strickland⁶⁹ reviewed the Toowoomba epidemic, and suggested a variety of transmitting agents. He thought that ticks

could probably be discounted, but considered that of the ticks, an Ixode was the most likely. He suggested that a mite would quite possibly prove to be the vector, and accounted for the absence of primary ulcer by postulating a mite with a long proboscis. In this connection he referred to Nagayo's observation that subcutaneous injection of virus gave rise to no local or lymphatic involvement, whereas intracutaneous did. In Australia there was a Gamasid mite, Laelaps australiensis, which satisfied this proviso.

In the same year Hone (1927)⁷⁰ gave a review of endemic typhus as it occurred in Australia, with particular reference to Adelaide. He added little to the clinical description which he had already given earlier. The rash he mentioned might easily be overlooked. It was commonest on the trunk, spreading to the thighs, and occasionally down the arms, and appeared between the 5th and 7th days. The face was rarely affected. The rash consisted of irregular dusky macules and papules, and subcuticular mottling was frequently observed. Petechiae were rare, and only occurred in severe cases. The rash faded at, or just before defervescence, which occurred rather abruptly about the 12th to 14th day. Leucocytosis was common, though in some cases leucopenia occurred. One case of suppurative parotitis occurred, and one of thrombosis of the iliac vein, but the commonest complication was broncho-pneumonia of a hypostatic type. In a series of 85 cases 5 deaths occurred, giving a death rate of 6%. Weil-Felix reactions were positive with indologenic strains of Proteus X.19. but he suggested that standardisation of the various strains of Proteus was necessary in Australia, in order to have a firm basis for comparison. He stated that cases occurred in localised outbreaks, and were more prevalent in summer months. This he thought might be due to an increase in the rodent population following the spring breeding, and also

possibly to an increase in the vector, particularly if this should prove to be a rat flea. Other outbreaks, he had become convinced, were connected with some local disturbance of the rat population, such for example as the moving of large quantities of grain.

Penfold and Corkhill (1928)⁷¹ described a case of typhus-like fever occurring in Melbourne characterised by sudden onset, fever, headache, delirium, and pain in the chest. The fever terminated on the 10th day. A positive Weil-Felix reaction was obtained both with an indologenic strain of Proteus X.19. and with the anindologenic "Kingsbury" strain.

In 1930 Davis⁷² recorded a case occurring in Brisbane, with sudden onset, severe headache, and a rubeolar rash appearing on the 7th day and fading on the 11th. The pyrexial period was of twelve to thirteen days duration and was followed by rapid convalescence. Blood serum taken on the 12th day gave a positive Weil-Felix reaction. Prior to his illness the patient had been employed as a dock labourer, and had been engaged in handling grain.

In the same year Newman (1930)⁷³ described a case occurring in Sydney with very much the same signs and symptoms as the Adelaide cases. The pyrexial period lasted 12 days, and the Weil-Felix reaction was positive to a titre of 1/960. The patient was employed in a garage, and a few weeks prior to his illness some old sheds, which probably harboured rats, had been demolished. His home also was rat infested. Lice were not implicated in either of the foregoing cases, and no further cases occurred.

In Australia there appears therefore to be both urban and rural typhus-like fever, but whether these can be distinguished from each other as can the Malayan types, is not clear. Serologically, and so far as can be ascertained clinically, the diseases of Adelaide and other urban centres, and those of Queensland are the same, and correspond very closely with the

urban type of Malayan tropical typhus. In all three agglutination takes place with the indologenic strains of Proteus X.19. The relationship of Mossman fever is not quite so clear, since the results of the Weil-Felix reaction are not known. One important point which arises from a consideration of the urban and rural types of disease found in Australia, so far at least at Adelaide and possibly the other affected towns, and Queensland are concerned is the possibility that both have the same vector since both are associated with grain in one form or another. This may explain why both belong to the same serological group in contrast to the Malayan forms, which it is suggested probably have different vectors. More knowledge concerning Mossman fever would be of considerable interest in this respect. It is possible that owing to its association with sugar canes, its vector differs from that of the other Australian varieties described, and it may prove to resemble more closely the Malayan "K" form or scrub typhus.

In 1911 McNaught⁷⁴ under the title "Paratyphoid fevers in South Africa" described various continued fevers encountered there. The title is misleading since he devoted most of his attention to describing three series of cases of a fever which he admitted was neither characteristic of typhoid or paratyphoid, and which he was convinced would prove to be a distinct entity. He described the disease as being characterised by abrupt onset, severe headache, pains in the back and limbs, flushed cheeks and conjunctival suffusion. A characteristic maculo-papular rash not unlike Rubella appeared earlier in the disease than in typhoid, sometimes being present on the second or third day of the illness. It was widely scattered over the trunk and limbs, the soles of the feet and palms of the hands also being affected. In many cases there were interspersed lighter red spots, rather similar to rose spots. On fading brown stains persisted for some time. The tongue was coated, but neither dry nor brown:

some abdominal fullness was present but distention was not marked; the spleen was generally enlarged. The fever usually lasted from ten to fourteen days, and the fall of temperature was by rapid lysis, or occasionally by crisis. The patient appeared very ill during the first week, but there were no deaths. Convalescence was rapid, and no relapses occurred. He considered it to be closely allied to Brill's disease.

In 1930 Pijper and Dau⁷⁵ drew attention to South African tick-bite fever, and emphasised the fact that it must be distinguished from Tick fever and relapsing fever. A characteristic feature was the presence of an initial sore at the site of the bite, with accompanying adenitis, in this respect resembling the pseudo-typhoid of Sumatra as described by Schüffner. Clinically they considered that it had features resembling Malayan tropical typhus, Rocky Mountain spotted fever, and tsutsugamushi disease. This African fever however was invariably mild, and there were no fatalities.

They reported that in experimentally inoculated guinea-pigs, brain nodules were constantly found, and that these contained Rickettsia-like bodies extremely pleomorphic in character. While some of these were intracellular, the majority were not. In their opinion the Rickettsiae were a direct cause of South African tick-bite fever, and they considered that it occupied a position somewhere between true typhus and Rocky Mountain spotted fever.

In 1931, Troup and Pijper,⁷⁶ described the clinical features of tick-bite fever of Southern Africa. The disease was characterised by a local lesion consisting of a red papule the centre of which later became necrotic. The centre dropped out and the resulting ulcer was one or two centimetres in diameter, and took some three weeks to heal. The neighbouring lymphatic glands were swollen and painful, and there might be lymphangitis but suppuration never took place. Occasionally apart from a slight degree of fever this was the whole picture in mild cases.

More usually, however, there was continuous fever lasting for about ten days, terminating by rapid lysis. Headache was severe and persistent. Pains were present in the limbs, the lumbar region, and the back of the neck. Toxaemia was marked, and hallucinations, and delirium were common. The eyes were generally suffused and there was a varying degree of photophobia. The pulse was generally slow for the degree of temperature, and in severe cases cardiac irregularity occurred. The rash, which usually appeared about the 5th day, consisted of macules or papules, dusky red or bright red in colour, sometimes resembling rose spots. The distribution was variable; the eruption might be discrete and confined to the trunk, or diffuse and appearing all over the body including palms of hands, and soles of feet. Typically it consisted of slightly raised bright red papules widely distributed over the whole body. It generally disappeared with the onset of convalescence, and no staining or desquamation occurred. Agglutinins for Proteus X19, Proteus X.2 and the "Kingsbury" strain were formed. In Pretoria the disease occurred most frequently in summer. In the hotter regions there was no definite seasonal incidence. They stated that it was transmitted not by adult ticks, but by larval forms.

Pijper and Dau⁷⁷ in 1932 described experimental work carried out by them in two South African typhus like fevers namely South African typhus fever, and the tick-bite fever already referred to. They stated in the first place that in their opinion South African typhus should not be considered in a category distinct from European typhus contrary to the view of other South African workers, who on account of clinical variations, and the absence of lice from infected individuals had done so. On the whole they considered it to be milder and less fatal than European typhus. They stated that the serum of patients agglutinated Proteus X 19 and Proteus X 2, but failed to agglutinate

the "Kingsbury" strain of the former.

They regarded the tick-bite fever of South Africa as a typhus-like fever on account of clinical similarity, and the formation of agglutinins in the patients serum for all three strains of Proteus mentioned. Further the virus was transmissible to guinea pigs, with resulting temperature curves resembling those caused by inoculation of true typhus virus and as they had already demonstrated in 1930, nodules were found in the brain tissue on post-mortem examination. They considered, however, that the primary tick-bite sore differentiated it from South African typhus.

On experimental inoculation into guinea-pigs they found that the virus of each of these diseases conferred immunity to subsequent injections of the same virus, but while a previous infection with South African typhus produced immunity to subsequent inoculation with tick-bite fever virus, a guinea-pig recovered from experimental tick-bite fever was susceptible to a later infection with South African typhus.

Apart from the somewhat remarkable observation that apparently a disease capable of producing agglutinins for three strains of Proteus, including the "Kingsbury" strain is unable to confer immunity to a disease producing only two of these agglutinins, while at the same time this second disease protects against infection by the other, there is the further significant point that typhus-like fevers exist in at least two forms in South Africa capable of distinction upon serological grounds.

While undoubtedly classical typhus exanthematicus occurs in South Africa with the louse as vector, a series of cases having been reported by Sheldon⁷⁸ in 1923, there would appear to be no justification for the sweeping assertion that all typhus-like fever occurring in that region belongs to the same category, not for the belief expressed by Sheldon that the extermination

of infected lice would affectively stamp out the disease.

Support for this view is afforded by Scroggie (1931)⁷⁸ who described a series of ten cases occurring in the Port Elizabeth district. The signs and symptoms were those of a mild typhus-like fever characterised by severe headache throughout, slow pulse, a rash appearing on the 5th or 6th day consisting of discrete, irregular red or dusky red macules, which faded without subsequent staining or desquamation. Lice were found on three cases belonging to one family, but in the other seven single cases no trace of lice was obtained, and no further cases occurred in the same households. In six of the cases it was found that the homes from which they had come were rat infested.

Gray (1931)⁷⁹ reporting the laboratory findings in connection with this outbreak, stated that the Weil-Felix reactions were positive with serums obtained from the ten cases in titres up to $\frac{1}{200}$ with Proteus X.19 but were consistently negative with the Kingsbury strain. He noted that leucocytosis was absent in all cases. He suspected ticks to be the vectors, and had commenced experiments in this direction.

In the following year Ross (1932)⁸⁰ described a series of cases occurring in Southern Rhodesia, during the summer and autumn months, this being the period of maximum rainfall. The cases occurred amongst Europeans living in excellent surroundings, predominantly rural, and were widely separated in regard to both time and place. The disease was characterised by abrupt onset, intense headache, nausea, muscular and articular pains, particularly in the lumbar region, conjunctival injection, and photophobia. The patients were generally dull and stuporose and in severe cases a varying degree of delirium occurred. Slight respiratory involvement was common, and the pulse rate was relatively slow. A black necrotic ulcer was present at the onset, the scab generally separating at the time of defervescence, though the scar persisted for a considerably longer period. A

rash appeared about the 4th or 5th day, consisting of discrete dusky red maculo-papules. It appeared initially on the extremities, but when fully developed the whole body was involved including the face. It was however most profuse on the limbs, and the palms of the hands, and soles of the feet were involved. No desquamation occurred, but staining persisted for some time after the rash had faded. Areas of congestion were observed on the hard and soft palates, and in the buccal and pharyngeal mucosa from the 4th day. The temperature rose to 102° or 103° soon after the onset, and was usually continuous. A slight drop occurred with the appearance of the rash, followed by a rise to reach the fastigium about the 7th or 8th day. The fall was by rapid lysis, and the pyrexial period was generally between ten and twelve days. Convalescence was rapid. There were no complications, and only one death occurred. The Weil-Felix reaction was negative as a rule. In five cases carefully investigated, all were negative when the "Kingsbury" strain was employed, while two were positive with a "W" strain to a titre of $\frac{1}{25}$. Animal inoculation failed to produce significant results. He considered that in certain respects the disease resembled tsutsugamushi disease, but was perhaps most closely related to the Fievre exanthématique of the Mediterranean. He suggested that a tick or a mite was the possible vector, and noted that in every case there had been contact with dogs, which at that season of the year were heavily infested with ticks.

This last observation is of some significance, as will be seen from a consideration later of Fievre boutonuse, Fievre exanthématique of the Mediterranean, the typhus like fevers of Rome and Greece, and the eastern type of Rocky Mountain spotted fever. This Rhodesian fever has many features in common with the tick-bite fever of South Africa described by Troup and Pijper⁷⁶

but would appear to differ serologically, since in their type agglutination occurred with three strains of Proteus, including the "Kingsbury" whereas in this type it only occurs occasionally with one, - Proteus X.19.

Further confusion arises when it is remembered that in Rocky Mountain spotted fever, long known to be transmitted by ticks no initial sore has been observed at the site of the bite, nor in the fevers described by Megaw and others in India, in which ticks are strongly suspected to be vectors.

It would be of considerable interest to ascertain whether in South Africa there is one or possibly two forms of typhus-like fevers predominantly rural as described by Troup and Pijper,⁷⁶ and by Ross,⁸⁰ characterised by initial ulcer, and another form as reported by Scroggie⁷⁸ from Port Elizabeth predominantly urban in which the initial ulcer is absent.

Davies and Johnson(1921)⁸¹ described a disease occurring in Nigeria, which they called "a twelve day fever of the dengue group". The signs and symptoms are given below, and from a consideration of these it will be seen that they coincide with the typhus-like fevers described in Malaya and elsewhere, much more closely than with dengue.

The onset was gradual. Headache was intense and insomnia troublesome. During the pyrexial period nervous irritability and depression were common, knee jerks diminished, and muscular pains frequently present. Conjunctival suffusion, and photobia were present in a moderate degree. There was commonly deep pharyngeal congestion. Constipation and a furred tongue were the rule, but there was no abdominal tenderness, distention or vomiting, and no marked enlargement of the liver or spleen. In the early stages a trace of albumen was present in the urine. The pulse was relatively slow for the degree of temperature (Chart Nos. 7,8.). The rash appeared on the fourth to the sixth day of the disease and was described as rubeolar, with slightly

raised spots. It was very profuse, and distributed widely over the body including hands and feet. It was never haemorrhagic and faded after two weeks, though in some instances it was faintly visible for some considerable time longer. The pyrexial period was from ten to thirteen days, the temperature usually reaching its maximum about the fourth or fifth day.

They noted that the cases were widely scattered in their occurrence, and direct contact could rarely be demonstrated. Two cases occurred in one house, but three children living there in contact with the patients were not affected. A medical officer contracted the disease after attending two patients, and one native patient developed the disease eleven days after his European master. They suggested sand flies, or domestic culicines as possible vectors, the latter being particularly numerous at the period of the year in which the cases occurred. They were unable to obtain any evidence of bites by fleas, bugs, or lice, in so far as the European patients were concerned at least, but they made no mention of the possibility of ticks or mites as vectors. A further observation which is of interest when the epidemiology of both tsutsugamushi disease and Rocky mountain spotted fever is recalled, was the occurrence of the disease in association with the rainy season, which in that particular year had been more than usually heavy.

In 1924 Balfour⁸² contributed a paper on "So called pseudo-typhus" to the Kenya Medical Journal, drawing attention to the points of similarity and points of difference between a typhus like fever occurring in Kenya, and other typhus like fevers, notably Fievre Boutonneuse which occurred in North Africa, particularly in Tunis. This fever and the fever of Kenya were similar in that both were associated with joint pains, and were characterised by rashes which were alike in appearance and which unlike most exanthems occurred on the sole of the feet and the

palms of the hands. In the North African variety it could neither be described as macular, or papular, rather it consisted of lenticular spots or nodosities, discrete, rose red or dark red in colour, and fading on pressure. The rash gave the appearance of pimples, and the French name for the disease was descriptive of this; palpation proved however, that in reality the spots were not raised. The rash persisted for some time after defervescence. The disease in Tunis was commonest in autumn and late summer. The pyrexial period lasted about fourteen days, but was associated with little or no malaise. Usually there was conjunctival injection, and while constipation was the rule, diarrhoea might occasionally be present. He mentioned that Conor and Euyat had distinguished Fievre Boutonneuse from Brill's disease on the grounds that in the latter condition prostration was much more severe; headache was intense; morning remissions of temperature were slight; splenic enlargement was present; the face was flushed and labial herpes common; the rash appeared about a week after onset, was morbilliform, and tended in some cases to become petechial.

So far as prostration was concerned Balfour considered that the Kenya fever more closely simulated Brill's disease. He thought that Mossman fever and Queensland fever were distinct from the Kenya variety, though bearing a resemblance to typhus. Finally he questioned Megaw's assertion that the Kenya variety was probably transmitted by a tick, and suggested a mite as a possible vector.

Anderson⁸³ in 1925 described a series of cases occurring in Kenya, and later in 1930 Jewell and Cormack⁸⁴ gave details of a further series of cases, and concluded by comparing the disease seen in Kenya with other typhus-like fevers occurring elsewhere. Consideration of the signs and symptoms described in both these accounts reveals a close resemblance to the urban

form of Malayan tropical typhus. Thus, the onset was abrupt, generally with rigor and temperature which reached 101° or 103° on the first day (Chart No.9). The face was flushed, the eyes bright, with injected conjunctivae and slight photophobia. Occasionally there was an initial erythema which faded with the appearance of the eruption. Jewell and Cormack describe a purplish subcuticular mottling preceding the rash, which appeared on the fourth or fifth day, and apparently varied in character from discrete rosy spots to irregular papules varying from the size of a pin head to that of a large pea, appearing in crops and covering the body extensively, including the soles of the feet and the palms of the hands, but not occurring on the scalp. At first it disappeared on pressure, but later brown staining was revealed which persisted after the rash had faded. Jewell and Cormack did not observe any eruption in the mouth but noticed deep congestion of the fauces. Anderson occasionally observed the presence of rash on the soft palate, and in a proportion of severe cases he described the occurrence of punctate petechiae scattered over the body. Both described the facies as being reminiscent of measles, dusky, bloated, and dull. The progress of the disease was characterised by prostration, drowsiness, marked insomnia, apathy, intense headache, and in severe cases, quiet delirium. Joint and muscular pains were commonly present, and Anderson stated that tenderness of the calf muscles was a fairly constant sign. The spleen was not generally palpable. In a proportion of cases the lymphatic glands were slightly enlarged but never suppurated. In the well developed stage the conjunctivae were brightly injected. The urine contained a trace of albumen. The pulse rate was relatively slow for the degree of temperature. The Weil-Felix reaction was positive in the cases tested, agglutination being obtained with Proteus X 19 strains, including the

"Warsaw" strain (indologenic), but not apparently with the "Kingsbury" strain. Complications did not appear to be common, Anderson reported two cases, pleurisy and phlebitis occurring in one, and mild pleurisy in the other. Jewell and Cormack described one case in which thrombosis of both internal saphenous veins developed, and another in which broncho-pneumonia supervened.

In the latter series out of twenty one cases there were two deaths.

An interesting feature reported by Jewell and Cormack was the presence of an angry looking mark about the size of a shilling which might have a small ulcer in the centre, ascribed by the patient as an insect bite. It was usually found on the fore-arms and legs, and though the corresponding lymphatic vessels might be tender, and the glands enlarged, suppuration never took place.

While cases occurred throughout the year, Anderson considered it was commonest from September to December, and from March to May, the two periods of heaviest rainfall. Jewell and Cormack gave August to December as the period of maximum incidence.

The epidemiology is obscure. They did not think that the vector could be a tick, as their patients were frequently bitten by ticks whose bites could easily be recognised; though they admitted that an infected bite might differ considerably from an ordinary bite so that patients would fail to recognise its true nature. They suggested that a mite would probably prove to be the vector, and while the reservoir host is not known, they suspected the rat.

In 1932 Tonking⁸⁵ inoculated a guinea-pig with an emulsion prepared by excising a portion of the initial lesion from a patient whose blood serum later gave a positive Weil-Felix reaction. The guinea-pig reacted with fever and a characteristic scrotal lesion, very similar to those previously described by

Mooser¹³ in Mexican typhus, and Anigstein^{11,12}, in Malayan tropical typhus. Smears from the tunica vaginalis, and from the exudate in the sac revealed minute coccoid, or slender rod-shaped bodies. Some of the latter were diplo-bacilli with bipolar staining. Pleomorphism was a prominent feature. Rickettsia-like bodies were found in the brain, testes, and adnexa. He was successful in transmitting the infection in series through four passages.

This disease of Kenya is of peculiar interest since it presents features common to a number of widely scattered typhus-like fevers. Mention has already been made of Balfour's⁵⁴ comparison of this fever with Fievre Boutonneuse of Tunis. The primary ulcer apparently at the site of inoculation is a feature observed in the tick-bite fever of South Africa, Marseilles fever, and tsutsugamushi disease. Unlike the latter disease, however, no agglutinins are formed for the "Kingsbury" strain of Proteus X 19. The identification of the vector of this disease will prove interesting. Balfour had suggested a mite; Megaw a tick. In view of the elevation of the endemic district, 5,000 feet above sea level, and on the analogy of the role played by the tick on Rocky Mountain spotted fever, and of its suspected role in Megaw's hill fever of India, the tick would appear to be the more likely vector in Kenya. This supposition is strengthened by the primary lesion, and its resemblance to that occurring in South African tick-bite fever, and the "tache noire" of Marseilles fever, and Fievre Boutonneuse, all of which are believed to be carried by ticks.

A further point of some interest is the association of the maximum incidence of the disease with the wet season. In this respect it shows similarity to the fever described by Davies and Johnson in Nigeria to that described by Ross in Southern Rhodesia, to tsutsugamushi disease, and to Rocky Mountain spotted

fever. It is probably most closely related to the tick-bite fever described by Troup and Pijper and to the Rhodesian fever described by Ross, despite the inconclusive Weil-Felix reaction in the latter disease.

The Fievre Boutonneuse of North Africa has been mentioned in passing and there is little further to add concerning this disease (Temp. Chart No. 6.) It occurs in the hot season, principally amongst field workers and people living in close contact with dogs. According to Scott (1930)⁸⁶ the Weil-Felix reaction is not always constant. The disease has been transmitted to monkeys, but guinea pigs have proved refractory.

Boinnet and Pieri⁸⁷ in 1927 discussed the fever occurring in Marseilles, which had various features reminiscent of Brill's disease. It had an abrupt onset, with headache, and rapid rise of temperature. It was frequently associated with congestion of the fauces. The rash, which appeared about the third day consisted of numerous spots at first pink, but later becoming violet. It commenced on the legs, and rapidly extended upwards over the body, finally reaching the face. It never became petechial, and generally faded after about a week, coincident with the fall in temperature. In nearly all cases a small black scar was found on some part of the body. The constitutional symptoms were not severe but occasionally nervous signs resembling meningitis were observed, and at times congestion of the bases of the lungs. Foetid diarrhoea and abdominal pain sometimes occurred. Only one fatal case was reported. The Weil-Felix reaction was negative. The cases were widely scattered and no two cases occurred in one house. Lice were not considered to play any part in transmission, and no parasites were found on the patients.

Scott⁸⁶ did not consider this a mild form of typhus, because of the absence of lice from the patients, the macular

nature of the rash, the presence of abdominal symptoms, the absence of conjunctival injection, and the negative Weil-Felix reaction. Moreover inoculation of patients blood into guinea-pigs was without effect, and while a febrile reaction was produced in monkeys, they were not rendered immune to a subsequent injection with the virus of true typhus.

He mentioned that Burnet and Durand considered this fever to be the same as Fievre Boutonneuse of Tunis and Morocco, and considered that it occupied a position midway between true typhus and tsutsugamushi disease. They classified it with Megaw's Indian fever, as belonging to the tick-typhus group.

On the other hand Plazy and Marcandier (1930)⁸⁸ found that in their experience the Weil-Felix reaction was constantly positive in Marseilles fever, as in the other typhus-like fevers of the Mediterranean, to titres of $\frac{I}{1280}$ and $\frac{I}{2240}$.

It has become increasingly evident in recent years, that typhus like fevers, sporadic in their nature, occur in Europe, in circumstances which almost certainly preclude transmission by the louse. Plazy and Marcandier (1930)⁸⁸ confirm the presence of a positive Weil-Felix reaction in the fever of Toulon and it is also referred to by Scott⁸⁶. It differs from Marseilles fever in that the "tache noire" is absent, but both are believed to be most commonly transmitted by a dog tick, Rhipicephalus sanguineus. Plazy and Marcandier, however, also implicated a rat mite - Dermanyssus muris, in the case of Toulon fever. This fever is very similar to Brill's disease excepting that agglutinins do not appear until defervescence, and maximum titres are not obtained until the tenth to twentieth day of apyrexia.

Marcandier and Pirot (1932)⁸⁹ stated that virus obtained from the brains of rats captured on warships at Toulon, produced, after inoculation into guinea-pigs, a reaction similar to that

caused by Mexican typhus virus. Fever, and scrotal lesions occurred, and they succeeded in transmitting the virus successfully through several passages. Rabbit inoculation resulted in the formation of agglutinins for Proteus X.19, positive Weil-Felix reactions occurring up to a titre of $\frac{1}{700}$.

Scott⁸⁶ mentioned a disease prevalent in and around Rome, which was clinically similar to Brill's disease, and serologically like Toulon fever. In this fever, as in the other typhus-like fevers of the Mediterranean region, lice did not appear to transmit the disease, but it was observed that patients had been closely associated with tick-infested dogs. From the description of this disease given by Pecori (1929)⁹⁰ and Alessandrini (1929)⁹¹ its inclusion among the typhus-like disease would appear to be fully justified. The malady was characterised by abrupt onset, severe aching, generalised muscular and articular pain, particularly in the lumbar region, conjunctival injection, insomnia, and delirium, usually of a quiet type, but occasionally noisy. The temperature generally fell by rapid lysis. The eruption was variable, consisting of irregular rosy macules or papules, and occasionally it became petechial. There appeared to be no evidence of direct contagion, and both suggested Rhipicephalus as a possible vector.

According to Scott⁸⁶ similar fevers have been found in other parts of Italy, Tripoli, Roumania, and some parts of France. In some cases the disease was similar to Fievre Boutonneuse, with "Tache noire", and an extensive rash commencing on the abdomen, spreading to the chest, upper arms, and legs, and in a day or two reaching the face, palms of the hands, and soles of the feet. The Weil-Felix reaction was not always constant. Monkeys generally reacted to inoculation of infective blood taken between the second and ninth days of the disease. Dog ticks were believed to be common vectors.

Lepine (1932)⁹² reported the presence of a virus in the brain of rats caught in areas in Athens and Pireus where a typhus-like fever was endemic. He successfully infected guinea-pigs by the inoculation of a brain emulsion obtained from these rats. Later Lepine and others (1932)⁹³ discovered the presence of virus in the rat fleas Xenopsylla cheopis and Leptosylla musculi taken from rats in the endemic areas. Inoculation of this virus into guinea pigs produced the typical scrotal lesions characteristic of Mexican typhus, and of the endemic typhus of the south-eastern United States. They suggested that Xenopsylla cheopis was the principal vector of the virus from rat to rat, and possibly from rat to man.

Again according to Scott⁸⁶ a disease occurred in Portugal known as escharo-nodule which appeared to have all the characteristics of Marseilles fever, including the initial "tache noire" followed in two to four days by an eruption. In nine cases tested the Weil-Felix was negative, but the number and character of the Proteus strain used was not given.

He referred also to a form of benign typhus found in Palestine, which generally occurred in agriculturalists. The Weil-Felix reaction was positive. Lice were not considered to be the vectors in this disease. It would appear to be very mild in character, since of eighty three cases reported in the course of one year there was only one death.

It is realised that in many of these examples of endemic or sporadic typhus occurring in Europe and the near East, it is difficult to exclude the louse altogether from any part in causation. The evidence however, seems to indicate that a modified form of typhus can occur, with an epidemiology differing widely from that of true typhus, with most probably an acarine vector, the nature of which must almost of necessity presuppose some reservoir host apart from man. Unlike true typhus the

incidence of the disease is greatest in the hotter months, and in many instances the patients lead outdoor, and presumably healthy lives.

Endemic typhus like-fevers have probably been more thoroughly investigated in America, particularly in the United States, than elsewhere.

Reference has been made to the occurrence of Brill's disease, and Tabardillo or Mexican typhus. Little attention need be devoted to the latter disease, in so far as its typical manifestations in the elevated regions of Mexico are concerned. There it occurs in a form practically indistinguishable from the typhus of Eastern Europe. It is associated with poverty, undernourishment and lice. The suggestion of Zinsser and Castaneda²⁵ that minor biological differences in the virus may exist has previously been mentioned, but clinically and epidemiologically they may be considered the same disease.

Brill's disease is more difficult to classify. According to Dyer³¹, Brill in 1915 recognised that the fever which he had first described in 1898 was typhus. Clinically it showed many of the signs and symptoms of classical typhus, but to a milder degree, and the mortality rate was less than 2%. He was struck by the patchy distribution of the disease, and the fact that contact between infected persons could rarely be demonstrated. The greatest incidence moreover was in summer and autumn, in contra distinction to true typhus, a disease of the colder months. In view of all these facts, Brill suggested that some vector other than the louse should be sought for. The work of Anderson and Goldberger⁹⁴ in 1912, in which they demonstrated cross immunity between Brills disease and Tabardillo, seemed definitely to prove the former disease to be a mild sporadic form of true typhus, and this view is still accepted by many authorities.

Maxcy and Havens⁹⁵ in 1923 described a series of cases

occurring in Alabama, characterised by fever lasting from twelve to fifteen days (Chart No.5), having a macular or maculo-papular eruption. In all cases a positive Weil-Felix reaction was obtained. No source of infection could be found, in no instance had there been contact with infected persons, and none of the patients harboured lice.

In 1925 Sinclair and Maxcy⁹⁶ described a further series of cases occurring in the Rio Grande Valley on the Mexican border, in which the symptoms were comparatively mild, more especially when contrasted with the typical Tabardillo of the interior. Body lice were not often found though head lice were common. They apparently considered this to be Brill's disease.

Attention was thus focussed on the south-eastern and south-western States of the U.S.A. and further descriptions of this endemic disease were published by Maxcy (1926)^{97,98}; Mooser (1928)⁹⁹. Maxcy (1929)¹⁴ and Dyer and others (1931)²⁹ and (1932)¹⁰⁰. A study of these various accounts discloses a common, and very constant clinical picture most fully delineated, perhaps, in the two reports by Maxcy in 1926.

His observations were based upon a series of two hundred and nine cases occurring during a period of two years, in Alabama and Georgia.

The onset was abrupt in 65% of the patients, with fever, headache, malaise, and early prostration. In some cases the onset was preceded by malaise for a varying period up to twelve days. There was a step-like rise of temperature with remissions, and throughout the course wide variations were recorded. The fastigium was generally reached between the fifth and eighth days. In 86% of cases defervescence took place between the twelfth and sixteenth day. In four abortive cases pyrexia only lasted ten days. The eruption appeared most frequently on the fifth day. The most outstanding feature was irregularity with

regard to size, outline, elevation, colour and distribution. Most parts of the trunk and limbs were affected to a varying degree, but the face, palms of the hands, and soles of the feet were generally spared. It consisted chiefly of macules or slightly raised papules, generally appearing first on the chest or abdomen, occasionally preceded by subcuticular mottling commonest on the interscapular region. The colour tended to change from a dull red to a dusky purple tinge. In several cases petechiae were present, and in a few no rash was observed. There was generally evidence of moderate pulmonary congestion, and Dyer refers to the frequent occurrence of unproductive cough. Nausea was a constant symptom and vomiting occurred in the early stages in a large number of cases. Constipation was the rule. The spleen was rarely palpable. Headache was severe throughout, and pain at the back of the neck was a frequent symptom. Pain and tenderness localised to some particular area, such as the lower back, or calf muscles, was often noted. The commonest mental signs were dullness and apathy, ranging from a mild degree, to profound depression or stupor, or a combination of apathy with irritability. In 27% some degree of delirium was present, usually at the height of the fever. Convalescence was prolonged as a rule. Complications were uncommon; in two cases broncho-pneumonia occurred; in one thrombosis of the femoral vein, while in a further case which ended fatally, suppurative parotitis supervened. The mortality rate was between 2% and 4%. In 76% of cases tested, the Weil-Felix reaction was positive to a titre of $\frac{1}{100}$ or higher.

Maxcy was of the opinion that the disease was clinically indistinguishable from mild typhus, and quoted Friedman to the effect that in Old World typhus in inter-epidemic periods, and in endemic areas the disease was mild and the mortality rate under 7%. His conviction that this disease actually belonged to the

typhus group was strengthened by the presence of positive Weil-Felix reactions in the majority of cases, and by the successful transmission of the disease to guinea-pigs by inoculation of patients' blood.

The epidemiology however appeared to be very different. From the available information the disease seemed to be confined to the southern districts of the States. The maximum incidence occurred in summer and early autumn, and cases were scattered with regard to time and place. A striking feature was the number of infected persons engaged in "trade" particularly those engaged in the handling of meat, groceries, grain and flour. In Montgomery and Savannah, two of the affected towns, one third of the patients were engaged in some such occupation. No cases could be traced to direct contact, and patients came from widely separated districts. The greatest concentration of cases appeared to be in the business quarters, and infectivity seemed to cling to certain premises, so that persons working in the same building might be affected, at considerable intervals of time. Lice were found on only 2% of patients, and the louse could be discounted as a vector in many cases on account of the social status of the patients, who were generally persons earning a reasonable living, and residing in satisfactory surroundings. No cases occurred in the goals, poorhouses, or lodging houses and the very poor, and the workless escaped. The fact that the greatest incidence was in the summer, was also against its transmission by the louse.

Investigations were carried out by various workers with the object of identifying the vector, or vectors. In 1930 Mooser and Dummer¹⁰¹ succeeded in infecting lice (Pediculus corporis) by rectal injection of the virus of endemic typhus of the southeastern States. Examination of these lice revealed Rickettsiae bodies indistinguishable morphologically from those found in lice infected with Mexican typhus virus, and inoculation of an

emulsion of crushed lice into guinea-pigs produced a typical reaction. They did not think, however, that these findings disproved Maxcy's hypothesis to the effect that endemic typhus was not carried by the louse, but they did suggest that once the disease had gained an entrance into man from Maxcy's hypothetical reservoir, it was capable of subsequent transmission from man to man by the body louse.

Castaneda and Zinsser¹⁰² carried out similar experiments using in this case, Mexican typhus passage virus. Their results with lice were similar to those of Mooser and Dummer. They also succeeded in infecting the bed bug Cimex letularius by rectal injection, and inoculation of guinea-pigs with an emulsion prepared from the organs of the bugs, resulted in typical reaction. Infection however did not occur by allowing infected bugs to feed upon guinea-pigs, nor when their crushed bodies were rubbed into unbroken skin. They thus failed to demonstrate a natural cycle of infection, and it is unlikely that the bed bug plays any significant part in transmission.

Mooser and others¹⁰³ in 1931 demonstrated the transmission of Mexican typhus from rat to rat, by the rat louse (polyplax spinulosus), They found that as in the case of the human louse, Rickettsia like bodies multiplied in the gut to an enormous extent, and ultimately brought about the death of the louse. Owing to the fact that this species of louse had never been known to feed on man, they did not consider it a possible vector of the human disease. They failed to transmit infection from rat to rat by fleas, ticks or mites, but suggested that possibly the disease was carried from rat to man by the flea Xenopsylla cheopis.

Mooser¹⁰⁴ while investigating Tabardillo in 1931, had found naturally infected rats in Mexico City, and had been able to reproduce the disease in laboratory animals by inoculation of virus obtained from these rats.

Very similar results were obtained in the case of endemic

typhus by Dyer and his co-workers,¹⁰⁰ who in view of the frequency with which rats appeared to be associated with the urban form of that disease, trapped large number of these from endemic areas. They were all Rattus norvegicus and were found to harbour Xenopsylla cheopis and Ceratophyllus fasciatus. Emulsions of these fleas on inoculation into guinea-pigs, produced a typical infection, with pyrexia and scrotal swelling, and they were able to reproduce the disease with passage virus to the forty-fifth generation. They compared these strains obtained from rats, with strains Maxcy's from a human case of endemic typhus and a Breinl strain of Old World typhus, and found that the first two produced results in guinea pigs, clinically identical. Cross immunity was found to be complete between all these strains. Monkeys inoculated with strains of virus isolated from the rat flea produced by the end of the first week, agglutinins for Proteus X.19. "O" in the majority of cases. Histological examinations of the brains of guinea-pigs reacting to the flea strain, revealed lesions similar to those produced by inoculation of human strains of endemic typhus, and smears from the tunica vaginalis demonstrated the presence of Rickettsia. They found that uninfected fleas of the species Xenopsylla cheopis became infected by allowing them to feed upon an infected rat, and further that fleas so infected were capable of transmitting the disease to an uninfected rat.

Dyer and his co-workers (1932)¹⁰⁵ prepared an emulsion from the brain of a wild rat trapped in a focus of endemic typhus with which they inoculated guinea-pigs. Typical reactions were produced and they were able to demonstrate complete cross immunity between this strain, and known endemic typhus strains. Further rabbits inoculated with this virus produced agglutinins for Proteus X.19. "O" type to a titre of in one case $\frac{I}{640}$.

As a result of further work Dyer and others (1932)⁴⁵ concluded that the virus of edemic typhus was capable of enormous multiplication within the body of the rat flea, so that forty

days after feeding $\frac{1}{128000}$ part of a flea contained sufficient virus to infect one guinea-pig, and considered that this, in conjunction with their previous observations, strongly incriminated the rat flea Xenopsylla cheopis as the vector of the endemic typhus encountered in the south-eastern States of the U.S.A.

Reference has already been made to the work of Dove and Shelmire (1931)³⁰ who believed that a tropical rat mite (Liponyssus bacoti Hirst) was capable of transmitting the disease in Mexico.

In 1932 Mooser and Castaneda¹⁰⁶ carried out a wide investigation of the ecto parasites of rats in Mexico, with a view to determining if possible, their relative importance as vectors. They were unable to confirm the findings of Dove and Shelmire so far as Liponyssus bacoti Hirst was concerned. They found, however, that fleas were more constantly infected than lice, and this applied to several species; Xenopsylla cheopis, Ceratophyllus fasciatus, Leptopsylla musculi, Ctenocephalus canis and Ctenocephalus felis. The two latter, however, they considered to be of no practical importance since they were rarely found on rats, while Leptosylla musculi could also be ignored since it never attacked man. Theoretically they considered the flea to be a more dangerous vector than the louse, on account of its longer life. In practice, however, it was much less harmful, and this they believed to be due to anatomical differences. In the flea Rickettsiae were never found in the salivary glands or anterior portion of the oesophagus, the virus apparently escaping by the faeces, as in the case of the louse. In contrast to the findings in the latter, however, comparatively few Rickettsiae were present in the lumen of the intestine, the discharge of any considerable number into the gut

being apparently prevented by the presence of the peritrophic membrane in the flea. Moreover as flea bites were less irritating, there was less likelihood of natural infection taking place as a result of inoculation of the virus by scratching, while the harder body rendered crushing of the flea into an abrasion more improbable.

At the same time attempts were made to produce a vaccine capable of protecting against these diseases.

Zinsser and Castaneda (1931)¹⁰⁷ treated Mexican typhus tunica vaginalis material for 24 to 48 hours with .2% formalin. They injected guinea-pigs with approximately 5.c.c. of the preparation and they believed that this afforded protection against a subsequent injection of European typhus virus. Later Zinsser and others (1931)¹⁰⁸ fed rats and guinea-pigs on a vitamin deficient diet by which means they considered a more constant and abundant source of vaccine material could be assured, since such animals developed a more severe infection when inoculated with Mexican typhus virus. Zinsser and Castaneda (1931)¹⁰⁹ described the preparation of a vaccine prepared from infective material obtained from the peritoneal washings of a guinea-pig infected with Mexican typhus virus, and previously rendered more susceptible by the induction of experimental scurvy. The material was washed out with .2% formalin in physiological saline solution, and was allowed to stand for 48 hours. 4.c.c. were injected into guinea-pigs on the 3rd, 13th and 18th days, and these reacted with a sharp rise of temperature due they thought to the toxicity of the vaccine. These guinea-pigs were protected against a subsequent inoculation with virulent material, the controls reacting in the characteristics manner. Zinsser and Castaneda¹¹⁰ again in 1931 prepared a vaccine by inoculating with virulent material from Mexican typhus, a rat, in which leucocytosis had been inhibited by the previous

injection of benzol. The rat was killed three or four days later, and the Rickettsiae from the peritoneal cavity and tunica vaginalis were extracted with 20 c.cs of .2% formalin in salt solution. They admitted that standardisation of a vaccine so obtained was difficult, and would continue to be, so long as its production depended upon living tissue cultures. The injection of 5 c.c. of this vaccine into Macacus rhesus produced only a transient rise of temperature and the subcutaneous injection of 3 to 4 c.c. in man caused no reaction. They were unable to say how long a vaccinated animal would remain relatively resistant.

Dyer and others^{III} in 1932 prepared a vaccine from fleas infected with endemic typhus of the southern states. These were emulsified in salt solution, treated with phenol and standardised so that 1 c.c. of vaccine contained the virus from twenty fleas. Of sixteen guinea-pigs inoculated with 1 c.c. of this vaccine, eight reacted to a greater or less degree, when injected with virulent material three months later, while eight were immune. They considered these results very encouraging in view of the fact that with the batch of fleas used $\frac{1}{50}$ part of a flea contained just sufficient virus to infect a guinea-pig. They hoped to get more satisfactory results by using a virus so potent, that $\frac{1}{128,000}$ part of a flea was infective for a guinea-pig.

In view of cross immunity reactions between Mexican typhus, endemic typhus of the U.S.A., and European typhus, it is not too much to expect that the preparation of a vaccine effective for any one of these will be of equal value for the others, if not indeed for some other of the typhus-like fevers, particularly the urban forms and those producing agglutinins for indologenic strains of Proteus X.19.

So far the endemic typhus described has been for the most

part, confined to urban areas, though no vector has actually been implicated, the flea Xenopsylla cheopis has been suspected.

In 1926, however, Spencer¹¹² described a case of typhus-like fever following tick-bites, occurring in a woman in Norfolk, Virginia. After an incubation period of ten days the disease commenced abruptly with chill, fever, severe headache, muscular and joint pains. On the fifth day a faint pink rash appeared on the chest and abdomen, but did not persist. On the tenth day, however, it reappeared more definitely. It was distributed evenly over the trunk and limbs, including the palms and soles, but the face was unaffected. The rash consisted of fine petechiae, and discrete irregular, dusky macules, some of which disappeared on pressure, but the majority being distinctly haemorrhagic. The conjunctivae were injected, the patient looked anxious, was mentally dull and apathetic, and concentration was poor. The heart and lungs were normal; the spleen was not palpable. A striking feature was the presence of three small ulcers, with surrounding redness, and swelling at the site of the tick bites. The inguinal glands on both sides were enlarged and slightly tender. The pyrexial period extended to three weeks, the fall of temperature being by lysis. Convalescence was protracted but there were no sequelae. The Widal and Weil-Felix reactions were both negative, though it would appear that in the latter test only one indologenic strain of Proteus X.19 was used. Animal inoculation was without result, so that tularaemia and Rocky Mountain fever could almost certainly be excluded.

This case is notable because of its resemblance to tsutsugamushi disease and pseudo-typhoid fever of Sumatra, both in regard to the length of the febrile period and the presence of initial ulcers. In the latter respect also it is reminiscent of African tick-bite fever, Kenya fever, Fievre Boutonneuse and

and Fievre exanthématique of the Mediterranean littoral.

Rumreich and others in 1931²⁹ and again in 1932¹¹³ described further examples of tick-bite fever in the eastern and southeastern states. Their observations were of peculiar interest since they described two distant typhus like fevers existing side by side. The one, predominantly urban, had all the signs and symptoms of the endemic typhus previously described by Maxcy. This disease in their experience was frequently associated with rats, 78% of the patients having either handled rats or lived in premises infested by rats,

The other type occurring in the same district was entirely confined to rural areas. Close association of the patients with rats was seldom proved, but in 48% of cases a definite history of tick bite prior to the onset of the disease was obtained. This rural type while exhibiting many of the signs and symptoms of the urban endemic typhus, was commonly much more severe. The temperature was generally more elevated, and in grave cases was less remittent. In both diseases the fall was usually by rapid lysis, but in the rural type defervescence was longer delayed, the fever continuing for twenty one days in over 25% of cases, while it lasted less than fifteen days in only 16%. Flushed face, pharyngeal congestion, and occasional bronchitis occurred in both, but conjunctival injection, photophobia, a remarkably slow pulse, and sore throat, were more constantly found in the urban endemic typhus.

On the other hand nervous manifestations were more conspicuous in the rural form, lethargy, insomnia, irritability, stupor and delirium all tended to be more severe and more prolonged. Pain in the back of the neck, abdominal pain and vomiting were frequently present, while there was marked acceleration of the pulse rate. In the urban endemic form splenic enlargement was only detected in two cases, whereas it

was present in 36% of cases of the rural disease. In the latter the rash also was characteristic. It appeared between the 3rd and seventh day, most commonly the third or fourth, first on the wrists and ankles, rapidly becoming generalised. The soles and palms were frequently affected, the face occasionally. In two or three days the rash became petechial and purpuric patches often developed. It was frequently confluent, more especially about the wrists. Staining persisted for several weeks, and desquamation was common. All these features were in marked contrast to the eruption of the urban type, which usually appeared about the fifth day, initially on the trunk, was rarely petechial, usually discrete, and staining and desquamation were uncommon. Convalescence, was rapid in this type, and there were no complications. In the rural form convalescence was protracted, and marked deafness or visual disturbances were occasional sequelae. No deaths occurred in the urban type, but the rural form had a death rate of 22.6%. In both types the Weil-Felix reaction was positive to titres of $\frac{1}{80}$ or higher.

In both diseases males predominated, and the majority of patients were middle aged. In both the greatest incidence occurred during the summer months.

The rural type of disease they thought belonged to the Rocky Mountain spotted fever group, notwithstanding its occurrence so far removed from the recognised endemic area. They believed the responsible vector in this locality to be the tick Dermacentor variabilis, a common parasite of the dog.

Badger (1932)¹¹⁴ prepared an emulsion from this dog tick, Dermacentor variabilis injection of which into laboratory animals produced the same symptoms as were caused by a known strain of Rocky Mountain spotted fever virus (Eastern type). Agglutinins were formed in monkeys and rabbits for B. proteus X.19 and he demonstrated complete cross immunity between the virus of

Rocky Mountain spotted fever and the virus obtained from the tick.

Rocky Mountain spotted fever has already been mentioned when reference was made to Ashburn and Craig's³³ comparison of this disease with tsutsugamushi disease, and many of its main signs and symptoms were indicated then. According to Stitt¹¹⁵ the disease was first noted in Montana in 1890, and in Idaho in 1893, while the first description was made by Wood in 1896. Since that time the etiology and epidemiology have been investigated by Ricketts, and Frick. Wolbach in 1916,^{116,117} and again in 1917¹¹⁸ studied the etiology and pathology, and demonstrated the infectivity of the tick. The disease is transmitted by a tick Dermacentor venustus var andersoni, but according to Manson Bahr¹¹⁹ in order to account for the striking difference in severity between the Montana type with a case mortality rate as high as 90%, and the Idaho type in which it was only 5%, Ricketts suggested there were two different species of tick capable of carrying infection; in the former instance D.venustus, in the latter D.maturatus.

The supposed causitive organism was named Dermacentroxenus rickettsia and displayed many of the characteristics of Rickettsia bodies. It was found abundantly in the endothelial cells of the blood vessels and testes of infected human beings and guinea-pigs, as well as in the bodies, salivary glands and eggs of infected ticks. The organism has not been obtained in pure culture, but will grow in tissue plasma cultures. The general view now held is that this organism is a Rickettsiae, and it has been named Rickettsia rickettsi.

Reference has been made to the work of Neill (1917)²² who observed that changes found in the scrotal sac and tunica vaginalis of guinea-pigs inoculated with the virus of Rocky Mountain spotted fever, and of Tabardillo (Mexican typhus), were essentially the same but were more severe in the former disease,

particularly with regard to the occurrence of necrosis, exudation and profliferation of the vessel walls.

The finding of Pinkerton¹⁵ that no cross immunity existed between European typhus and Rocky Mountain spotted fever has also been mentioned.

The Weil-Felix reaction had been thought to be consistantly negative in Rocky Mountain spotted fever, but in 1929 Kerlec and Spencer¹²⁰ obtained a positive reaction in a proportion of cases, both in experimental animals and in man.

In rabbits inoculated with virus a proportion gave positive reactions with the "Warsaw" strain Kuala Lumpur, while others reacted with the "Kingsbury" strain. The maximum titre occurred on about the ninth day, and as the inoculation period in rabbits is about four days, this corresponds closely to true typhus in which the maximum titre is obtained on about the fourteenth day. Of eight human cases in which a positive reaction occurred, three reacted with the "Kingsbury" strain. In one case the reaction was partial up to $\frac{I}{80}$ while at the same time a positive reaction was obtained with an indologenic strain to a titre of $\frac{I}{640}$. In a second case no reaction occurred with the indologenic strain, but partial reaction took place with the "Kingsbury" strain to a titre of $\frac{I}{160}$. The third case was of peculiar interest since the reactions were carried out one year after the individual had recovered from the disease. No reaction took place with the indologenic strain, the reaction with the "Kingsbury" strain on the other hand, was positive to a titre of $\frac{I}{640}$, and a partial reaction occurred to a titre of $\frac{I}{1280}$.

This work was confirmed and amplified by Spencer and Maxcy¹²¹ in 1930. They concluded that contrary to general belief, a positive Weil-Felix reaction occurred in a majority of cases of Rocky Mountain spotted fever, though on the whole the titres tended to be lower than in typhus. They compared sera from cases of Rocky Mountain spotted fever, endemic typhus of the U.S.A.

and one case of Adelaide fever against a variety of Proteus strains. In the two latter diseases diagnostic titres were invariably obtained with the indologenic strains of Proteus X.19, but the results were inconclusive with all other strains. Rocky Mountain spotted fever showed a tendency to aggluninate not only the indolgenic strains of Proteus X 19 but also Proteus X.2, the "Kingsbury" strain of Proteus X.19 and even on occasion Proteus vulgarus.

In their conclusion they stated that though both endemic typhus of the U.S.A. and Rocky mountain spotted fever are clinically similar the fact that they were immunologically distinct presupposed that the etiological agents were biologically distinguishable even though closely related.

Davis (1932)¹²² was of the opinion that the number of strains required, and the variations in the results, rendered the Weil-Felix reactions of considerably less value than in true typhus. He noted, however, that, as a general rule, agglutination occurred to higher titres with Proteus X.2. than with any of the other strains used, and that, on occasion, this was the only strain with which a significant result could be obtained.

Badger (1933)¹²³ claimed to have demonstrated in guinea-pigs complete cross immunity between Rocky Mountain spotted fever virus, and the virus of Fievre Boutonneuse. This observation, if confirmed, is of considerable interest and importance, more particularly in view of the work which has been recently carried out on a South American typhus-like fever by Parker and Davis, and by Dyer, fuller reference to which will be made when dealing with that region.

As far as can be ascertained there appears to be at least three distinct varieties of typhus occurring in the North American continent, and possibly four. In Mexico, and the Mexican border of the U.S.A. Tabardillo occurs, clinically and epidemiologically

indistinguishable from European typhus, but differing to some degree in its effects upon experimentally inoculated guinea-pigs.

In the south-western and south-eastern states of the U.S.A., an urban form of endemic typhus is found, clinically similar to mild Tabardillo, producing the same results in experimental animals, and indistinguishable on immunological and serological grounds, but differing widely in its epidemiology.

Finally in the western states of the American Union, particularly in Idaho and Montana, Rocky Mountain spotted fever is endemic in certain valleys and foothills of the mountains, and according to Rumreich and Dyer, is also present in rural districts of the eastern and south-eastern states. It has many points in common with the urban endemic typhus, but is generally more severe and protracted, while the eruption displays marked distinguishing features both in regard to its distribution in the early stages, and its later characteristics.

In their immunology and epidemiology these three types are also distinct, but serologically minor differences only can be demonstrated, while the results of animal inoculation vary only in degree.

Schneider (1930)¹²⁴ had differentiated Brill's disease of New York, and the eastern seaboard, from the endemic typhus of the southern states, on the ground that the latter was the more virulent. This however is not in accord with the account given by Maxcy, who apparently did not recognise any outstanding differences since he frequently applied the term Brill's Disease to the typhus like fever of the south. There would appear to be however, a broad tract of country intervening between the focal areas. It is possible that the northern type is of European origin, and the southern of Mexican.

Typhus or typhus-like fevers have apparently occurred in

the South American continent for a considerable period of time. In 1921 Kraus and Barrera¹²⁵ concluded that the typhus fever occurring in Peru, Bolivia, Argentina, and Chile was identical with that found in Europe and the North American continent, in the latter instance Tabardillo no doubt being in their mind.

In 1931, however, Monteiro¹²⁶ gave an account of a typhus-like disease occurring in Sao Paulo, Brazil, which undoubtedly was not typhus exanthematicus. He summarised the various typhus-like fevers occurring throughout the American continent, and mentioned an endemic form occurring in Argentina and Chile, in which the Weil-Felix reaction was positive with Proteus X.19, the result with the "Kingsbury" strain however being as yet unknown. He drew a distinction between these fevers, and that of Sao Paulo, in which the Weil-Felix reaction, unknown with the "Kingsbury" strain was variable with Proteus X.19. Of forty four cases of this disease, seventeen were males, twenty one were females, while in six he had no record of the sex. Twenty six of the patients were between the ages of eleven years and thirty years. The death rate was no less than 77%. The vector was unknown but he suggests an acarine with possibly wild rodents as intermediate hosts. Animal experiments resulted in a high mortality (69%). The incubation period in animals was three to four days and the febrile period lay between four and eight days. Guinea-pigs reacted with fever, and marked scrotal lesions. In monkeys after four days fever, collapse, and death generally supervened, and extensive haemorrhagic lesions were characteristic.

Piza, Salles-Gomes and others (1931)¹²⁷ described the clinical picture in this disease. The incubation period in human beings was unknown. The onset was abrupt, with severe headache, bodily pains, congestion of the face and eyes, and elevated temperature. An eruption appeared about the third days, and was distributed widely over the trunk, limbs, palms

of hands, soles of feet and face. It was irregular and of dusky red colour, in severe cases giving the appearance almost of extensive ecchymosis. They considered that it had probably been endemic for some considerable time, but that mild cases might quite easily have been overlooked. They observed that it occurred most commonly in the hotter months, was not associated with lice or overcrowding, and since many of the cases resided in the environs of the town, they suggested a rural origin for the disease, although the vector was unknown. They observed a resemblance in many respects between this disease, and Rocky Mountain spotted fever, but, unlike Monteiro, failed to obtain characteristic lesions following upon animal inoculation.

Parker and Davis (1933)¹²⁸ using a serum obtained from rabbits, recovered from Sao Paulo fever were able to protect guinea-pigs from the affects of an injection of Rocky Mountain spotted fever serum virus. No protection was afforded against Rocky Mountain spotted fever virus, when they substituted South African tick-fever, or tsutsugamushi disease convalescent sera, for the Sao Paulo fever convalescent serum.

About the same time Dyer (1933)¹²⁹ allowed ticks, which he had obtained from Monteiro, and which had previously fed on guinea-pigs infected with Sao Paulo fever, to feed on uninfected guinea-pigs, and he also injected an emulsion prepared from the crushed bodies of these ticks into guinea-pigs. The mortality rate was high, being in the vicinity of 90%. In those that survived the febrile period was eight days. In 90% a marked scrotal reaction occurred, similar to that obtained by the use of virulent Rocky Mountain spotted fever material, and much more severe than that resulting from the employment of the virus of either endemic typhus or Tabardillo. Guinea-pigs which had recovered from European typhus were not immune to Sao Paulo fever, but, on the other hand, guinea-pigs immune to Rocky Mountain spotted fever were, at the same time, immune to

Sao Paula fever. In monkeys he demonstrated complete cross immunity between Sao Paulo fever, and Rocky Mountain spotted fever.

Confirmation of this work would indicate that so-called Rocky Mountain spotted fever can no longer be considered as a disease having strictly local significance, and the name Rocky Mountain spotted fever has become a misnomer. It had already been observed to occur in the eastern states of the United States, and now it would appear almost certain that it occurs in Brazil, if not in other regions of South America also. Moreover the claim of Badger¹²³ to have demonstrated cross immunity between Rocky Mountain spotted fever, and Fievre Boutonneuse opens up still further interesting possibilities, and there appears to be justification for assuming a close affinity between the fever of Sao Paulo in South America, Rocky Mountain spotted fever in North America, and Fievre Boutonneuse in North Africa, if not also certain of the typhus-like fevers of Southern Europe.

The relationship of these American typhus-like fevers to the Malayan varieties is somewhat obscure. A close similarity of signs and symptoms, and clinical course would appear to exist between the endemic typhus of the southern states, and Brill's disease of the eastern states, and Malayan tropical typhus. The epidemiology shows many striking points of resemblance to that of the urban or "W" form in Malaya, while at the same time recalling that of the fever described by Hone in Adelaide. All three are hot weather diseases confined primarily to urban centres. The most remarkable characteristic exhibited by all, however, is the greater susceptibility to infection of those engaged in trade more particularly where this involves the handling of food stuffs, grain or cattle feed. Serologically they resemble each other closely, in that all three produce agglutinins for the indologenic strains of

Proteus X.19 but not for the anindologenic or "Kingsbury" strain.

The rural forms in the two countries appear to have much less in common. It is true that a number of corresponding signs and symptoms are found in both diseases, but there are also very important distinguishing features. Of the three Malayan typhus-like fevers, tsutsugamushi disease most nearly resembles Rocky Mountain spotted fever, but nevertheless distinct and clear cut differences exist, and were indicated by Ashburn and Craig³³ so long ago as 1908, and have been further emphasised by the recent work of Parker and Davis¹²⁸ on convalescent sera.

The Rocky Mountain spotted fever group in which are included the eastern states type and Sao Paulo fever are, like Fievre Boutonneuse, and Fievre exanthématique of the Mediterranean, difficult to place in relationship to the other typhus like fevers which have been reviewed, and it must still be an open question whether these diseases can legitimately be included in the typhus group. The failure to demonstrate immunological affinity between these, and the other typhus-like fevers must in the light of our present knowledge of this subject at least, present a serious difficulty. The apparent affinity, however, between Rocky Mountain spotted fever, Fievre Boutonneuse, and possibly Fievre exanthématique of the Mediterranean, tends to lessen the problem, since these may eventually be found to form one distinct group instead of being, as in the past, separate and puzzling entities.

CONCLUSION.

Within recent years it has become more fully recognised that typhus-like fevers are occurring in widely scattered parts of the world, where hitherto the presence of typhus was unsuspected, and where on account of the generally accepted epidemiology, its occurrence was considered to be improbable.

It may be argued that since the Weil-Felix reaction has never been proved to be other than heterologous, its specificity for typhus exanthematicus has been too readily assumed in the past, and that as a consequence the presence of positive reactions in many of these diseases does not necessarily prove their affinity to true typhus, but rather demonstrates the heterologous nature of the reaction in that disease. This argument is countered by a consideration of the signs and symptoms set forth in tabular form in Appendix "B", and of the temperature charts taken from actual cases of certain of these diseases. While the table is incomplete in certain sections, and it has not been possible to obtain charts in every instance, sufficient evidence is presented, when taken in conjunction with post-mortem findings, and the results of experimental inoculation in laboratory animals, to demonstrate a closer resemblance of these fevers to typhus exanthematicus than to any other known disease. The recognition of these typhus-like diseases, and the presence of positive reactions in the majority of them, tends rather to enhance the value of the Weil-Felix reaction as a specific aid to diagnosis, more particularly, since they suggest refinement in technique by the employment of a series of different strains of Proteus. Felix and Rhodes (1931)¹³⁰ in commenting upon the serological varieties of typhus fever, have pointed out that agglutination of the "H" type may be a source of error, only "O" type agglutination being of diagnostic significance. They

considered that the weakly positive reaction with the Kingsbury strain occurring in tsutsugamushi disease, was due to a common "O" reaction, and suggested that OXK stood in the same relation to an unknown Proteus strain corresponding to the virus of tsutsugamushi disease, as Proteus X.2. did to Proteus X.19. in Polish typhus, in which disease the Weil-Felix reaction is positive to much higher titres with the latter strain, than with the former. They concluded by suggesting that the viruses of tsutsugamushi disease, Rocky Mountain spotted fever, and Fievre exanthématique of Marseilles, corresponded to further serological strains of Proteus X. as yet unknown.

The recognition of these endemic and sporadic forms of typhus must re-orientate views previously held with regard to this disease, and its possible eradication by hygienic measures, combined with all round amelioration of the standard of living. So long as the disease appears to be confined to man, and the human louse, such a consummation could be legitimately contemplated. The persistence of the disease, however, in a reservoir host immediately renders the problem infinitely more complex. Much of the evidence resulting from investigations into the epidemiology in widely separated localities, strongly incriminates the rat, and the fact that an animal so widespread in its incidence, so subterranean in its habits, and so difficult to exterminate, is capable of perpetuating the disease, indicates that typhus must be considered an ever present menace, actual or potential.

At the same time the question of possible vectors is of paramount importance, both in so far as it related to the spread of the disease from rat to rat, and more particularly the transmission from rat to man. Considerable diversity of opinion exists on this subject and a fairly wide selection of suspected

carriers already exists. Mooser¹⁰³ has advanced strong evidence to support his view that the rat louse (Polyplax Spinulosus) transmits infection from rat to rat, at least so far as Mexican typhus is concerned. In Japan tsutsugamushi disease is carried from field mouse to man by a larvae mite of the genus Trombicula, and a closely allied species has been suspected of transmitting related diseases in the Dutch East Indies and Malaya. Other mites have been suggested, notably the tropical rat mite Liponyssus bacoti in America, and Dermanyssus muris in the South of France. Ticks of the genus Dermacentor have been implicated in the spread of Rocky Mountain spotted fever, and the apparently identical disease in the south eastern states of the American Union. It is possible that others of the Ixodidae are responsible elsewhere, and in the exanthematic fevers of the Mediterranean region, Rhipicephalus sanguineus has been incriminated in at least a proportion of cases. In so far as the predominantly urban forms of the disease are concerned, suspicion has been directed principally to various rat fleas, more particularly the tropical and sub-tropical species Xenopsylla cheopis, and the temperate species Ceratophyllus fasciatus. It is becoming increasingly evident that the number of vectors involved may be considerable, climate, locality and opportunity, determining their relative importance, and when dealing with a disease, the virus of which is present in the peripheral blood, the possibility of as yet undiscovered acarine, or insect vectors must always be kept in view. This point had already been stressed by Sambon (1928)¹³¹.

The varying virulence of these typhus-like diseases may depend to a great extent upon the particular reservoir hosts and vectors concerned in any given locality. The modification of the virulent disease, smallpox, to the mild vaccinia by passage of the virus through cattle need only be mentioned as a parallel

instance. Recently Ledingham (1932)¹³² has referred to the effects of inoculation intracerebrally, of mice and monkeys, with yellow fever virus. In the former a definite encephalitis is produced without any liver lesions, while in the latter typical liver changes result, and cerebral involvement is absent. If, however, virus which has been previously accommodated to mice, is later inoculated intracerebrally into monkeys, they react with an acute disseminated encephalomyelitis, with necrosis of ganglion cells, the liver being unaffected. Some such modification may explain variations in the elective affinity of typhus virus for different tissues in experimental animals, so that in one instance scrotal lesions predominate, in another, cerebral. Analogous changes occurring in nature, through the agency of the particular reservoir hosts, or very possibly the vectors concerned, may determine the varying degrees of virulence encountered in cases of human infection. The striking difference between the Montana, and the Idaho forms of Rocky Mountain spotted fever may possibly be explained in this manner, and it is perhaps a matter of some significance, that in the less severe and fatal form of this disease, local lesions such as gangrene of tonsils, scrotum or prepuce are more common.

With an apparently fairly wide selection of reservoir hosts and vectors, the number of permutations of the disease may well be large, and while the majority have many features in common, types at the extreme limits of the range are liable to differ in many respects.

The complexity of the subject is not diminished when the various serological, and immunological findings are taken into consideration, and until the causative organisms of these typhus like fevers have been isolated and propagated in pure culture, much is likely to remain obscure. In dealing with organisms apparently so protean in their characteristics, the causation

of typhus and the typhus-like fevers must still be considered sub judice. Further investigation may reveal that Rickettsia prowazeki, R.rickettsi, R.manchuriae, R.braziliensis, and R.Akamushi, R.orientalis, or R.tsutsugamushi are all variants of the one primary organism.

Any views concerning the origin of typhus as an epidemic disease of mankind can only be highly speculative. Nevertheless a study of the various endemic forms of the disease provides matter for conjecture. The much wider differences existing between the rural types suggests that, originally the disease was almost entirely confined to rodents in rural areas, distinct local variations arising from the choice of vector, the type of climate, and the influence of more obscure factors, man in such circumstances being only occasionally infected.

With the tendency of mankind to concentrate to a greater extent in cities, the disease in such centres became more exclusively confined to rats and mice, the only rodents capable of existing under such artificial conditions. At the same time, and for very much the same reason, the varieties of ectoparasites of the rat able to transmit the disease became considerably reduced, and were limited possibly, so far as those with the capacity for attacking man were concerned, to the rat fleas Xenopsylla cheopis and Ceratophyllis fasciatus.

In tropical countries always, and in colder countries in the absence of lice, infection of man still continued to be sporadic and accidental, but with the limitation of host and vector, the disease when it did occur, tended to be more uniform than the varying rural forms. If however, a large proportion of the population were to become lice infested, the disease would rapidly tend to assume an epidemic form, and be entirely independent, of reservoir hosts. With concomitant overcrowding and lowered resistance as a result of famine and exposure, the ravages of the disease would become more severe and widespread.

Amelioration of conditions, acquisition of immunity, and natural causes not fully understood, result in the virulence of the disease dying down, and its restriction to limited areas or districts in an endemic form, still possibly transmitted in those later sporadic cases, from man to man by the louse.

Nevertheless it is now clear that extirpation of all the lice from such a focal area, will not remove the potential menace, and as Mooser²⁰ has pointed out, it is no longer possible to maintain the rule cited by Otto and Munter, "without lice, no typhus". The virus once more continues dormant in the reservoir host until such time as conditions are again favourable for a further devastating outbreak. It can, however, be asserted confidently "no lice, no epidemic typhus", and the conditions for an epidemic are only present when a sporadic case occurs amid a population already lice infested.

The greater virulence of typhus exanthematicus as compared with the majority of the endemic forms, may be due as suggested by Mooser¹⁰⁶, to the fact that the louse was not the original vector of typhus, but appeared comparatively late in the evolution of the disease, and has not yet had time in the biological sense, to convert Rickettsiae by adaptation, into harmless saprophytes, a view which appears to be borne out by the high mortality among infected lice.

All this is admittedly hypothetical, but it receives some support from the work of Nicolle and Anderson (1927)¹³³ in Spain on relapsing fever. As a result of their investigations they concluded that relapsing fever was originally a localised endemic disease, transmitted by the tick only, usually from rat to rat, but occasionally from rat to man. Later the spirochaete became adapted to the louse, and the disease acquired an epidemic character. They believed that in Spain the process of adaptation could actually be observed, since the endemic relapsing fever

there was tick borne, but occasional epidemics of louse borne fever occurred, the resulting disease, however, still retaining the more severe characteristics of tick transmitted fever. The fact that in this parallel example the disease tended to become less virulent when adapted to transmission from man to man by the louse does not lessen the force of the argument that such changes in the epidemiology of a disease are possible.

Classification of these typhus-like diseases, is a matter of considerable difficulty. Goodall¹³⁴ in 1927 writing with reference to the possibility of Fievre exanthématique of Marseilles being the same as Brill's disease deplored the use of such terms as Brill's disease, tick typhus, tropical typhus and so forth, and asserted that Brill's disease was nothing but typhus, and that the introduction of any other nomenclature could only result in confusion.

Such an attitude however appears to be indefensible, in view of the widely differing epidemiology disclosed by a study of these diseases. A knowledge of this must profoundly influence the choice of prophylactic measures, and the management of cases, according to the particular locality in which the disease is encountered.

Fletcher (1930)¹³⁵ pointed out that the typhus-like diseases fell into two main classes, an urban form more closely related to typhus exanthematicus, in which the Weil-Felix reaction was always positive, and a rural form, more closely related to tsutsugamushi disease, and Rocky Mountain spotted fever, in which the Weil-Felix reaction was almost always negative, though some of the fevers in this group produced agglutinins for a special anindologenic strain of Proteus X. 19, the "Kingsbury". More recent work has shewn that a bigger proportion of the fevers in the second group give positive Weil-Felix reactions

with some strains of Proteus than had previously been thought, and it is doubtful whether urban and rural types as such, can be used as a basis for classification, since the differences appear to depend more upon the vector, and the locality is only of importance in so far as it influences the nature of the latter.

Plazy and Marcandier⁸⁸ had suggested that these fevers might be classified according to the rapidity with which agglutinins for Proteus X.19. developed, and the titres to which reaction took place. In tropical territories particularly in rural areas, facilities for a full investigation of the Weil-Felix reaction frequently do not exist, and this method as a consequence is hardly practicable. Nevertheless, it is possible when more knowledge concerning the serological characteristics of these fevers has been gained, and particularly when their behaviour towards a wider range of strains of Proteus is understood and standardised, that the Weil-Felix reaction will then prove a valuable basis for classification.

In the light of our present knowledge the classification suggested by Megaw (1928)⁵⁷ based upon vectors, is probably the most satisfactory. The retention of such names as Rocky Mountain spotted fever, Japanese river fever, and pseudo typhoid fever of Sumatra appears to be irrational however, since these diseases are almost certainly not confined to the localities indicated. Similarly the terms, tick-bite fever of South Africa Fievre Boutonneuse, and Brill's disease, might well be discarded since they can only lead to confusion and error. As a further modification of Megaw's classification, the terms typhus might be reserved for the severe and fatal forms of the disease, paratyphus being applied to the milder type. An objection can immediately be raised to this, to the effect that there is no proof that these fevers stand in the same relationship to typhus exanthematicus as paratyphoid fevers do to typhoid, and it might further be argued that there is more justification for considering

the severe Rocky Mountain spotted fever group, and the tsutsugamushi disease as paratyphus fevers than any of the mild urban forms which give a positive Weil-Felix reaction with indologenic strains of Proteus X.19. Nevertheless since any classification at the moment can only be provisional, one along the lines suggested appears to provide a working basis. Since many of the fevers still appear within the category "vector unknown" it is better that the name of the locality wherein they occur should be retained, and it would further assist identification of the words "Typhus" or "Paratyphus" were followed by the symbol "W" or "K", or both, whenever possible, to indicate the presence or absence of agglutination with indologenic or ~~indologenic~~ indologenic strains of "Proteus X.19" to diagnostic titres. This classification is shown in Appendix C.

The tick paratyphus group is perhaps the least satisfactory, since it includes in one category, diseases which very possibly differ from each other in many respects, and some of which may indeed ultimately fail to justify their inclusion among the typhus-like fevers at all.

Much further work remains to be done in these endemic and tropical forms of typhus, and if their elucidation is to be completely achieved, close co-operation between investigators in widely scattered parts of the world must be attained. Reactions must be standardised and serological and immunological affinities accurately determined. Acquisition of a fuller knowledge concerning these milder forms of the disease in the newer countries, may at the same time provide a weapon with which to combat the dreaded scourge of the old.

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Case No.	APPENDIX A.I.		Occupation	Locality	Date of Onset	Date Admitted	Mode of Onset	Fever		Rash		Date of dis- appearance	Con- junc- tival In- jection	Photo- phovia	Deafness	Headache	Giddiness	Mental Signs	Knee jerks	Lymphatic Glands	
	Sex	Age						Type of Fever	Duration of Fever	Mode of Fall	Date of Appearance										Characteristics
1.	Female	25 yrs.	Weeder	Estate "B"	28.3.31.	3.4.31	Abrupt with chill, diarrhoea and body pains	Continued reaching 104° with variable remissions	30 days. Last six days inter- mittent not above 100°	Lysis	-	None observed	-	Nil.	Nil.	Nil.	Severe	Present at times	Insomnia Delirium 3rd week	Normal	Not enlarged
2.	Female	30 yrs.	Weeder	Estate "B"	31.4.31.	7.5.31	5 days pro- dromal. Abrupt fever with rigor, vomiting, headache and muscular pains	Continued reaching 105° with daily remissions	15 days	Rapid lysis	? Present on ad- mission	Scattered macules and a few slightly raised papules, dusky, fading on pressure. On back, chest, and abdomen.	11th Day	Nil.	Nil.	Slight	Severe	Nil.	Insomnia Irritability	Diminished	Not enlarged
3.	Female	27 yrs.	Weeder	Estate "A"	3.6.31.	8.6.31	Abrupt with rigor and aching of limbs	Continued around 103° Maximum 104° with daily remissions	16 days	Rapid lysis	-	None observed	-	Nil.	Nil.	Nil.	Severe	Nil.	Nil.	Normal	Not enlarged
4.	Male	38 yrs.	Harvester (Overseer)	Estate "A"	? 10.6.31	16.6.31	Indefinite. History not clear	Continued with marked remissions, later inter- mittent	Until death 24 days in hospital ? 30 days from onset	Death	? Present on ad- mission	Scattered slightly raised papules over both scapulae, fading on pressure and difficult to distinguish	9th Day	Moderate	Moderate	Slight	Moderate	Present at times	Apathy, quiet delirium. coma before death.	Normal	Inguinal and maxillary enlarged. Not tender.
5.	Female	30 yrs.	Weeder	Estate "B"	3.7.31	9.7.31	Abrupt with rigor; head- ache and severe muscle pains	Continued with slight remissions, maximum 104°	24 days	Lysis	? Present on ad- mission	Scattered macules and papules first seen over scapular region, upper chest, and face. Later appeared on abdomen, thighs, and upper arms. Size irregular.	17th Day	Moderate	Slight	Moderate 1st week	Nil.	Nil.	Nil.	Diminished	Inguinals enlarged not tender
6.	Male	30 yrs.	Factory worker	Estate "B"	28.7.31	5.8.31	Gradual, states daily fever, severe headache and muscle pains	Continued with slight remissions, maximum 105°	22 days	Lysis	-	None observed	-	Nil.	Nil.	Slight 1st week	Severe	Present at times	Insomnia. Irritability	Normal	Not enlarged

Signs	Knee jerks	Lymphatic Glands	Pulse	Respirations	Lung Signs	Cough	Joint pains	Muscular pains	Calf Tenderness	Spleen	Vomiting	Diarrhoea	Tympanites	Urine	Widal Reaction	Weil Felix Reaction	Other Features	Complications	Convalescence.
ia um ek	Normal	Not enlarged	Relatively slow until 3rd and 4th weeks rapid and irregular	40-60	Shifting dullness rhonchi and crepitations	Frequent short and dry	Severe knees ankles and shoulders	General aching. Chest pains	Severe	Enlarged 1 1/2" below costal margin	Nil.	Moderate 2nd and 4th week	Nil.	Trace of Albumen	25th Day T - 0 A - 0 B - 1/190 C - 1/96 T(o) - 0	25th Day "K" - 1/1000 "W" - 0	Nil.	Broncho-Pneumonia	Slow, post febrile asthenia. Discharged 41st Day.
ia ability	Diminished	Not enlarged	Tends to follow temperature	40-60	Absent	Nil.	Nil.	General aching	Severe	Not palpable	Present in early stages	Moderate 12th-18th day	Nil.	No Albumen	15th Day Day T-1/25-1/125-1/50 A-1/25-1/280-1/96 B - 0 - 0 - 0 C - 0 - 0 - 0 T(o)-0-11 - 8 units units	15th Day Day Day Neg. "K"-1/125-1/44 "W"- 0 - 0	Nil.	Nil.	Uneventful. Discharged 34th day.
	Normal	Not enlarged	Tends to follow temperature	30-40	Absent	Slight dry	Nil	General aching	Severe	Not palpable	Nil.	Moderate 2nd week	Nil	Trace of Albumen	18th Day Day T-1/1130 T-1/560 A - 0 A - 0 B - 0 B - 0 C - 0 C - 0 T(o)- 0 T(o)-0	18th Day Day "K"-1/1130 "K"-1/580 "W" - 0 "W" - 0	Nil.	Nil.	Rapid. Discharged 28th day.
y, quiet um. before	Normal	Inguinal and maxillary enlarged. Not tender.	Initially tends to follow temperature 4th week. Rapid, irregular & low tension	40-60	2nd week Broncho-Pneumonia both lungs	Frequent, short, dry	Severe knees especially	General aching. Chest pains	Severe	Not palpable	Occasional	Nil.	Nil.	Albumen present	21st Day T - 1/140 A - 0 B - 0 C - 0 T(o)- 0	21st Day "K" - 1/380 "W" - 0	Oedema of feet throughout, legs, and face.	Broncho-Pneumonia	Died 10.7.31. ? 31 days from onset.
	Diminished	Inguinals enlarged not tender	Initially slow 3rd and 4th weeks rapid low tension	30-50	Rhonchi and moist rales both lungs	Short dry, later productive	Nil.	General aching. Chest pains	Slight	Enlarged 3" below costal margin	Present at onset	Nil.	End of first week	Albumen present	18th Day Day T - 0 Negative A - 0 B - 1/80 C - 0 T(o)-0	18th Day Day "K"-1/85 Negative "W"- 0	Oedema of feet and legs middle of 3rd week (Hb rate 50%)	Bronchitis	Uneventful Discharged 35th day.
ia. ability	Normal	Not enlarged	Initially slow. 3rd week rapid	30-35	Scattered moist rales both lungs	Loose cough	Nil.	General aching	Severe	Not palpable	Nil.	Nil.	Nil.	No albumen	37th Day Negative.	37th Day "K" - 1/620 "W" - 0	Nil	Bronchitis	Uneventful. Discharged 30th day.

Case No.	APPENDIX A.I. (Contd.)			Locality	Date of Onset	Date Admitted	Mode of Onset	Type of Fever	Duration of Fever	Mode of Fall	Date of Appearance	Characteristics	Date of Disappearance	Conjunctival Injections	Photophobia	Deafness	Headache	Giddiness	Mental Signs	Knee Jerks	Lymphatic Glands	Pulse
	Sex	Age	Occupation																			
7.	Female	20 yrs.	Weeder	Estate "A"	11.8.31	15.8.31	Abrupt with headache and shivering	Continued with remissions, maximum 106°	21 days	Lysis	-	None observed	-	Nil.	Nil.	Nil.	Severe	Nil.	Nil.	Normal	Not enlarged	Initially slow in relation to temperature. 3rd week rapid low tension
8.	Male	52 yrs.	Draincutter and fruit sorter	Estate "B"	29.8.31	2.9.31	Abrupt, no chill, severe headache and aching of body	Continued with marked remissions, maximum 105°	23 days	Lysis	7th Day	Few scattered, irregular, dusky papules over scapulae. Later scanty, indistinct, maculo-papular eruption on chest.	11th Day	Moderate	Slight	Moderate	Severe	Nil.	Nil.	Normal	Inguinals slightly enlarged	Initially follows temperature. 3rd week rapid and irregular
9.	Male	35 yrs.	Harvester	Estate "A"	7.9.31	10.9.31	Abrupt with rigor, vomiting and headache	Continued with marked remissions, maximum 104°	14 days	Crisis	7th Day	Widely scattered macules and a few papules over scapulae. Fading on pressure.	11th Day	Nil.	Nil.	Slight	Severe	Present on admission	Insomnia Apathy	Normal	Not enlarged	Markedly slow in relation to temperature
10.	Female	25 yrs.	Weeder	Estate "B"	9.10.31	12.10.31	Abrupt with rigor, vomiting, headache	Initially intermittent, then continued with marked remissions maximum 105°	15 days	Lysis	5th Day	Blotchy irregular papules first seen on face, spreading to back chest and abdomen.	12th Day	Moderate	Moderate	Nil.	Nil.	Present at times	Apathy	Normal	Not enlarged	Slow in relation to temperature. Irregular low tension
11.	Female	28 yrs.	Weeder	Estate "A"	13.10.31	16.10.31	Abrupt with rigor, headache, giddiness and body pains	Continued with variable remissions, maximum 105°	15 days	Rapid Lysis	6th Day	Dusky macules and irregular papules appeared first on shoulders, and spread to chest, back and abdomen. Scanty on face.	12th Day	Nil.	Nil.	Slight end of 1st week	Severe	Marked	Apathy Insomnia Irritability at times. Delirium several nights	Slightly diminished	Left inguinals enlarged and tender	Tends to follow temperature
12.	Female	35 yrs.	Weeder	Estate "A"	13.10.31	16.10.31	Abrupt with rigor, headache, giddiness and body pains	Continued with remissions maximum 104°	12 days	Lysis	5th Day	Indistinct, dusky, slightly raised papules first seen on face and over scapulae, later spread to chest, limbs and abdomen. Few scattered macules.	10th Day	Slight	Slight	2nd week moderate	Severe	Present at times	Nil.	Exaggerated	Left inguinals enlarged and tender	Markedly slow in relation to temperature
13.	Female	20 yrs.	Weeder	Estate "A"	16.10.31	21.10.31	Abrupt with rigor, headache, giddiness and body pains	Continued with marked remissions, maximum 105°	17 days	Lysis	7th Day	Indistinct, dusky, maculo-papular eruption of irregular shape and size, on face, over scapular region, upper chest, and umbilical region.	10th Day	Moderate Vision dim	Marked	Moderate 2nd week	Severe	Marked	Apathy Muttering Delirium several nights	Normal	Right Inguinals enlarged and tender	Relatively slow

Phatic Glands	Pulse	Respirations	Lung Signs	Cough	Joint pains	Muscular pains	Calf Tenderness	Spleen	Vomiting	Diarrhoea	Tympanites	Urine	Widal Reaction	Weil Felix Reaction	Other Features	Complications	Convalescence
enlarged	Initially slow in relation to temperature. 3rd week rapid low tension	40-50	Scattered rhonchi both lungs	Frequent loose	Nil.	General aching. Chest pains.	Nil.	Not palpable	Nil.	Nil.	Nil.	Trace of albumen	23rd Day Negative	23rd Day "K" - 1/380 "W" - 1/56	Face puffy at height of fever	Bronchitis	Uneventful Discharged 33rd day.
inguinals slightly enlarged	Initially follow temperature. 3rd week rapid and irregular	40-55	2nd week rhonchi and rales both bases	Frequent dry, later loose productive	Severe knees and ankles	Severe back limbs and chest	Severe	1" below costal margin	Occasional	Moderate 7th-9th and 16th-19th days	Nil.	Trace of albumen	53rd Day Negative (3 previous specimens Haemoly- sed or contaminated)	53rd Day "K"-between 1/35-1/110 "W"- 0 (3 previous specimens as in Widal)	Sore throat with congestion of the pharynx	Broncho-pneumonia	Uneventful Discharged 33rd day.
enlarged	Markedly slow in relation to temperature	35-40	2nd week few rhonchi	Frequent dry	Nil.	General aching.	Moderate	1 1/2" below costal margin	Present 1st week	Nil.	Nil.	No albumen	31st Day T - 1/96 A - 0 B - 0 C - 0 T(o) - 4 units	31st Day "K" - 1/1500 "W" - 1/19	Nil.	Nil.	Rapid Discharged 24th day.
enlarged	Slow in relation to temperature. Irregular low tension	40-60	Rhonchi and rales both lungs	Frequent dry	Nil.	General aching, severe in back and neck, chest pains	Nil.	Not palpable	Present 1st week	Severe 2nd week	2 days with abdominal pain.	Trace of albumen 1st week	27th Day Negative	27th Day "K" - 1/500 "W" - 1/17	On admission septic ulcer of left ankle (old standing) Sore throat 2nd week	Nil.	Slow, marked asthenia Discharged 51st day.
inguinals enlarged and tender	Tends to follow temperature	40-60	Few scattered rales	Slight dry	Nil	General aching	Nil.	Not palpable	Nil.	Moderate 9th - 12th day	Nil.	No albumen	15th Day T - 1/650 A - 0 B - 0 C - 0 T(o) - 0	15th Day "K" - 1/600 "W" - 1/22	Nil.	Nil.	Rapid Discharged 24th day.
inguinals enlarged and tender	Markedly slow in relation to temperature	30-35	Nil.	Nil.	Nil.	General aching	Nil.	1" below costal margin	Nil.	Moderate 5th - 9th day	Nil.	No albumen	29th Day-37th Day Negative	29th Day-37th Day "K"-1/85 1/85 - 1/250 "W"- 0 1/38	Nil.	Nil.	Rapid Discharged 24th Day.
inguinals enlarged and tender	Relatively slow	40-50	Nil.	Slight dry	Nil.	Backache and stiffness of neck muscles.	Moderate	Not palpable	Nil.	Nil.	Marked with diffuse pain	Trace of albumen	20th Day Negative	20th Day "K"- 1/5600 "W"- 1/17	Nil.	Nil.	Rapid Discharged 24th day.

APPENDIX A.I. (Contd.)

Case No.	Sex	Age	Occupation	Locality	Date of onset	Date Admitted	Mode of Onset	Fever			Characteristics	Date of Disappearance	Conjunctival Injection	Photophobia	Deafness	Headache	Giddiness	Mental Signs	Knee Jerks	Lymphatic Glands	Pulse	Remarks
								Type of Fever	Duration of Fever	Mode of Fall												
14.	Female	22 yrs.	Weeder	Estate "A"	16.10.31	23.10.31	Abrupt with rigor, headache, giddiness, and muscle pains	Continued with marked remissions maximum 104°	13 days	Rapid lysis	? Present on admission	Scattered, irregular, dusky, papules on face, back and chest. Occasional macules. All fading on pressure.	13th Day	Slight	Slight	Slight 2nd week	Severe	Present on admission	Nil.	Normal	Right inguinals enlarged and tender	Relatively slow.
15.	Female	25 yrs.	Weeder	Estate "A"	17.10.31	23.10.31	Abrupt with rigor, headache, giddiness and body pains	Continued with remissions maximum 103°	12 days	Lysis	? Present on admission	Chiefly dusky, irregular, indistinct macules, with a few slightly raised papules over face, back, chest and abdomen. Fading on pressure.	10th Day	Nil.	Nil.	Slight end of 1st week	Severe	Present on admission	Nil.	Normal	Not enlarged	Rapid variable volume and tension
16.	Female	35 yrs.	Weeder	Estate "A"	16.10.31	24.10.31	Abrupt with rigor, headache, vomiting, diarrhoea and body pains	Continued with remissions maximum 102°	12 days	Lysis	? Present on admission	Scattered, indistinct, dusky, macules on face, chest, and back, later spreading to flanks and abdomen. Fading on pressure. Last seen on face.	12th Day	Slight	Slight	Slight 2nd week	Severe in early stages	Nil.	Nil.	Normal	Inguinals, and axillary enlarged and slightly tender	Rapid in relation to temperature Good volume & tension
17.	Female	30 yrs.	Weeder	Estate "A"	23.10.31	28.10.31	Abrupt with rigor, headache, body pains and diarrhoea	Continued with remissions, later intermittent maximum 105°	28 days	Lysis	8th Day	Dusky, irregular maculo-papular eruption, commenced on chest and spread to back, abdomen and face. Fading on pressure.	14th Day	Moderate Eye pains	Moderate	Marked 3rd week	Severe	Present at times	Apathy Muttering delirium	Sluggish	Inguinals enlarged and tender	Relatively slow 3rd & 4th weeks rapid, irregular, low tension
18.	Female	30 yrs.	Weeder	Estate "B"	4.11.31	10.11.31	Abrupt with rigor, headache, pain in calves and abdomen. Diarrhoea	Continued with remissions maximum 104°	16 days	Rapid lysis	? Present on admission	Scattered, irregular maculo-papular eruption over scapulae. Later spread to chest and abdomen, flanks, thighs, arms and face, profuse on trunk. Fading on pressure. Last seen on back.	12th Day	Well marked	Marked	Marked 2nd week	Severe	Nil	Apathy	Normal	Left inguinals enlarged and tender	Tends to follow temperature Regular good tension
19.	Female	25 yrs.	Weeder	Estate "A"	17.11.31	20.11.31	Abrupt with shivering, cough, headache and body pains	Continued with variable remissions maximum 105°	Until death 20 days	-	7th Day	Very indistinct maculo-papular eruption over scapulae. Later spread to chest and abdomen. Fading on pressure.	12th Day	Slight	Slight	Slight 2nd week	Severe	Occasional	Apathy Low delirium Later stages tremor, subsultus, coma, death.	Diminished	Right inguinals enlarged and painful	Relatively slow, later irregular, and of low tension
20.	Male	35 yrs.	Harvester	Estate "A"	6.12.31	12.12.31	Abrupt with rigor, headache and backache	Remittent for 4 days, later continued maximum 105°	15 days	Crisis	? Present on admission	Indistinct scattered slightly raised papules over scapulae and on face. Later spread to chest, abdomen and flanks. Few scattered macules.	12th Day	Moderate	Slight	Slight	Severe	Occasional	Insomnia Irritability Anxiety	Normal	Inguinal and axillary enlarged and tender	Markedly slow in relation to temperature

Case	Mental Signs	Knee Jerks	Lymphatic Glands	Pulse	Respirations	Lung Signs	Cough	Joint Pains	Muscular Pains	Calf Tenderness	Spleen	Vomiting	Diarrhoea	Tympanites	Urine	Widal Reaction	Weil Felix Reaction	Other Features	Complications	Convalescence
ent n ssion	Nil.	Normal	Right inguinals enlarged and tender	Relatively slow.	30-60	Nil.	Nil.	Nil.	General aching	Moderate	Not palpable	Nil.	Nil.	Nil.	No albumen	18th Day Negative	18th Day "K" - 1/2200 "W" - 1/25	Nil.	Nil.	Rapid Discharged 24th Day.
ent 1 ssion	Nil.	Normal	Not enlarged	Rapid variable volume and tension	30-40	Nil.	Nil.	Nil.	General aching	Slight	Not palpable	Present 1st and 2nd days	Nil.	Nil.	No albumen	24th Day Negative	24th Day "K" - 1/2800 "W" - 0	Nil.	Nil.	Rapid Discharged 23rd Day.
	Nil.	Normal	Inguinals, and axillary enlarged and slightly tender	Rapid in relation to temperature Good volume & tension	30-50	Nil.	Nil.	Nil.	General aching	Slight	Not palpable	Present 1st and 2nd days	Moderate 13th-15th days	Nil.	No albumen	19th Day Negative	19th Day "K" - 1/380 "W" - 1/44	Nil.	Nil.	Rapid Discharged 24th Day.
t	Apathy Muttering delirium	Sluggish	Inguinals enlarged and tender	Relatively slow 3rd & 4th weeks rapid, irregular, low tension	40-60	Rhonchi and moist rales both lungs; shifting dullness	Frequent loose	Early stages severe knee and ankles	General aching Chest pains	Moderate	Not palpable	Nil.	Slight 9th-11th day	Nil.	Trace of albumen	27th Day Negative	27th Day "K" - 1/770 "W" - 1/17	Catarrh, sore throat. Rt. ear-ache 20th-25th day. No discharge, exam - N.A.D.	Parotitis (Right) 20th-26th days Broncho-pneumonia	Slow, discharged 39th day. Re-admitted 2 months later with acute right mastoiditis. Operation, recovery.
	Apathy	Normal	Left inguinals enlarged and tender	Tends to follow temperature Regular good tension	30-50	Scattered rhonchi and rales both lungs	Frequent loose	Nil.	General aching Chest pains	Severe	Palpable 1 1/2" below costal margin	Nil.	Moderate 2nd week	Present with abdominal tenderness (no rigidity)	No albumen	15th Day 28th Day Negative	15th Day 28th Day between "K" - 1/85-1/140-1/280-1/380. "W" - 0 - 0	Nil.	Nil.	Rapid Discharged 27th Day
o-	Apathy Low delirium Later stages tremor, subsultus, coma, death.	Diminished	Right inguinals enlarged and painful	Relatively slow, later irregular, and of low tension	40-60	Scattered rales and crepitations shifting dullness	Frequent	Nil	General aching Chest pains	Moderate	Palpable 1 1/2" below costal margin	Nil.	Severe week before death	Nil.	Trace of albumen	15th Day T - 0 A - 0 B - 1/25 C - 1/75 T(o) - 3 units	15th Day "K" - 1/1000 "W" - 1/17	Congestion of pharynx Sore throat	Broncho-pneumonia	Died 6-12-31 20th day of disease
o-	Insomnia Irritability Anxiety	Normal	Inguinal and axillary enlarged and tender	Markedly slow in relation to temperature	20-40	Few rhonchi and moist rales both lungs	Occasional loose	Nil	General aching Severe backache and chest pains	Nil	Not palpable	Nil	Nil.	Nil.	No albumen	16th Day 24th Day T-1/340 T) all A-1/340 A) over B-1/240 B) 1/250 C-1/340 C) 1/250 T(o)-0 T(o)-0	16th Day 24th Day "K"-1/170 "K" 1/375 "XOK" I "W"- 0 250 "W"- 0	Had T.A.B. inoculations previously	Nil.	Rapid Discharged 24th Day.

Case No.	APPENDIX A.I. (Contd.)			Locality	Date of		Mode of Onset	Fever		Rash		Date of Disappearance	Conjunctival Injection	Photophobia	Deafness	Headache	Giddiness	Mental Signs	Knee Jerks	Lymphatic Glands	Pulse	Respirations	
	Sex	Age	Occupation		Onset	Admitted		Type of Fever	Duration of Fever	Mode of Fall	Date of Appearance												Characteristics
21.	Female	25 yrs.	Weeder	Estate "A"	18.12.31	22.12.31	Abrupt with rigor, headache, and abdominal pain	Continued, later remittent maximum 104°	16 days then after 2 days, fever re-occurred for 3 days	Lysis	-	No definite rash observed.	-	Slight	Nil.	Marked 1st and 2nd weeks	Severe	Marked	Insomnia Apathy	Normal	Not enlarged	Initially relatively slow. End of 2nd week rapid, regular, good tension	20-40
22.	Male	40 yrs	Harvester	Estate "A"	25.12.31	28.12.31	Abrupt with rigor, headache, and severe muscular pains giddiness	Intermittent for 6 days, later remittent maximum 104°	16 days	Rapid lysis	? 9th Day	Few indistinct scattered dusky macules over scapular region, fading on pressure.	11th Day	Moderate	Slight	Nil.	Severe	Marked	Insomnia Apathy	Normal	Right inguinals enlarged and painful	Relatively slow	20-40
23.	Male	12 yrs.	Weeder	Estate "A"	13.1.32	16.1.32	Abrupt with rigor, headache, giddiness and vomiting	Continued with marked remissions maximum 105°	13 days	Rapid lysis	7th Day	Scattered maculo-papular eruption back, chest and abdomen. Fading on pressure.	11th Day	Slight	Slight	Nil.	Severe	Occasional	Insomnia Irritability	Normal	Not enlarged	Tends to follow temperature	30-60
24.	Female	35 yrs.	Weeder	Estate "A"	13.1.32	16.1.32	Abrupt with rigor, headache and giddiness, joint pains vomiting and diarrhoea	Continued with remissions maximum 104°	10 days	Rapid lysis	? 4th Day	Scattered slightly raised papules on face, chest, back and abdomen. Fading on pressure.	10th Day	Nil.	Nil.	Nil.	Severe	Occasional	Nil.	Normal	Inguinals enlarged and painful	Relatively slow	30-50
25.	Female	27 yrs.	Weeder	Estate "A"	13.1.32	15.1.32	Abrupt with rigor, headache, backache and vomiting	Continued with remissions maximum 105°	14 days	Rapid lysis	5th Day	Scattered Maculo-papular eruption on face, back, chest and abdomen, fading on pressure.	12th Day	Moderate	Slight	Slight	Severe	Marked	Apathy	Diminished	Not enlarged	Markedly slow in relation to temperature	30-40
26.	Female	16 yrs.	Weeder	Estate "A"	13.1.32	20.1.32	Abrupt with rigor, headache and body pains	Continued with remissions maximum 104°	15 days	Rapid lysis	-	No rash observed.	-	Slight	Slight	Slight variable	Severe 1st 2 days	Nil.	Nil.	Normal	Left inguinals enlarged and tender	Markedly slow	30-40
27.	Female	15 yrs.	Weeder	Estate "A"	28.1.32	30.1.32	Abrupt with rigor, nausea, headache and diarrhoea	Continued with remissions maximum 105°	14 days	Crisis	5th Day	Scattered, irregular, dusky macules and slightly raised papules over scapulae. spreading to chest, face, abdomen, thighs, calves and upper arms.	11th Day	Moderate	Moderate	Very severe	Moderate	Slight	Apathy Insomnia	Diminished	Inguinals enlarged and painful	Relatively quick throughout Regular low tension	40-60

Mental Signs	Knee Jerks	Lymphatic Glands	Pulse	Respirations	Lung Signs	Cough	Joint pains	Muscular Pains	Calf Tenderness	Spleen	Vomiting	Diarrhoea	Tympanites	Urine	Widal Reaction	Weil Felix Reaction	Other Features	Complications	Convalescent		
Insomnia Apathy	Normal	Not enlarged	Initially relatively slow. End of 2nd week rapid, regular, good tension	20-40	Few scattered rhonchi and rales	Occasional dry	Nil.	General aching Severe in back of neck.	Nil.	Not palpable	On two occasions small quantities of blood	Nil.	Nil.	No albumen	12th Day T - o A-1/125 B - o C - o T(o)-15 units Cultures negative	24th Day T - o A-1/1000 B - o C - o T(o)-o	12th Day "K"- 1 760 "W"- 1 65	24th Day 1 470 o	No enteric organisms isolated from urine or faeces. Secondary rise of temperature due to chill with coryza	Nil.	Uneventful Discharged 30th Day.
Insomnia Apathy	Normal	Right inguinals enlarged and painful	Relatively slow	20-40	Nil.	Occasional dry	Nil.	Severe general aching	Severe	Not palpable	Nil	Moderate 11th-15th day	Nil.	No albumen	17th Day T - o A-1/17 B - o C - o T(o)-10 units Cultures negative	24th Day T - o A-1/4400 B - o C - o T(o)-o	17th Day "K"- 1 192 "W"- 1 44	24th Day 1 770 1 17	Nil.	Nil.	Rapid Discharged 27th Day.
Insomnia Irritability	Normal	Not enlarged	Tends to follow temperature	30-60	Few scattered rhonchi and moist rales both lungs	Occasional loose	Nil.	General aching.	Nil.	Palpable 1" below Costal margin	Present at Onset	Moderate 9th - 11th day	Nil.	No albumen	23rd Day T - 1/1000 A - o B - o C - o T(o) - 4 units	23rd Day "K" - 1/4000 "W" - 1/13	B.T.Malaria on admission Sinton's modified treatment given for 7 days	Nil.	Rapid Discharged 23rd Day.		
Nil.	Normal	Inguinals enlarged and painful	Relatively slow	30-50	Few moist rales left base	Slight loose	Moderate knees and elbows	General aching Backache severe.	Moderate	Not palpable	Present at Onset	Nil.	Nil.	No albumen	15th Day T - o A - o B - 1 125 C - 1 140 T(o)-o	22nd Day T - o A - o B - 1 185 C - 1 85 T(o)-o	15th Day "K" - 1 200 "W" - 1 25	22nd Day 1 200 1 13	Nil.	Nil.	Rapid Discharged 23rd Day.
Apathy	Diminished	Not enlarged	Markedly slow in relation to temperature	30-40	Scattered rhonchi and moist rales both lungs	Frequent loose	Nil	General aching Severe back of neck and chest.	Moderate	Not palpable	Present at onset	Nil.	Nil.	No albumen	14th Day Negative	14th Day "K" - 1/630 "W" - o	Congestion of pharynx with sore throat 2nd week	Nil.	Rapid Discharged 22nd Day.		
Nil.	Normal	Left inguinals enlarged and tender	Markedly slow	30-40	Nil.	Short dry	Nil.	General aching.	Nil.	Palpable 1 1/2" below costal margin	Nil.	Nil.	Nil.	No albumen	14th Day T - o A - o B - o C - 1/30 T(o)-5 units	21st Day T - o A - o B - 1/17 C - 1/17 T(o)- 4 units	14th Day "K"- 1 100 "W"- 1 22	21st Day "K"- 1 380 "W"- 1 13	Nil.	Nil.	Rapid Discharged 23rd Day.
Apathy Insomnia	Diminished	Inguinals enlarged and painful	Relatively quick throughout Regular low tension	40-60	Scattered moist rales both lungs	Infrequent loose	Present in knees	Pains in chest.	Slight	Not palpable	Nil.	Moderate 5th - 13th day	Nil.	Trace of albumen	14th Day Negative	14th Day "K" - 1/5500 "W" - 1/55	Nil.	Nil.	Rapid Discharged 26th Day.		

APPENDIX A.1. (Contd.)

Case No.	Sex	Age	Occupation	Locality	Date of Onset	Date Admitted	Mode of Onset	Fever			Rash													
								Type of Fever	Duration of Fever	Mode of Fall	Date of Appearance	Characteristics	Date of Disappearance	Conjunctival Injection	Photophobia	Deafness	Headache	Giddiness	Mental Signs	Knee Jerks	Lymphatic Glands	Pulse	Respirations	Lung S
28.	Female	25 yrs	Weeder	Estate "C"	31.1.32	2.2.32	Abrupt with rigor, headache, giddiness, vomiting	Remittent maximum 104°	15 days	Rapid lysis	6th Day	Scattered dusky, slightly raised papules over scapulae and spreading to face, chest, abdomen, flanks, thighs and back of legs. Profuse on abdomen and back, fading on pressure.	11th Day	Moderate	Moderate	Marked ?quinine	Severe	Marked	Apathy 2nd week Quiet delirium	Normal	Right inguinals enlarged and tender	Rapid, irregular at times, low tension	30-50	Few scattered moist both
29.	Female	20 yrs	Weeder	Estate "A"	16.3.32	23.3.32	Abrupt with rigor, headache and vomiting	Continued with remissions maximum 104°	13 days	Rapid lysis	? Present on admission	Few faint, indistinct dusky papules on face and over scapulae, fading on pressure.	11th Day	Nil.	Nil.	Nil.	Severe	Nil.	Nil.	Normal	Inguinals enlarged and painful	Relatively slow	30-40	Nil.
30.	Female	20 yrs.	Weeder	Estate "A"	24.3.32	30.3.32	2 days malaise with headache 3rd day fever with rigor	Continued maximum 104°	15 days	Rapid lysis	? Present on admission	Irregular slightly raised dusky papules on back, chest, face and abdomen, thighs and back of legs, fading on pressure.	13th Day	Moderate	Moderate	Moderate	Very severe	Marked	Apathy Occasional quiet delirium	Diminished	Not enlarged	Markedly slow in relation to temperature	30-45	Scattered rhonchi moist both
31.	Female	25 yrs	Weeder	Estate "B"	28.3.32	4.4.32	Gradual, 3 or 4 days malaise with headache, then rigor, fever and giddiness	Remittent maximum 103.6°	13 days	Lysis	? Present on admission	Maculo-papular eruption on face, back chest and abdomen. Most profuse over scapulae and umbilical region.	11th Day	Moderate	Slight	Moderate	Severe	Nil.	Nil.	Normal	Right inguinals enlarged and tender	Markedly slow in relation to temperature	30-40	Nil.
32.	Female	15 yrs	Weeder	Estate "A"	13.4.32	16.4.32	4 days headache and aching of limbs. 5th day rigor, severe headache, deafness	Continued with remissions. maximum 106°	16 days	Rapid lysis	? Present on admission	Small slightly raised papules on face, back, chest, abdomen and thighs, fading on pressure.	11th Day	Slight	Nil.	Moderate	Moderate	Nil.	Apathy	Normal	Right inguinals enlarged and tender	Markedly slow in relation to temperature	30-40	Few scattered rhonchi rales lungs
33.	Male	27 yrs	Harvester	Estate "A"	5.5.32	11.5.32	Abrupt with rigor, headache, vomiting and aching of limbs	Continued with remissions maximum 104°	16 days	Lysis	? Present on admission	Scattered dusky irregular papules on face, back and chest, fading on pressure	11th Day	Nil.	Nil.	Slight	Severe	Occasional	Insomnia Apathy Occasional irritability	Normal	Right inguinals enlarged and painful	Relatively slow	30-40	Nil.
34.	Female	30 yrs	Weeder	Estate "D"	10.5.32	17.5.32	Abrupt with rigor, headache, giddiness, vomiting and body pains	Remittent maximum 103°	14 days	Rapid lysis	? Present on admission	Scattered dusky macules and slightly raised papules on face, chest, back and abdomen, fading on pressure.	13th Day	Moderate	Moderate	Marked	Severe	Marked	Nil.	Diminished	Not enlarged	Tends to follow temperature	20-30	Nil.

Central Signs	Knee Jerks	Lymphatic Glands	Pulse	Respirations	Lung Signs	Cough	Joint Pains	Muscular Pains	Calf Tenderness	Spleen	Vomiting	Diarrhoea	Tympanites	Urine	Widal Reaction	Weil Felix Reaction	Other Features	Complications	Convalescence
athy 2nd ek iet delirium	Normal	Right inguinals enlarged and tender	Rapid, irregular at times, low tension	30-50	Few scattered moist rales both lungs	Occasional loose	Nil.	General aching Chest pains.	Nil.	Palpable $\frac{2}{3}$ " below costal margin	First 2 days	Moderate 10th-17th day	Present with abdominal pain and tenderness No rigidity	Trace of albumen	16th Day T - o A - o B - 1/34 C - 1/15 T(o) - o	16th Day "K" - 1/2900 "W" - 1/19	S.T. Malaria on admission Sinton's modified treatment given for 7 days	Nil.	Slow. Asthenia. Discharged 42nd Day.
l.	Normal	Inguinals enlarged and painful	Relatively slow	30-40	Nil.	Occasional dry	Nil.	General aching.	Nil.	Not palpable	Continued until fall of temperature	Moderate 7th-9th days	Nil.	No albumen	14th Day 30th Day T - o T - o A - o A - o B - o B - o C - o C - o T(o)-7 T(o)-5 units units	14th Day 30th Day "K"-1 "K"-1 $\frac{125}{96}$ "W"-o "W"-o	Nil.	Nil.	Uneventful. Discharged 30th Day
athy asional iet delirium	Diminished	Not enlarged	Markedly slow in relation to temperature	30-45	Scattered rhonchi and moist rales both lungs	Frequent loose	Nil.	Chest pains.	Nil.	Not palpable	Nil.	Nil.	Nil.	Trace of albumen	22nd Day T - o A - 1/85 B - 1/44 C - 1/25 T(o) - 12 units Cultures negative	22nd Day "K" - 1/890 "W" - 1/17	Nil.	Nil.	Rapid Discharged 25th Day.
l.	Normal	Right inguinals enlarged and tender	Markedly slow in relation to temperature	30-40	Nil.	Occasional dry	Nil.	Nil.	Nil.	Not palpable	Nil.	Nil.	Nil.	No albumen	18th Day Negative	18th Day "K" - 1/785 "W" - o	Nil.	Nil.	Rapid Discharged 26th Day
athy	Normal	Right inguinals enlarged and tender	Markedly slow in relation to temperature	30-40	Few scattered rhonchi and rales both lungs	Frequent loose	Nil.	General aching Chest pains.	Nil.	Not palpable	Nil.	Moderate 2nd week	Present 2 days	Trace of albumen	8th Day 20th Day Negative	8th Day 20th Day "K" - 1 "K"-1 $\frac{250}{450}$ "W" - o "W"-o	Nil.	Nil.	Rapid Discharged 23rd Day.
omnia athy asional itability	Normal	Right inguinals enlarged and painful	Relatively slow	30-40	Nil.	Occasional dry	Nil.	General aching	Slight	Not palpable	Before admission only	Nil.	Nil.	No albumen	15th Day negative	15th Day "K" - 1/420 "W" - o	Nil.	Nil.	Rapid Discharged 24th Day.
.	Diminished	Not enlarged	Tends to follow temperature	20-30	Nil.	Nil.	Nil.	General aching.	Severe	Not palpable	Before admission only	Nil.	Nil.	Trace of albumen	15th Day 23rd Day Negative	15th Day 23rd Day "K" - 1 "K"-1 $\frac{260}{338}$ "W" - o "W"-o	Nil.	Nil.	Rapid Discharged 22nd Day.

Case No.	APPENDIX A.I. (Contd.)			Locality	Date of Onset	Date Admitted	Mode of Onset	Fever			Rash		Date of Disappearance	Conjunctival Injection	Photo-phobia	Deafness	Headache	Giddiness	Mental Signs	Knee Jerks	Lymphatic Glands	Pulse	Respirations	Lung Signs	Cough
	Sex	Age	Occupation					Type of Fever	Duration of Fever	Mode of Fall	Date of Appearance	Characteristics													
35.	Female	25 yrs	Weeder	Estate "A"	? 12.6.32	18.6.32	Gradual with malaise headache and shivering	Remittent and intermittent maximum 103°	? 10 days from onset 4 days in hospital	Rapid lysis	? Present on admission	Scattered dusky indistinct macules and slightly raised irregular papules on back, chest and abdomen	11th Day	Marked	Moderate	Moderate	Moderate	Nil.	Normal	Normal	Not enlarged	Relatively slow	20-40	Scattered rhonchi and moist rales both lungs	Frequent loose
36.	Female	18 yrs	Weeder	Estate "A"	14.6.32	18.6.32	Abrupt with vomiting and headache	Remittent later intermittent maximum 102.6°	10 days	Rapid lysis	-	No rash observed.	-	Nil.	Nil.	Nil.	Nil.	Nil.	Normal	Inguinals slightly enlarged	Tends to follow temperature	20-30	Scattered moist rales both lungs	Slight loose	
37.	Male	35 yrs	Harvester	Estate "A"	8.8.32.	13.8.32	Abrupt with rigor, headache and weakness of limbs	Continued with remissions maximum 105°	15 days	Rapid lysis	? 8th Day	Fine subcuticular mottling, and scattered, irregular, slightly raised dusky papules, on back, chest and abdomen. Fading on pressure. Few scattered petechiae.	? 20th Day	Nil.	Nil.	Marked ? Quinine	Severe	Occasional	Apathy Occasional quiet delirium	Normal	Inguinals enlarged and painful	Markedly slow in relation to temperature Irregular and of low tension	20-35	Scattered rhonchi and moist rales both lungs	Occasional loose
38.	Female	35 yrs.	Weeder	Estate "A"	30.8.32	6.9.32	Abrupt with headache, aching of body, and giddiness	Remittent maximum 104.6°	15 days	Rapid lysis	? Present on admission	Scattered scanty indistinct papules on back and chest, fading of pressure.	11th Day	Moderate	Slight	Moderate	Very Severe	Marked	Apprehensive irritable Occasional delirium	Diminished	Inguinals enlarged and tender	Tends to follow temperature	20-30	Scattered rhonchi and moist rales both bases	Occasional dry
39.	Male	35 yrs.	Weeder	Estate "B"	28.10.32	2.11.32	Abrupt with chill, headache, nausea, pain in chest and all over body	Remittent later intermittent maximum 103°	16 days	Lysis	-	No rash observed.	-	Moderate	Slight	Slight	Severe	Occasional	Insomnia Apathy Occasional irritability	Normal	Inguinals enlarged and tender	Slow in relation to temperature	30-40	Nil.	Nil.
40.	Female	18 yrs	Weeder	Estate "A"	30.11.32	2.12.32	Abrupt with rigor, headache, and vomiting	Continued maximum 104°	? 17 days from onset 15 days in hospital (? 1st 3 days malaria)	Rapid lysis	6th Day	Scattered, indistinct, dusky macules and irregular slightly raised papules, first on face, spreading to back, chest, abdomen, thighs and backs of legs. Fading on pressure.	16th Day	Nil.	Nil.	Nil.	Severe	Nil.	Insomnia Apathy	Normal	Inguinals enlarged and tender	Markedly slow in relation to temperature	30-40	Nil.	Occasional loose
41.	Female	22 yrs	Weeder	Estate "A"	20.1.33	25.1.33	Abrupt with chill and severe headache Bilious vomiting	Remittent and intermittent	17 days	Lysis	-	No rash observed.	-	Slight	Slight	Slight one day only	Severe	Present at height of fever	Anxiety Occasional irritability and restlessness	Normal	Not enlarged	Tends to follow temperature	20-40	Nil.	Nil.

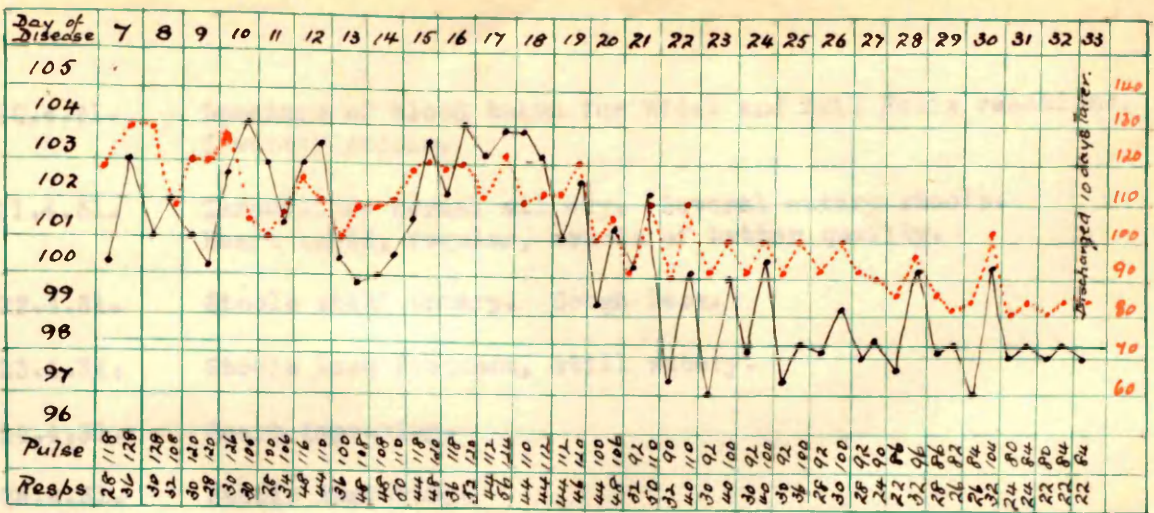
ms	Knee Jerks	Lymphatic Glands	Pulse	Respirations	Lung Signs	Cough	Joint Pains	Muscular Pains	Calf Tenderness	Spleen	Vomiting	Diarrhoea	Tympanites	Urine	Widal Reaction	Weil Felix Reaction	Other Features	Complications	Convalescence
	Normal	Not enlarged	Relatively slow	20-40	Scattered rhonchi and moist rales both lungs	Frequent loose	Nil.	General aching Chest pains.	Severe	Not palpable	Nil.	Nil.	Nil.	No albumen	23rd Day negative	23rd Day (alc) (living) K - $\frac{1}{300}$ $\frac{1}{440}$ OxK.1 $\frac{1}{250}$ $\frac{1}{440}$ W- o - $\frac{1}{38}$	Nil.	Nil.	Rapid Discharged ? 18th Day.
	Normal	Inguinals slightly enlarged	Tends to follow temperature	20-30	Scattered moist rales both lungs	Slight loose	Nil.	Chest pains.	Nil.	Not palpable	At Onset Nil in hospital	Nil.	Nil.	No albumen	21st Day negative	21st Day (alc) (living) "K" $\frac{1}{385}$ $\frac{1}{680}$ OxK $\frac{1}{250}$ $\frac{1}{680}$ "W" o - o	Nil.	Nil.	Rapid Discharged 16th Day.
	Normal	Inguinals enlarged and painful	Markedly slow in relation to temperature Irregular and of low tension	20-35	Scattered rhonchi and moist rales both lungs	Occasional loose	Moderate knees, ankles and shoulders	General aching Chest pains.	Severe	Palpable 1" below costal margin	Nil.	Nil.	Nil.	Trace of albumen	17th Day Negative	17th Day "K" - 1/1065 "W" - o	S.T.Malaria on admission. Sinton's modified treatment given for 7 days. Slight oedema of feet (Hb. 45%)	Nil.	Uneventful Discharged 29th Day.
e	Diminished	Inguinals enlarged and tender	Tends to follow temperature	20-30	Scattered rhonchi and moist rales both bases	Occasional dry	Severe upper and lower limbs	General aching Severe pain back of neck Chest pains.	Moderate	Not palpable	Nil.	Nil.	Nil.	Albumen present	14th Day Negative	14th Day "K" - 1/575 "W" - o	Oedema of feet and legs	Nil.	Uneventful Discharged 28th Day.
ty	Normal	Inguinals enlarged and tender	Slow in relation to temperature	30-40	Nil.	Nil.	Nil.	General aching Chest pains	Nil.	Palpable 2" below costal margin (Has had malaria)	Nil.	Nil.	Nil.	No albumen	12th Day T - 1/38 A - o B - o C - o T(o) - 4 units	12th Day "K" - 1/630 "W" - 1/22	Nil.	Nil.	Slow, developed signs of amoebic dysentery. Had 12 days Emetine treatment Discharged 39th Day.
	Normal	Inguinals enlarged and tender	Markedly slow in relation to temperature	30-40	Nil.	Occasional loose	Nil.	General aching	Moderate	Not palpable	Nil.	Nil.	Nil.	Trace of albumen	14th Day 20th Day Negative	14th Day 20th Day "K" - $\frac{1}{125}$ $\frac{1}{100}$ "W" o - o	S.T.Malaria on admission. Atebrin with Plasmoquin given for 5 days Oedema of feet & ankles, face puffy Ankylostomiasis, haemic murmur (Hb. 25%)	Nil.	Slow, had treatment for ankylostomiasis and anaemia Discharged 37th Day
y s	Normal	Not enlarged	Tends to follow temperature	20-40	Nil.	Nil.	Nil.	Bachache and pains in thighs.	Nil.	Not palpable	At onset only	Moderate 2nd week with abdominal pain	Nil.	No albumen	Day 11th Day 21st Day 28th Negative	Day 11th Day 21st Day 28th K- $\frac{1}{60}$ $\frac{1}{100}$ $\frac{1}{130}$ W- o - o - o	Nil.	Nil.	Rapid Discharged 24th Day

APPENDIX A.I. (Contd.)

Case No.	Sex	Age	Occupation	Locality	Date of Onset	Date Admitted	Mode of Onset	Fever			Rash												
								Type of Fever	Duration of fever	Mode of Fall	Date of Appearance	Characteristics	Date of Disappearance	Conjunctival Infection	Photophobia	Deafness	Headache	Giddiness	Mental Signs	Knee Jerks	Lymphatic Glands	Pulse	Respirations
42.	Female	25 yrs	Weeder	Estate "D"	29.1.33	3.2.33	One day prodromata, headache and aching of body. Then abrupt fever, chill, headache & pain in back of neck	Markedly remittent maximum 106.2°	Until death 12 days	Death	? Present on admission	Small, discrete, slightly raised, dusky papular rash on back, particularly scapular region, flanks, and backs of thighs.	Faintly present at death	Marked	Marked	Moderate	Intense	Present	Stupor alternating with violent delirium	Decreased	Not enlarged	Initially relatively slow, later irregular and dicrotic	40-60
43.	Female	16 yrs.	Weeder	Estate "A"	30.1.33	3.2.33	Indefinite, with fever, rigors, severe headache Pain in back of neck, cough and vomiting	Markedly remittent maximum 104.4°	? 9 days	Rapid lysis	? Present on admission	Small, discrete, slightly raised, dusky maculo-papular rash on back, chest and abdomen and upper thighs.	10th Day	Slight	Nil.	Moderate	Severe	Nil.	Nil.	Normal	Right inguinal glands enlarged and tender	Tends to follow temperature Relatively slow	20-40
44.	Female	20 yrs.	Weeder	Estate "A"	4.3.33	6.3.33	Abrupt with chill, headache, and cough	Remittent and intermittent before death maximum 105°	Until death 10 days	Death	-	No rash observed.	-	Moderate	Moderate	Slight	Severe	Marked	Insomnia Muttering delirium Last 3 days subsultus and marked tremor	Decreased	Right inguinal glands enlarged and tender	Rapid irregular and finally dicrotic	30-60
45.	Female	15 yrs	Weeder	Estate "A"	7.3.33	12.3.33	Gradual with fever, chills, headache and aching of limbs	Markedly remittent Maximum 104° 7th Day	9 days	Crisis	? Present on admission	Irregular, slightly raised, dusky papules on face, abdomen, back, flanks and legs.	11th Day	Slight	Nil.	Present from birth	Severe	Nil.	Nil.	Normal	Inguinal glands both sides enlarged and tender	Initially relatively slow Regular good volume	30-40
46.	Male	28 yrs	Harvester and Truck-loader	Estate "A"	4.4.33	6.4.33	Abrupt fever with chill and severe headache	Remittent Maximum 104° 4th Day	12 days	Rapid lysis	8th Day	Few widely scattered irregular purpuric macules on chest and back.	12th Day	Extreme	Marked	Nil.	Severe	Nil.	Insomnia Noisy delirium 7th & 8th days with occasional muttering	Normal	Inguinal glands both sides enlarged and tender	Markedly slow, good volume	30-40
47.	Male	35 yrs	Harvester	Estate "A"	23.4.33	26.4.33	Abrupt fever with daily chill, headache and aching body	Markedly remittent Maximum 103.4° 4th & 5th day	10 days	Rapid lysis	? Present on admission	Small, discrete dusky maculo-papules on chest, back and abdomen, later appearing on forehead and cheeks.	11th Day	Moderate	Slight	Severe	Severe	Nil.	Insomnia, noisy delirium 5th-7th day	Normal	Inguinal and axillary glands both sides enlarged and slightly tender	Relatively slow, good volume and tension	30-40

Headache	Stiffness	Mental Signs	Knee Jerks	Lymphatic Glands	Pulse	Respirations	Lung Signs	Cough	Joint Pains	Muscular Pains	Calf Tenderness	Spleen	Vomiting	Diarrhoea	Tympanites	Urine	Widal Reaction	Weil Felix Reaction	Other Features	Complications	Convalescence
Intense	Present	Stupor alternating with violent delirium	Decreased	Not enlarged	Initially relatively slow, later irregular and dicrotic	40-60	Widely scattered rhonchi and rales both lungs. Shifting dullness & fine creps. both bases	Troublesome Short dry	Nil.	General aching Severe pain back of neck.	Severe	Not palpable	Nil.	Severe 7th day until death, foetid	Present from 9th day with abdominal tenderness	Trace of albumen	Specimen contaminated Death before 2nd specimen could be obtained	Specimen contaminated Death before 2nd specimen obtained	Plague like toxæmia Urine and faeces passed involuntarily	Commencing Broncho-pneumonia	Died on 12th day of disease.
Severe	Nil.	Nil.	Normal	Right inguinal glands enlarged and tender	Tends to follow temperature Relatively slow	20-40	Nil.	Occasional Short dry	Nil.	General aching Pains in back of neck.	Severe	Not palpable	At onset only	Nil.	Nil.	No albumen	? 17th Day Negative	? 17th Day "K" - 1/780 "W" - 0	Nil.	Nil.	Rapid Discharged 17th Day.
Severe	Marked	Insomnia Muttering delirium Last 3 days subsultus and marked tremor	Decreased	Right inguinal glands enlarged and tender	Rapid irregular and finally dicrotic	30-60	N.A.D. on admission 9th day scattered moist rales and fine crepitations both bases	Frequent dry	Nil.	Severe general aching.	Moderate	Not palpable	Nil.	Slight 6th-8th day	Nil.	Trace of albumen	Death occurred before specimen could be obtained	Death occurred before specimen could be obtained	Haemoglobin 25% Oedema of face & ankles. Soft blowing systolic murmur at base on admission	Commencing Broncho-pneumonia ankylostomiasis	Died on 10th day of disease
Severe	Nil.	Nil.	Normal	Inguinal glands both sides enlarged and tender	Initially relatively slow Regular good volume	30-40	Widely scattered rhonchi and moist rales both lungs	Occasional short dry	Nil.	General aching.	Moderate	Not palpable	Nil.	Nil.	Nil.	No albumen	16th Day T - 1/17 A - 0 B - 0 C - 0 T(o) - 0	16th Day "K" - 1/420 "W" - 0	Nil.	Nil.	Rapid Discharged 17th Day
Severe	Nil.	Insomnia Noisy delirium 7th & 8th days with occasional muttering	Normal	Inguinal glands both sides enlarged and tender	Markedly slow, good volume	30-40	Nil.	Nil.	Generalised pains Severe in knee joints	Pain in Chest wall.	Nil.	Not palpable	Nil.	Marked 4th-15th day	Nil.	No albumen	15th Day T - 0 A - 1/34 B - 0 C - 0 T(o) - 4 units	15th Day "K" - 1/560 "W" - 1/44	Heavy infection with S.T. Malaria on admission. Atebrin and Plasmoquin given for 5 days. On 9th day 10.c.c. convalescent serum from Case No. 45	Nil.	Rapid Discharged 22nd Day.
Severe	Nil.	Insomnia, noisy delirium 5th-7th day	Normal	Inguinal and axillary glands both sides enlarged and slightly tender	Relatively slow, good volume and tension	30-40	Nil	Occasional slight	Nil.	General aching.	Nil.	Not palpable	Nil.	Nil.	Nil.	No albumen	11th Day Negative	11th Day "K" - 1/400 "W" - 1/17	10.c.c. of convalescent serum from case No. 46 given on 7th-8th days	Nil.	Rapid Discharged 16th Day

CASE HISTORIES AND TEMPERATURE CHARTS
of the
FORTY SEVEN CASES IN THE PRESENT SERIES.



CASE No. 1.

AGE 25 years.

FEMALE

WEEDER

ESTATE "B"

ADMITTED 3-4-31.

COMPLAINT:- 6 days ago fever started with chill, aching of body and joints, and diarrhoea.

ON ADMISSION:- No rash, severe headache, general aching and pains in chest. Spleen enlarged $1\frac{1}{2}$ " below costal margin. Heart, lungs and abdomen N.A.D.

- 4.4.31. Severe general aching, joint pains, chest pains, and calf tenderness.
- 5.4.31. Stools relaxed, tongue coated, moist. Dry cough.
- 6.4.31. Frequent dry cough. Severe headache with giddiness. Several watery stools.
- 7.4.31. Joint pains severe. Stools watery.
- 8.4.31. Dull and listless. Headache severe, marked giddiness. Several watery stools.
- 9.4.31. Scattered moist rales both lungs, frequent cough.
- 10.4.31. Insomnia. Stools improved. Heart sounds indistinct, occasional irregularity.
- 11.4.31. Shifting dullness, rhonchi and crepitations both lungs.
- 12.4.31. Low muttering delirium at night. Frequent cough with expectoration.
- 13.4.31. Insomnia, Apathy. Joint and muscle pains less. Heart irregular, 1st sound shortened and muffled.
- 14.4.31. Dull and listless, low muttering delirium at night.
- 15.4.31. Several hours sleep. Lung condition unchanged, free expectoration. Heart rapid, marked irregularity.
- 16.4.31. Mental condition clearer, cough less frequent.
- 17.4.31. Lung condition improving. Heart irregular, rapid. 1st sound soft and blowing.
- 18.4.31. Sleeping better.
- 19.4.31. Heart improving, irregular at times only. Several watery stools.

- 20.4.31. Specimen of blood taken for Widal and Weil Felix reactions.
3 watery stools.
- 21.4.31. Temperature normal all day. Several watery stools.
Heart rapid, regular, sounds of better quality.
- 22.4.31. Stools still watery. Cough less.
- 23.4.31. Stools less frequent, still watery.
- 24.4.31. Heart improving.
- 25.4.31. Stools improving.
- 26.4.31. Stools semiformal.
- 27.4.31. General improvement.
- 28.4.31. Lungs clear. Heart N.A.D.
- 30.4.31. Sleeping well, appetite improving, bowels regular.
- 3.5.31. Convalescent.
- 7.5.31. Discharged from hospital.

Urine

React. Sp.Gr.

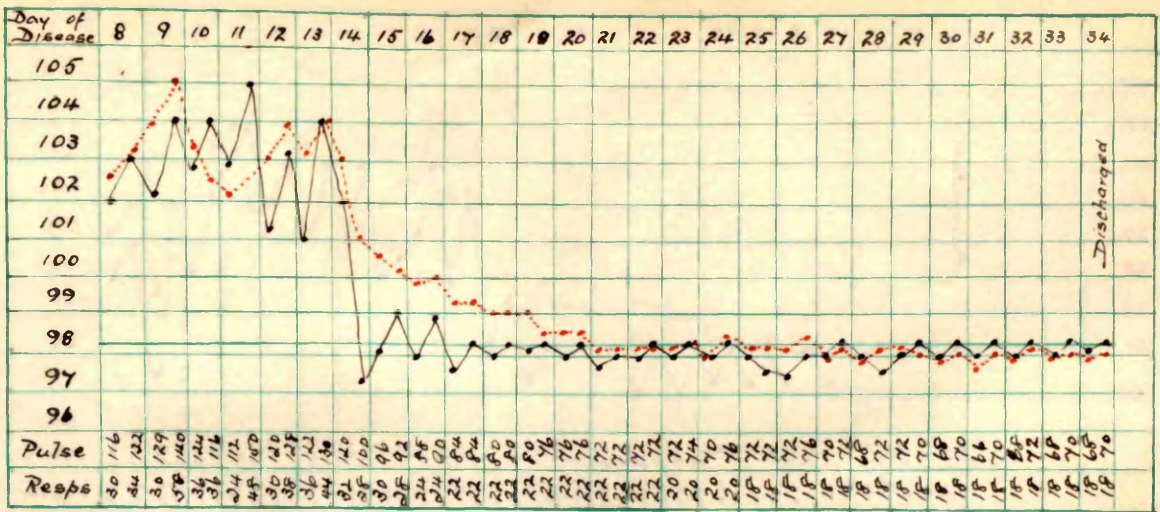
- 4.4.31. Acid. 1024. Trace of albumen.
- 11.4.31. Trace of albumen.
- 18.4.31. " " "
- 25.4.31. No albumen.

Haemoglobin rate 65%.No Malarial parasites.Widal Reaction.

	25th Day	
T	-	0
A	-	0
B	-	$\frac{1}{190}$
C	-	$\frac{1}{46}$
T(o)	-	0

Weil Felix Reaction.

	25th Day	
"K"	-	$\frac{1}{1000}$
"W"	-	0



CASE No. 2.

AGE 30 years.

FEMALE

WEEDER

ESTATE "B"

ADMITTED 7.5.31.

COMPLAINT:- 7 days ago fever started with rigor, vomiting, headache and aching of body. Slight cough.

ON ADMISSION:- Rash present on face and chest. Scattered macules and a few slightly raised dusky papules, fading on pressure. Severe headache, slight deafness. Heart, lungs and abdomen N.A.D. Knee jerks decreased.

- 8.5.31. Rash spread to back, scanty on abdomen. Severe calf tenderness, general aching, and pain in chest.
- 9.5.31. Insomnia and irritability, severe headache, slight deafness.
- 10.5.31. Rash faded, slight cough, lungs clear, heart rapid, sounds good.
- 11.5.31. Very irritable. Severe calf tenderness.
- 12.5.31. Several watery stools, abdominal pain, no tenderness.
- 13.5.31. Headache less, deafness cleared. 3 watery stools. Heart N.A.D.
- 14.5.31. General condition improving. Specimen of Blood taken for Widal and Weil Felix reactions.
- 15.5.31. Stools formed. Sleeping well. Temperature normal.
- 17.5.31. Convalescent.
- 25.5.31. Second Specimen of Blood taken.
- 2.5.31. Discharged from hospital. 3rd specimen of blood taken.

Urine

7.5.31. - React acid Sp.Gr. 1026
No albumen.

Haemoglobin 55%

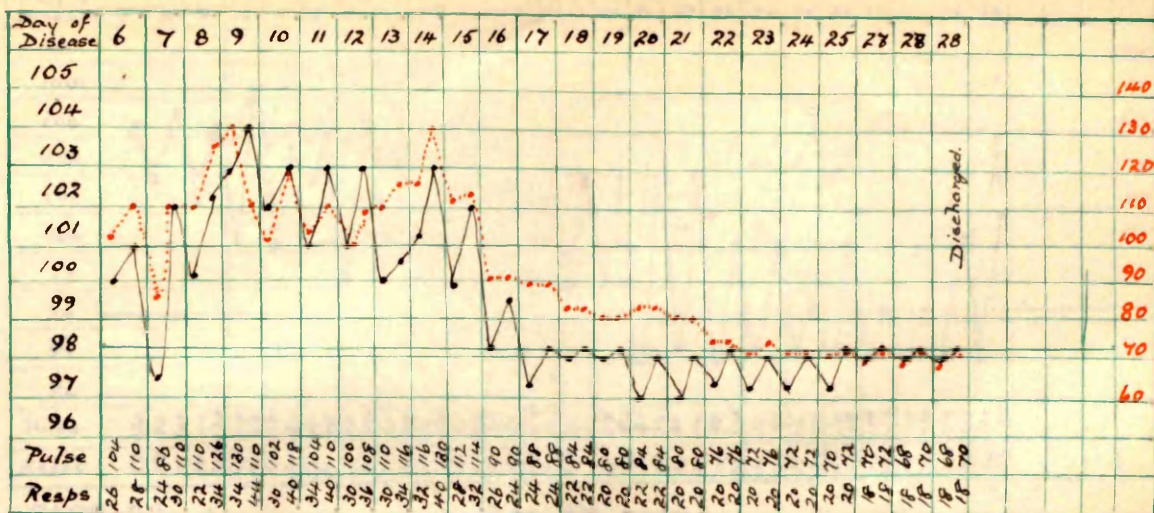
No Malarial parasites.

Widal Reaction

15th Day	26th Day	34th Day
T - 1/25	- 1/125	- 1/50
A - 0	- 1/280	- 1/96
B - 0	- 0	- 0
C - 0	- 0	- 0
T(o) - 0	- 11 units	- 8 units

Weil Felix Reaction

15th Day	26th Day	34th Day
Negative	"K"-1/125	1/44
	"W" - 0	- 0



CASE No. 3.

AGE 27 years

FEMALE

WEEDER

ESTATE "A"

ADMITTED 8-6-31.

COMPLAINT:- 5 days ago fever started with rigor, aching of body and limbs.

ON ADMISSION:- No rash. No conjunctival injection. Calf tenderness. Heart, lungs and abdomen N.A.D.

- 9.6.31. Severe headache and general aching.
- 10.6.31. Stools relaxed and frequent.
- 11.6.31. Slight dry cough, lungs clear.
- 12.6.31. Dull and listless, headache severe. Several loose stools.
- 13.6.31. Stools loose and frequent. Pain in chest. Frequent dry cough. Lungs clear.
- 15.6.31. Headache less. Heart sounds normal.
- 16.6.31. Calf tenderness and pain in chest. Bowels regular.
- 18.6.31. General improvement. Temperature normal.
- 20.6.31. Specimen of blood taken for Widal and Weil Felix Reactions.
- 21.6.31. Convalescent.
- 30.6.31. 2nd Specimen of blood taken for Widal and Weil Felix Reactions.
- Discharged from hospital.

Urine

- 8.6.31. React. acid. Sp.Gr: 1020
Trace of albumen.
- 12.6.31. No albumen.

Haemoglobin 50%.

No Malarial parasites.

Widal Reaction

18th Day	28th Day
T - 1/1130	T - 1/560
A - 0	A - 0
B - 0	B - 0
C - 0	C - 0
T(o) - 0	T(o) - 0

Weil Felix Reaction

18th Day	28th Day
"K" - 1/1130	- 1/880
"W" - 0	- 0

Day of Disease	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30				
105																												
104																												
103																												
102																												
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97																												
96																												
Pulse	120	112	110	120	118	118	124	118	120	117	128	118	104	120	90	110	118	112	118	111	118	110	120	120	120	120	120	
Resps	28	28	29	30	31	30	32	30	32	31	32	30	26	34	36	44	42	44	44	46	46	48	48	46	44	44	44	

CASE NO. 4.

Age 38 years.

MALE.

HARVESTER (Overseer)

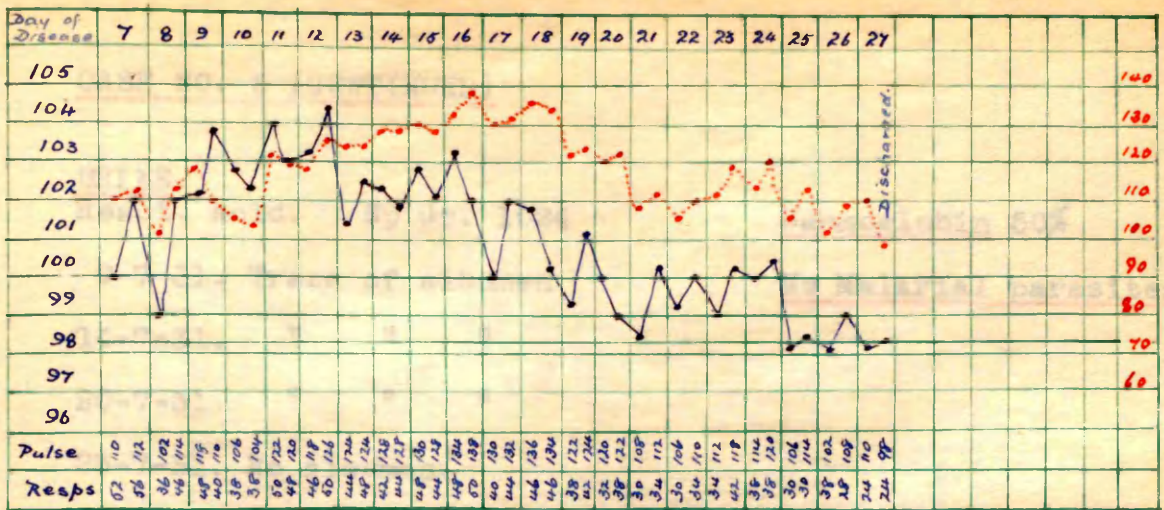
ESTATE "A"

ADMITTED. 16-6-31.

COMPLAINT :- Fever with severe pain and swelling of both legs and knee joints. Said to have had measles for 6 days.

ON ADMISSION :- Slightly raised papules over both scapulae, fading on pressure and difficult to distinguish. Face puffy and conjunctivae injected. Heart N.A.D. Moist râles both lungs.

- 17-6-31. Frequent cough, chest pains. Axillary glands enlarged.
- 18-6-31. Inguinal glands enlarged, not tender. Rash faded. Bowels regular.
- 19-6-31. Severe general aching, calf tenderness and pain in knee joints.
- 20-6-31. Headache, giddiness, vomited \bar{i} , moderate photophobia
- 21-6-31. Apathetic; cough troublesome. Slight deafness.
- 22-6-31. Coarse râles and scattered fine crepitations both lungs. Heart :- occasionally irregular, first sound muffled.
- 23-6-31. Frequent cough, oedema of feet and legs increasing.
- 24-6-31. Dull, apathetic. Low tension pulse. Bowels regular.
- 25-6-31. Low muttering delirium. Heart :- irregular, 1st sound indistinct . soft murmur aortic area and over sternum.
- 26-6-31. Inguinal and axillary glands enlarged and tender.
- 27-6-31. Quiet delirium, cough loose, free expectoration.
- 28-6-31. Apathetic, occasional quiet delirium. Pulse irregular low tension. Blood specimen sent for Weil Felix and Widal reactions.
- 29-6-31. Cough frequent. Oedema of feet and legs, and puffiness of face increasing.
- 30-6-31. Temperature normal. Perspiring freely. Dyspnoea occasionally.
- 1-6-31. Signs of extensive broncho-pneumonia both lungs. Heart :- Left border 1" beyond nipple line. 1st sound irregular, faint and indistinct. Pulse dicrotic.
- 2-6-31. Quiet delirium.
- 3-7-31. Stuporous. Oedema increasing.
- 4-7-31. Stupor, alternating quiet delirium, heart irregular.
- 6-7-31. Heart irregular, soft systolic murmur at aortic area conducted down sternum.
- 7-7-31. Stupor increasing.
- 8-7-31. Semiconscious, heart unchanged, irregularity more marked.
- 9-7-31. Semiconscious. Heart very irregular. Pulse markedly dicrotic, rapid, at times imperceptible.
- 10-7-31. Died.



CASE NO. 5.

Age 30 years.

FEMALE.

WEEDER.

ESTATE "B"

ADMITTED. 9-7-31.

COMPLAINT :- 6 days ago fever commenced suddenly with rigor, headache, vomiting, and pains all over body.

ON ADMISSION :- Scattered macules and papules over scapular region and face. Conjunctivae injected. Calf muscles tender. Respirations increased. Slight cough. Heart, lungs and abdomen N.A.D. Knee jerks decreased. Spleen 4" below costal margin.

- 10-7-31. Rash present on chest, abdomen, thighs, and upper arms. Tympanites present. No headache.
- 11-7-31. Inguinal glands enlarged and tender. Slight deafness.
- 12-7-31. Joint pains severe, especially knees. Chest pains Slight dry cough.
- 13-7-31. Cough more persistant. Insomnia. Tympanites less
- 14-7-31. Rash still present. Conjunctivae clear.
- 15-7-31. Rhonchi and moist râles both lungs. Heart - Impairment of first sound, Occasional irregularity.
- 16-7-31. Frequent cough with expectoration. Chest pains severe.
- 17-7-31. Rapid low tension pulse. Heart condition unchanged.
- 18-7-31. Oedema of feet and legs. Cough frequent.
- 19-7-31. Rash faded. Slight deafness. Heart irregular, Sounds indistinct.
- 20-7-31. Specimen of blood taken for Widal and Weil Felix reactions.
- 21-7-31. Lungs clearing. Heart condition the same.
- 22-7-31. Free expectoration.
- 24-7-31. Oedema of feet and legs subsided. Heart regular, 1st sound indistinct.
- 27-7-31. General improvement. Temperature normal.
- 29-7-31. Lungs clear. Heart sounds improved.
- 31-7-31. Convalescent.
- 6-8-31. Discharged from hospital.

2nd specimen of blood taken 5 days later. (30th day)

CASE NO. 5 (CONTINUED)

URINE.

React. acid. Sp.Gr. 1024

Haemoglobin 50%

9-7-31. Trace of albumen

No Malarial parasites.

14-7-31. " " "

20-7-31. " " "

25-7-31. No albumen.

WIDAL REACTION.

18th Day. 30th Day.

T - o Negative

A - o

B - $\frac{1}{85}$

C - o

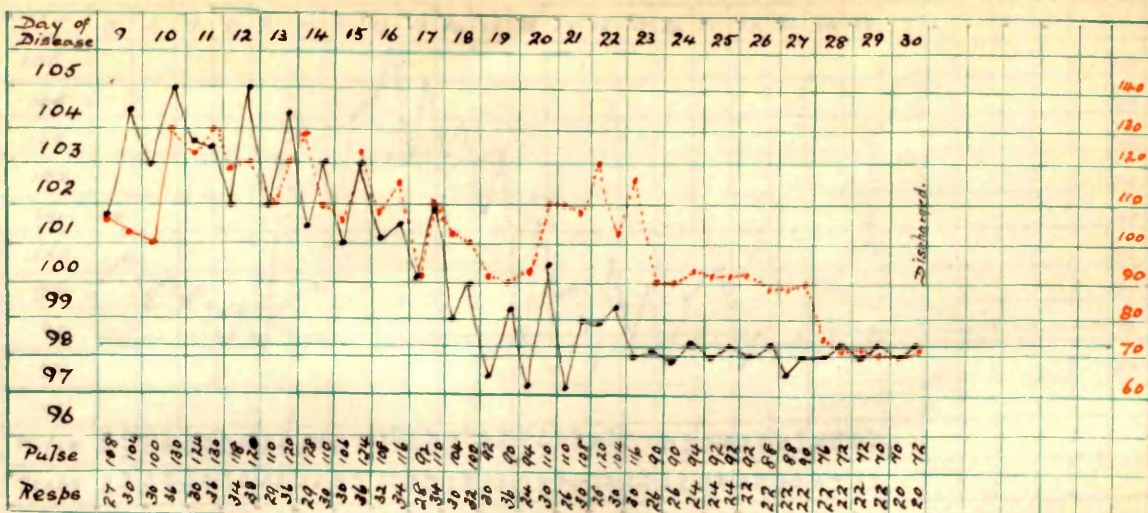
T(o) - o

WEIL FELIX REACTION.

18th Day. 30th Day.

"K" - $\frac{1}{85}$ Negative

"W" - o



CASE No. 6.

AGE 30 years

MALE

FACTORY WORKER

ESTATE "B"

ADMITTED 5-8-31.

COMPLAINT:- 8 days ago fever commenced with rigor, severe headache, and aching of body.

ON ADMISSION:- No rash. Scattered moist rales, both lungs. Heart N.A.D. Calf tenderness. Tongue coated with white fur.

- 6.8.31. Headache with giddiness and slight deafness.
- 7.8.31. Severe calf tenderness. Cough troublesome. Insomnia.
- 8.8.31. Moist rales and rhonchi, shifting dullness, both lungs.
- 9.8.31. Irritable. Pulse rapid, heart regular. Severe headache.
- 10.8.31. Insomnia. Frequent cough with expectoration.
- 11.8.31. Several loose stools. Headache less severe.
- 12.8.31. Deafness cleared.
- 13.8.31. Lung condition clearing. Heart regular.
- 14.8.31. General condition improving.
- 15.8.31. Sleeping naturally. Cough less frequent.
- 17.8.31. Few moist rales both apices. Heart regular.
- 18.8.31. General improvement.
- 19.8.31. Lungs clear. Temperature normal.
- 22.8.31. Convalescent.
- 26.8.31. Discharged from hospital.

5.8.31. Urine
Acid. React.
 1028 Sp.Gr.
 No albumen.

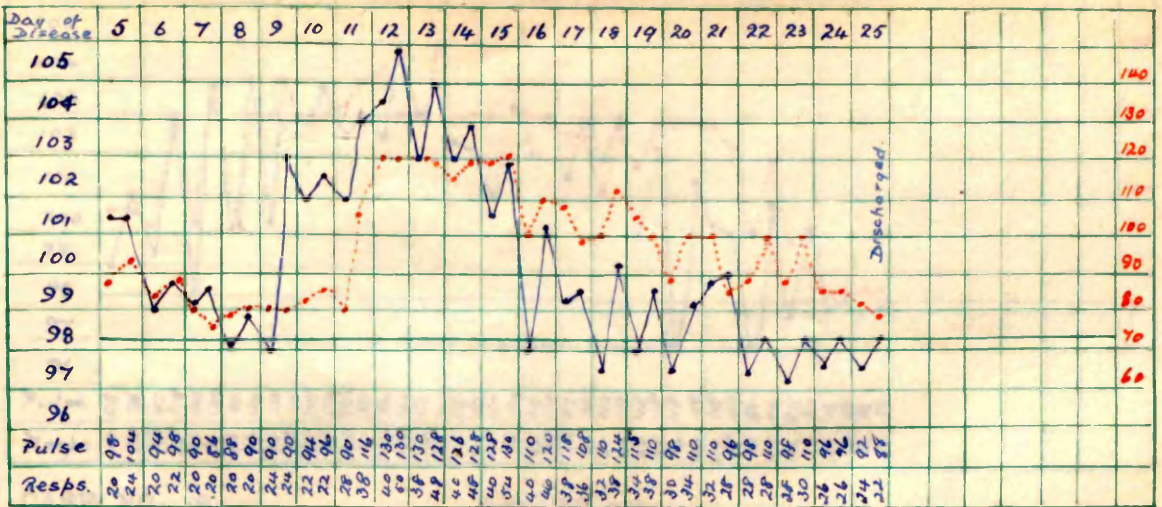
Haemoglobin 65%
No malarial parasites.

Widal Reaction
 37th Day

T	-)	
A	-)	
B	-)	Negative
C	-)	
T(o)	-)	

Weil Felix Reaction
 37th Day

"K"	-	1/620
"W"	-	0



CASE NO. 7.

Age 20 Years.

FEMALE.

WEEDER.

ESTATE "A"

ADMITTED. 15-8-31.

COMPLAINT :- Indefinite history of malaise and headache for 4 days.

ON ADMISSION :- No rash. Conjunctival injection. Moist râles both lungs. Heart N.A.D.

16-8-31. Headache. General aching. Chest pains.

17-8-31. Frequent productive cough.

18-8-31. Severe general aching. Dull and listless.

19-8-31. Moderate deafness. Headache and giddiness.

20-8-31. Frequent cough, moist râles and rhonchi both lungs.

21-8-31. Severe chest pains. Heart regular.

22-8-31. Dull and listless. Rapid low tension pulse. Heart regular.

23-8-31. Frequent cough, free expectoration.

24-8-31. Deafness cleared.

25-8-31. Rapid low tension pulse. Frequent cough.

26-8-31. Lung condition improving.

29-8-31. Cough less frequent. Less apathetic.

31-8-31. General condition improving.

2-9-31. Specimen of blood taken for Widal and Weil Felix Reactions.

6-9-31. Lungs clear. Convalescent.

12-9-31. Discharged from hospital.

URINE.

15-8-31. React. acid. Sp.Gr. 1024
Trace of albumen.

Haemoglobin 50%
No Malarial parasites

20-8-31. " " " "

24-8-31. No albumen.

Widal.

23rd day - Negative.

Weil Felix.

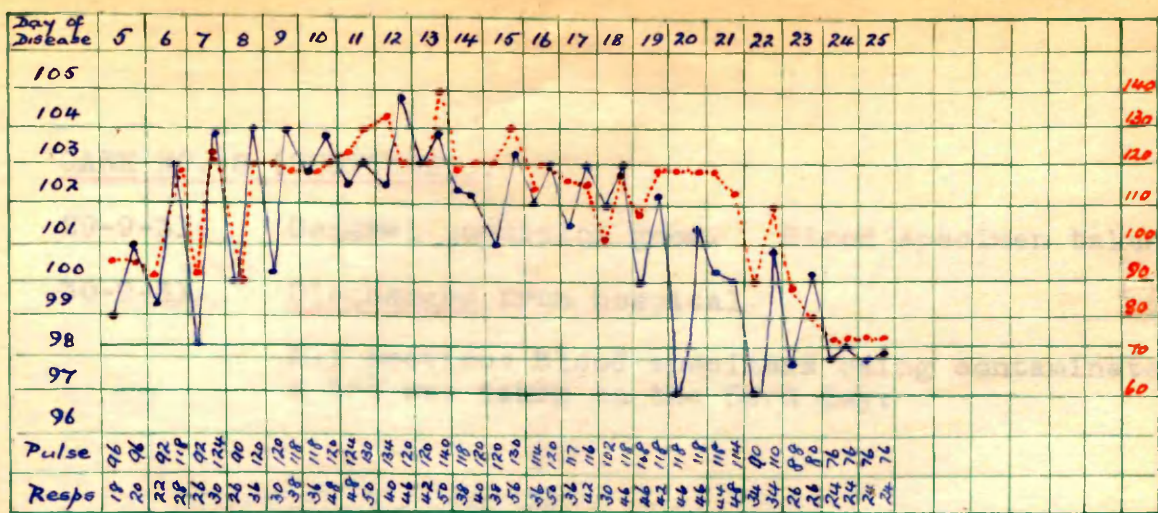
23rd day.

"K" - 1

380

"W" - 1

56



CASE NO. 8.

Age 52 years.

MALE.

DRAIN CUTTER AND
FRUIT SORTER.

ESTATE "B"

ADMITTED. 2-9-31.

COMPLAINT :- 4 days ago fever started with headache and aching of body.

ON ADMISSION :- No rash. Conjunctival injection. Severe calf tenderness. Slight enlargement of inguinal glands. Knee jerks absent. Spleen 1" below costal margin. Heart, Lungs and abdomen N.A.D.

3-9-31. Joint pains in knees and ankles. Pain in chest. Vomited $\frac{11}{11}$.

4-9-31. Few scattered irregular, dusky papules over scapular region. Several watery stools.

5-9-31. Slight photophobia. Deafness. Frequent dry cough.

6-9-31. Indistinct maculo-papular eruption on chest. Stools watery.

7-9-31. Severe headache, deafness, and giddiness. Sore throat and congestion of pharynx.

8-9-31. Rash faded. Still has chest pains. Stools formed.

9-9-31. Rhonchi and râles both bases.

Heart sounds muffled, occasional irregularity.

10-9-31. Noisy delirium at night. Frequent cough.

11-9-31. Noisy delirium, supsultus coma and vigil tremors.

Broncho-pneumonia right lung.

12-9-31. Irregular low tension pulse. Delirium, restlessness. Heart irregular, 1st sound indistinct.

13-9-31. Frequent dry cough.

14-9-31. Several watery stools. Some expectoration.

15-9-31. Mental torpor. Low tension pulse. Heart sound irregular and indistinct. Throat less congested. Several watery stools.

16-9-31. Frequent loose cough. Stools frequent.

17-9-31. Muttering delirium at times. Heart irregular, 1st sound almost imperceptible at times.

18-9-31. Deafness cleared.

19-9-31. Lung condition improving, free expectoration. Throat clear.

20-9-31. Delirium and tremors ceased. Heart condition improved, occasional irregularity.

21-9-31. Temperature normal. Cough less frequent.

22-9-31. Lungs clearing. Heart regular, sound improved.

24-9-31. 2nd specimen of blood sent for Widal and Weil Felix reactions.

25-9-31. Lungs almost clear, slight cough, no expectoration. Heart regular, sounds good.

CASE NO. 8 (CONTINUED).

29-9-31. General condition good. Blood specimen taken.

30-9-31. Discharged from hospital.

All previous Blood specimens being contaminated,
a 3rd was taken on the 53rd day.

URINE.

Haemoglobin rate 55%

2-9-31. React. Acid. Sp. Gr. 1024. No Malarial parasites.
Trace of albumen. •

7-9-31. " " "

14-9-31. " " "






21-9-31. No albumen.

WIDAL REACTION.

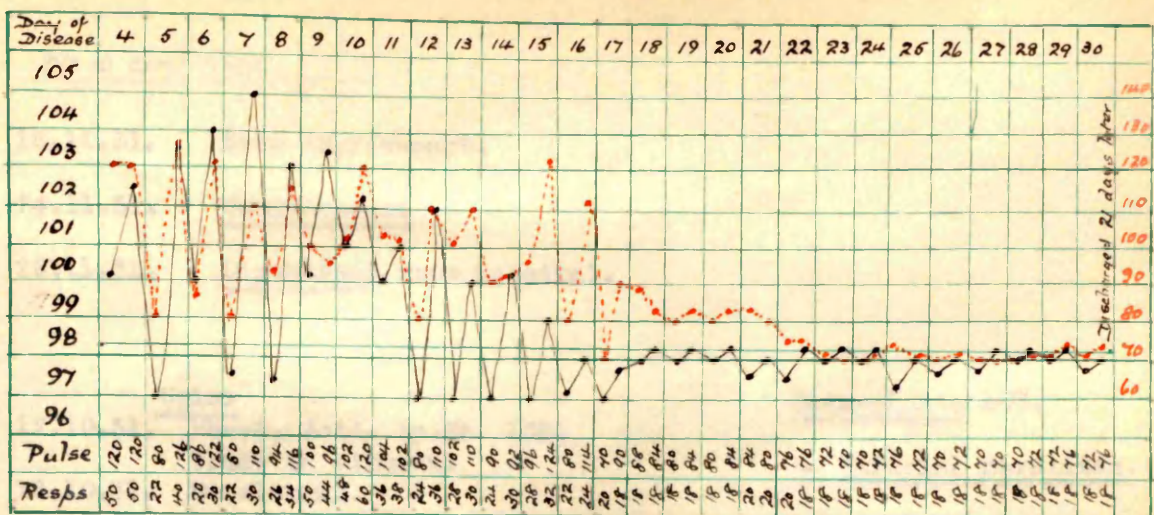
WEIL FELIX REACTION.

53rd day.

53rd day.

T - 
A -  Negative.
B -  3 previous
C -  specimens
T(o) -  contaminated.

"K" - Between $\frac{1}{35}$ - $\frac{1}{110}$
"W" - o
3 previous specimens
contaminated.



CASE No. 10.

AGE 25 years

FEMALE

WEEDER

ESTATE "B".

ADMITTED 12-10-31.

COMPLAINT:- 3 days ago fever commenced with rigor, headache, vomiting and aching of limbs.

ON ADMISSION:- Rhonchi and rales both lungs. Heart N.A.D. No rash. Conjunctival injection. Old standing septic ulcer on right ankle.

- 13.10.31. Blotchy irregular papules on face. Pain in chest, and back of neck.
- 14.10.31. Rash on back, chest, and abdomen. Vomiting.
- 15.10.31. Sore throat, congestion of pharynx, no exudate on tonsils. Giddiness. Photophobia.
- 16.10.31. Dull and listless. Tympanites with abdominal pain, no tenderness. Frequent dry cough.
- 17.10.31. Heart irregular, 1st sound indistinct, low tension pulse. Several watery stools.
- 18.10.31. Apathetic. Frequent watery stools.
- 19.10.31. Conjunctivae clearing. Stools watery.
- 20.10.31. Rash faded. Stools less frequent, no tympanites.
- 21.10.31. Lungs clearing. Heart - occasional irregularity, 1st sound improving.
- 22.10.31. Throat clear. Stools formed.
- 24.10.31. Lungs clear. Heart regular.
- 25.10.31. Ulcer of ankle clean and healing. General improvement.
- 27.10.31. Specimen of blood taken for Widal and Weil Felix reactions.
- 30.10.31. Marked asthenia.
- 4.11.31. Second specimen of blood taken.
- 6.11.31. General improvement.
- 12.11.31. Ulcer healed.

No 10. CONTINUED

- 18.11.31. Slow improvement.
 24.11.31. Convalescent.
 28.11.31. Discharged from hospital.

Urine

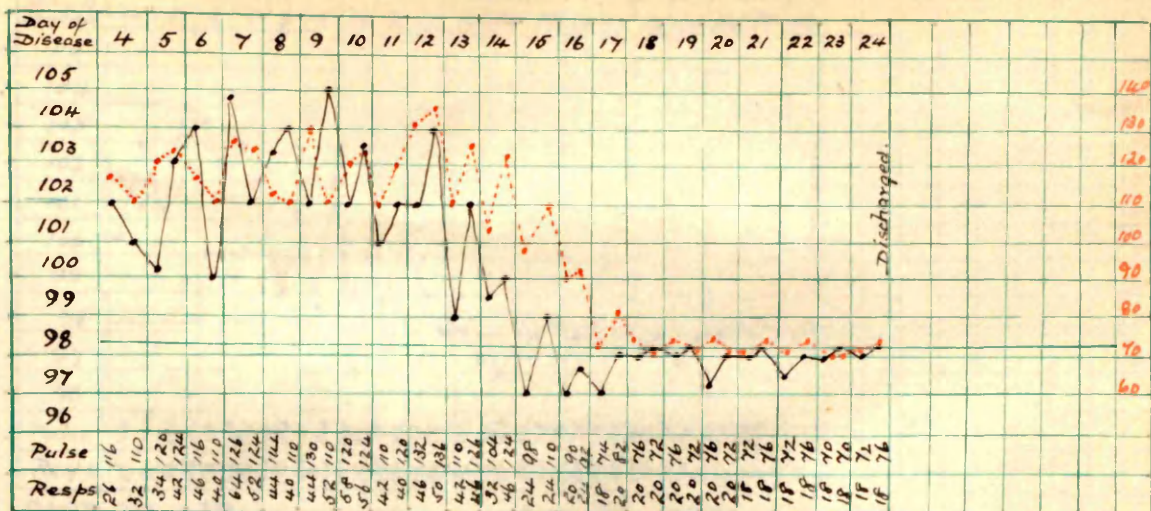
- 12.10.31. React. Acid. Sp.Gr. 1024
 Trace of albumen.
 16.10.31. No albumen.
 20.10.31. No albumen.

Haemoglobin 50%.No Malarial parasites.Widal Reaction

27th Day
 Negative.

Weil Felix Reaction.

27th Day
 "K" - 1/500
 "W" - 1/17.



CASE No. 11.

AGE 28 years.

FEMALE

WEEDER

ESTATE "A".

ADMITTED 16-10-31.

COMPLAINT:- 3 days ago fever started with rigor, headache, giddiness, and body pains.

ON ADMISSION:- No rash. Inguinal glands enlarged and tender. Few scattered rales. Heart N.A.D. Knee jerks decreased.

- 17.10.31. General aching, severe headache and giddiness.
- 18.10.31. Dusky macules and irregular papules on shoulders.
- 19.10.31. Rash on chest, back, and abdomen, scanty on face.
- 20.10.31. Irritability, insomnia. Rash well marked.
- 21.10.31. Dull delirium. Deafness.
- 22.10.31. Dry cough, scattered rales both lungs. Heart regular.
- 23.10.31. Dull, apathetic. Stools loose.
- 24.10.31. Inguinal glands subsiding.
- 25.10.31. Lungs clearing, cough less. Deafness cleared.
- 26.10.31. Rash faded. Mental condition improved.
- 27.10.31. Specimen of blood taken for Widal and Weil Felix Reactions.
- 28.10.31. Temperature normal. General improvement.
- 31.10.31. Convalescent. Lungs clear. Heart N.A.D.
- 5.11.31. Discharged from hospital.

Urine

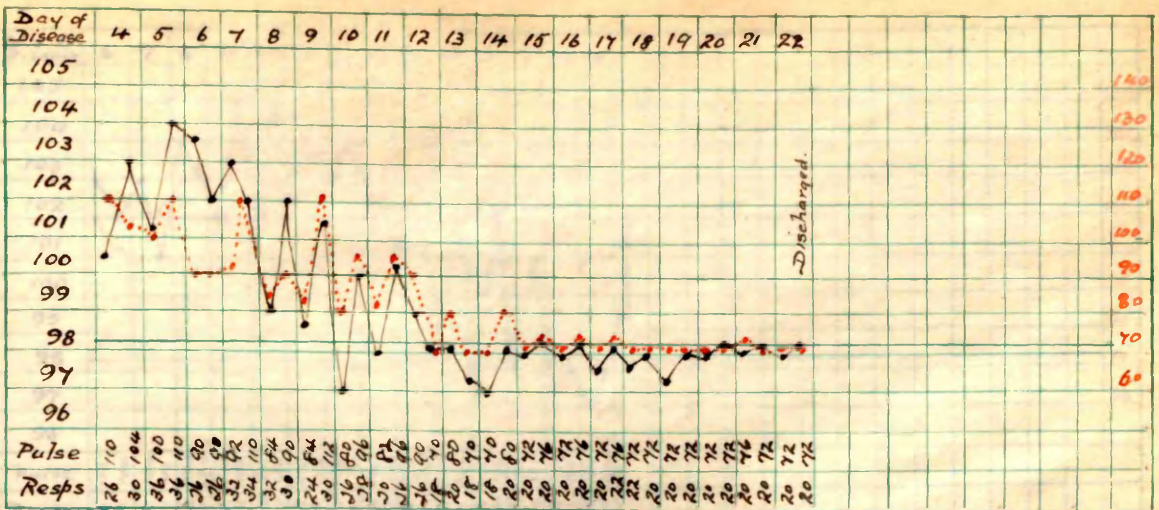
React. Sp.Gr.
16.10.31. Acid. 1028.
No albumen.

Haemoglobin 55%.No malarial parasites.Widal Reaction

	15th Day
T	- 1/650
A	- 0
B	- 0
C	- 0
T(o)	- 0

Weil Felix Reaction

	15th Day
"K"	- 1/650
"W"	- 1/22



CASE NO. 12.

Age 35 years.

FEMALE.

WEEDER.

ESTATE "A"

ADMITTED. 16-10-31.

COMPLAINT :- 3 days ago sudden fever commenced with rigor, headache, giddiness, and pain all over body.

ON ADMISSION :- Heart, lungs, and abdomen - N.A.D. No rash. Conjunctival injection and slight photophobia. Spleen 1" below costal margin. Knee jerks exaggerated. Tongue coated.

17-10-31. Indistinct, dusky, and slightly raised papules on face and over scapular region. Left inguinals enlarged and tender.

18-10-31. Rash faintly seen on chest, flanks, and abdomen. General aching and calf tenderness. Stools loose.

19-10-31. Headache severe, slight deafness. Stools watery.

20-10-31. Headache with giddiness and slight deafness. 3 watery stools.

21-10-31. Rash fading, stools improved.

22-10-31. Rash faded. Headache less. Deafness cleared.

23-10-31. Inguinal glands subsided.

24-10-31. Conjunctivae clear. No headache.

25-10-31. Temperature normal. General improvement.

28-10-31. Convalescent.

3-11-31. Specimen of blood taken for Widal and Weil Felix reactions. Haemolised in transport, 2nd and 3rd specimens taken on 27th and 37th days.

URINE. Haemoglobin 65%

16-10-31. React. Acid, Sp.Gr.1026. No Malarial parasites.

WIDAL REACTION.

WEIL FELIX REACTION.

27th Day. 37th Day.

27th Day. 37th Day.

"K" - $\frac{1}{85}$ "K" - $\frac{1}{85}$ $\frac{1}{250}$
 "W" - 0 "W" - $\frac{1}{38}$

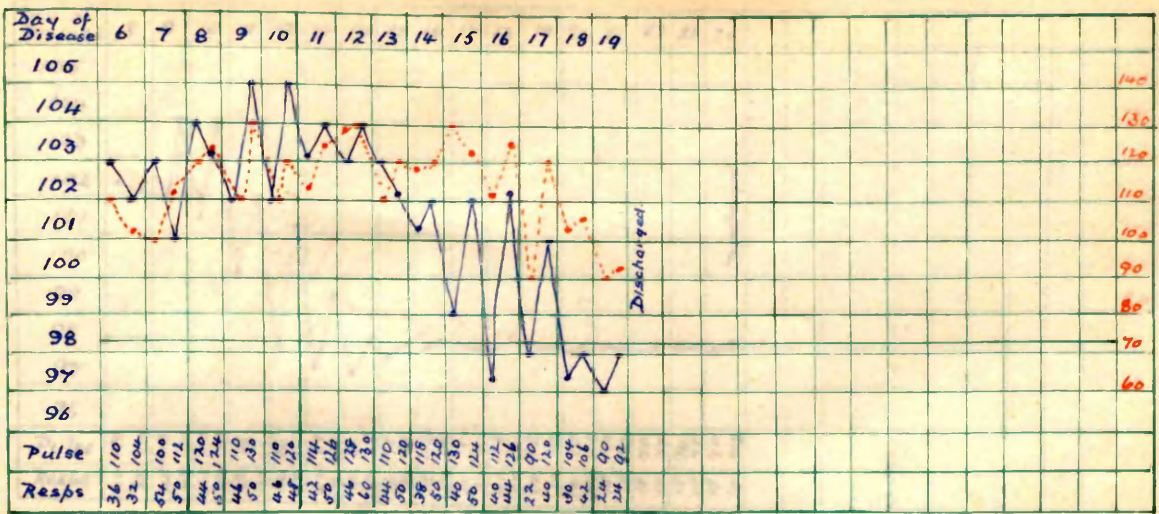
WIDAL REACTION.

WEIL FELIX REACTION.

20th Day
Negative.

20th Day

"K" - $\frac{1}{5600}$
 "W" - $\frac{1}{17}$



CASE NO. 13.

Age 20 years.

FEMALE.

WEEDER

ESTATE "A"

ADMITTED. 21-10-31.

COMPLAINT :- 5 days ago fever commenced suddenly with headache, giddiness and pain all over body.

ON ADMISSION :- No rash. Conjunctivae injected. Marked photophobia. Right inguinal glands enlarged and tender. Heart, lungs and abdomen N.A.D.

22-10-31. Indistinct dusky maculo-papular eruption on face, scapulae, chest, and abdomen - Severe headache and giddiness. Backache, and stiffness of neck muscles.

23-10-31. Marked giddiness, moderate deafness. Calf tenderness

24-10-31. Vision dim. Dull and listless. Dry cough. Lungs clear.

25-10-31. Rash faded. Tympanites with diffuse pain, 1 watery stool.

26-10-31. Dull and listless. Muttering delirium. Severe headache.

27-10-31. Less abdominal discomfort. Vision still dim and giddiness marked.

28-10-31. Headache less severe. Vision improved.

29-10-31. Very dull, stuporous. Muttering delirium last night.

30-10-31. Heart :- Occasional irregularity, 1st sound indistinct and of poor quality.

Pain and stiffness at back of neck. Low tension pulse.

31-10-31. Lungs clear - dry cough. Deafness clearing.

2-10-31. Temperature normal. Delirium ceased.

4-10-31. Less apathetic. Vision clear. No muscular pains. Inguinal glands subsided. Specimen of blood taken for Widal and Weil Felix reactions.

6-10-31. Convalescent.

8-11-31. Discharged from hospital.

URINE.

21-10-31. Ract. acid. Sp.Gr.1028.
Trace of albumen.

28-10-31. Trace of albumen.

2-11-31. No albumen.

Haemoglobin 65%

No Malarial parasites

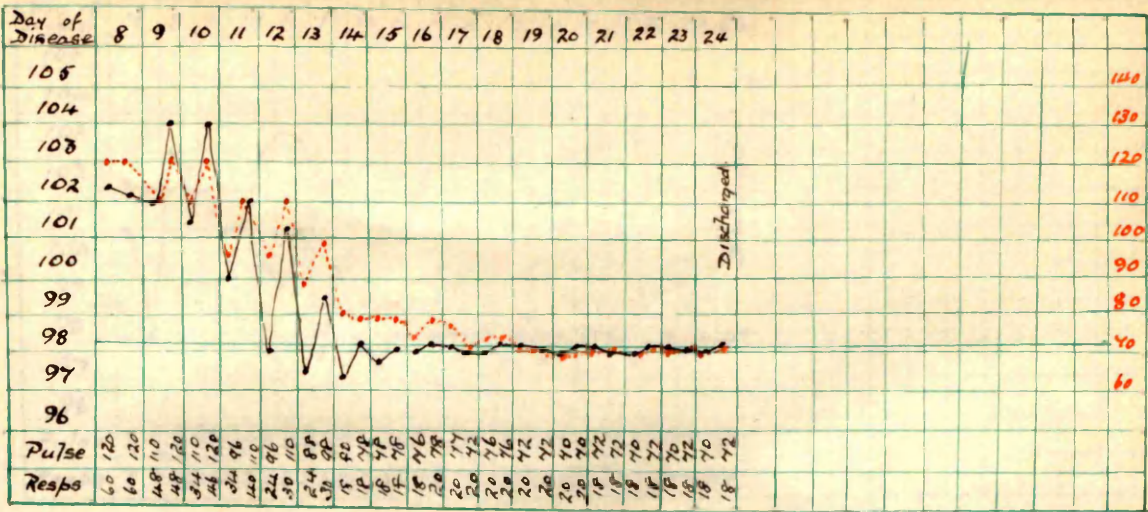
WIDAL REACTION.

20th Day
Negative.

WEIL FELIX REACTION.

20th Day

"K" - $\frac{1}{5600}$
"W" - $\frac{1}{17}$



CASE No. 14.

AGE 22 years.

FEMALE

WEEDER

ESTATE "A".

ADMITTED 23-10-31.

COMPLAINT:- 7 days ago fever started abruptly with rigor, headache, giddiness and general aching.

ON ADMISSION:- Scattered irregular dusky papules on face, back, and chest. Right inguinal glands enlarged and tender. Heart, lungs and abdomen N.A.D.

- 24.10.31. Calf tenderness. Deafness and conjunctival injection.
- 25.10.31. Slight photophobia. Severe headache.
- 26.10.31. Deafness cleared.
- 27.10.31. No headache. Conjunctivae clearing.
- 28.10.31. Rash faded.
- 30.10.31. General improvement.
- 2.11.31. Blood sent to I.M.R. for Widal and Weil Felix Reactions.
- 4.11.31. Convalescent.
- 8.11.31. Discharged from hospital.

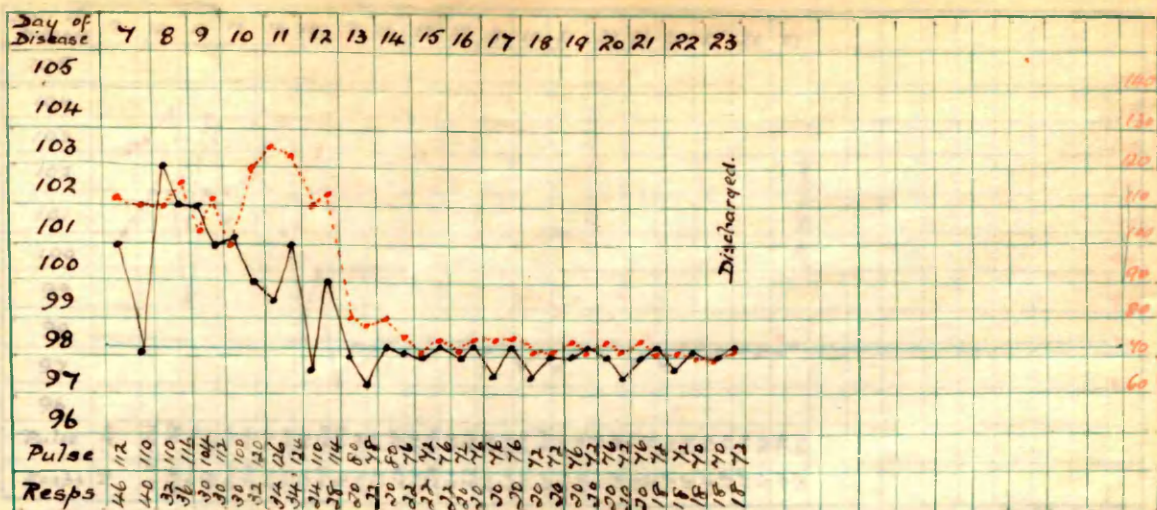
23.10.31.

Urine
React. Acid.
Sp.Gr. 1020.
No albumen.

Haemoglobin 45%.No malarial parasites.

Widal Reaction
18th Day
Negative

Weil Felix Reaction
18th Day
"K" - 1/2200
"W" - 1/25.



CASE NO. 15.

Age 25 years.

FEMALE.

WEEDER.

ESTATE "A"

ADMITTED. 23-10-31.

COMPLAINT :- 6 days ago fever commenced suddenly with vomiting, giddiness, headache, and general aching.

ON ADMISSION :- Dusky, irregular, indistinct macules, and slightly raised papules over face, back, chest, and abdomen. Heart, lungs, and abdomen N.A.D.

24-10-31. Severe headache, general aching. Slight deafness.

25-10-31. Calf muscles tender.

26-10-31. Rash faded.

27-10-31. Deafness cleared. Stools loose.

28-10-31. Headache less.

29-10-31. Temperature normal. General improvement.

31-10-31. Convalescent.

3-11-31. Blood specimen taken for Widal and Weil Felix reactions. (Specimen haemolysed, taken again on 24th day).

38-11-31. Discharged from hospital.

URINE.

23-10-31. React. Acid. Sp.G.1024.

No albumen.

Haemoglobin 65%

No Malarial parasites.

WIDAL REACTION.

24th Day.

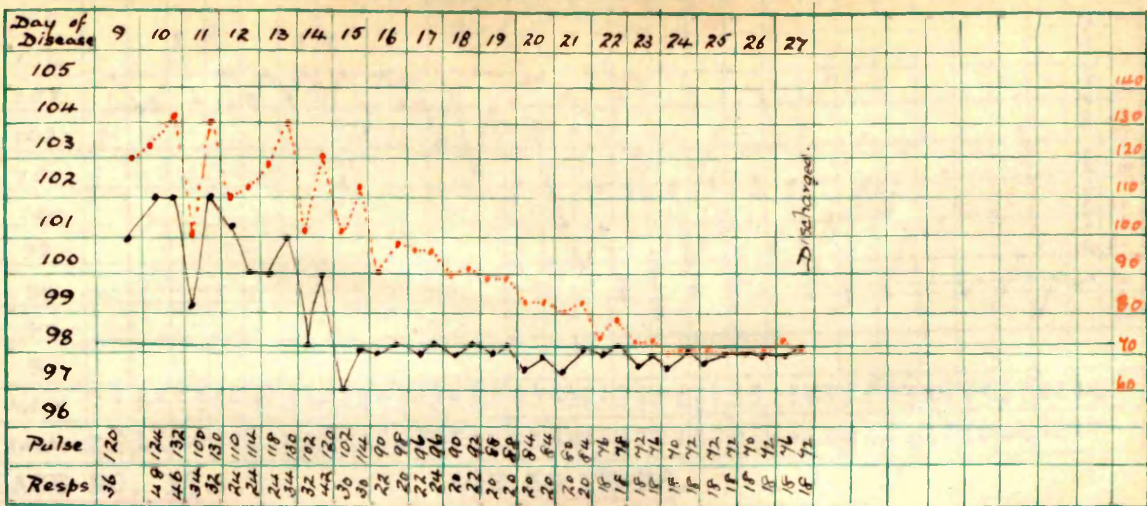
Negative

WEIL FELIX REACTION.

24th Day.

"K" - $\frac{1}{2800}$

"W" - 0



CASE No. 16.

AGE 35 years.

FEMALE

WEEDER

ESTATE "A".

ADMITTED 24-10-31.

COMPLAINT:- 8 days ago fever commenced suddenly with rigor, headache, vomiting, diarrhoea, and body pains.

ON ADMISSION:- Scattered indistinct dusky macules on face, chest, and back. Inguinal and axillary glands enlarged and tender. Slight conjunctival injection and photophobia. Heart, lungs and abdomen N.A.D.

- 25.10.31. Rash on flanks and abdomen. Slight deafness.
- 26.10.31. Headache severe. Chest pains.
- 27.10.31. Rash faded. Calf tenderness.
- 28.10.31. Several watery stools.
- 29.10.31. Deafness cleared. Stools watery.
- 30.10.31. Stools improved. Temperature normal.
- 31.10.31. General improvement. Glands subsiding.
- 3.11.31. Specimen of blood taken for Widal and Weil Felix reactions.
- 4.11.31. Convalescent.
- 8.11.31. Discharged from hospital.

Urine.

24.10.31. React. Acid. Sp.Gr. 1022.
No albumen.

Haemoglobin 65%.

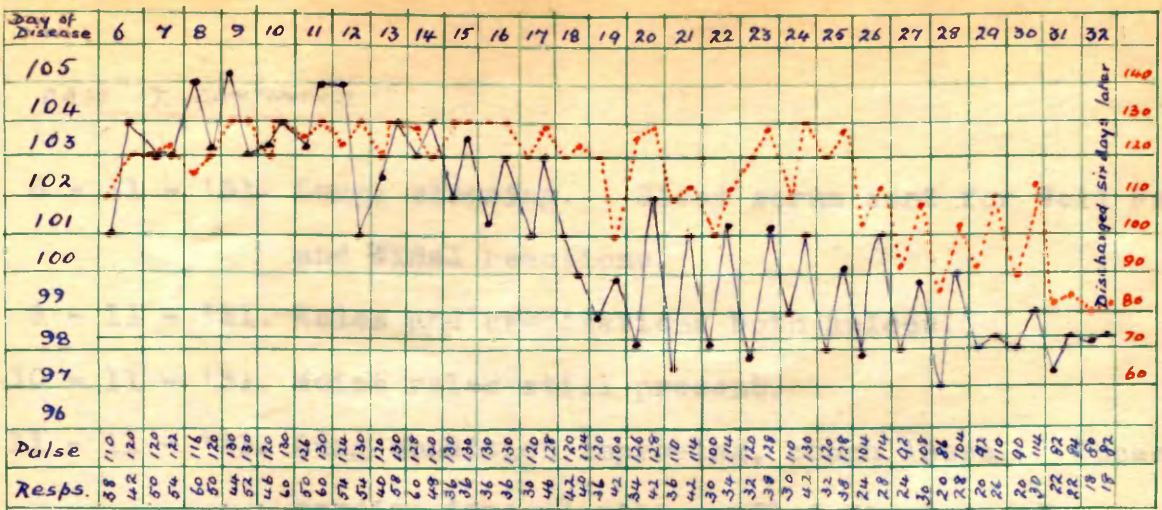
No Malarial parasites.

Widal Reaction

19th Day
Negative

Weil Felix Reaction

19th Day
"K" - 1/380
"W" - 1/44.



CASE NO. 17.

AGE 30 YEARS.

FEMALE.

WEEDER.

ESTATE "A".

ADMITTED 28.10.'31.

COMPLAINT :- Fever, headache, aching of body and limbs for five days.

- ON ADMISSION :- Fever, headache, general aching, calf tenderness, and joint pains. Conjunctivae injected, slight photophobia. No rash. Scattered rhonchi and moist rales both lungs. Loose cough, pharyngeal catarrh. Heart N.A.D. Constipation.
- 29 - 10 - '31. Headache severe with giddiness. Slight deafness. Dull and listless.
- 30 - 10 - '31. Dusky maculo-papular eruption on chest, fading on pressure. Left inguinal gland enlarged.
- 31 - 10 - '31. Rash on back, abdomen, and face. 3 Watery stools.
- 1 - 11 - '31. Severe headache and giddiness, pain in both eyes. 3 Watery stools. Deafness present.
- 2 - 11 - '31. Dull and listless muttering delirium at night. Frequent cough. Severe calf tenderness. Stools frequent and watery.
- 3 - 11 - '31. Severe pain in both eyes. Low tension pulse.
- 4 - 11 - '31. Rash fading. Rhonchi, moist rales and crepitations both lungs, tubular breathing, shifting dullness.
- 5 - 11 - '31. Muttering delirium. Frequent cough. Rash faded.
- 6 - 11 - '31. More rational. Headache and deafness clearing, cough severe at night. Pulse rapid, low tension.
- 7 - 11 - '31. Cough troublesome.

CASE 17. CONTINUED

- 8 - 11 - '31. Lungs clearing. Blood serum sent for Weil Felix and Widal reactions.
- 9 - 11 - '31. Rales and crepitations both apices.
- 10 - 11 - '31. Moist rales still present.
- 11 - 11 - '31. Lung condition improving, cough loose. Occasional cardiac irregularity muffled first sound.
- 12 - 11 - '31. Right parotid gland enlarged, still slight deafness
- 13 - 11 - '31. Right ear-ache, parotid gland enlarged and tender.
- 14 - 11 - '31. Right ear examined, N.A.D. ear-ache persists.
Rt. parotid still enlarged and painful.
- 15 - 11 - '31. Lung clearing, cough loose, free expectoration.
- 16 - 11 - '31. Occasional cardiac irregularity.
- 17 - 11 - '31. Parotid gland subsiding, no ear-ache, total deafness N.A.D. on examination.
- 18 - 11 - '31. Deafness still marked - Cardiac condition improving. 2nd Specimen of blood serum sent for Widal and Weil Felix reactions.
- 19 - 11 - '31. Deafness less. Temperature normal all day.
Heart sounds normal.
- 20 - 11 - '31. Parotid gland subsided, slight deafness, no ear-ache, Lungs clear.
- 21 - 11 - '31. General improvement, appetite good.
- 25 - 11 - '31. Deafness cleared - Aural exam. N.A.D.
- 26 - 11 - '31. Patient convalescent.
- 30 - 11 - '31. Discharged from hospital.
-
- 28 - 11 - '31. Haemoglobin rate 60%. Urine :- Acid. Sp.G.1024
Trace of albumen.
- 5 - 12 - '31. " Trace of albumen.
- 14 - 12 - '31. " Clear.

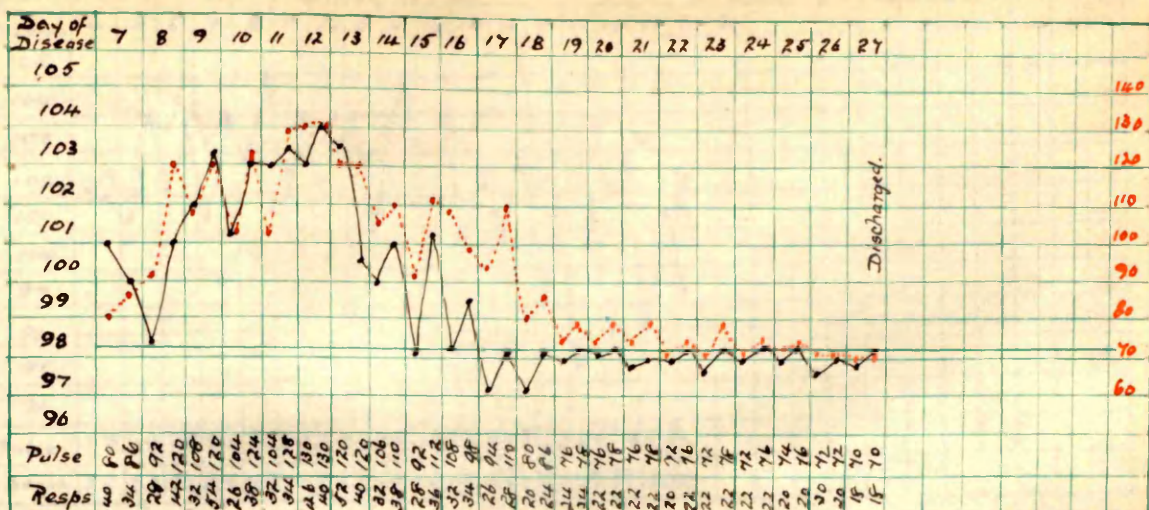
Widal Reaction.

27th day - Negative.

Weil Felix Reaction.

27th day.

"K" - $\frac{1}{770}$
"W" - $\frac{1}{17}$



CASE No. 18.

AGE 30 years

FEMALE

WEEDER

ESTATE "A".

ADMITTED 10-11-31.

COMPLAINT:- 6 days ago abrupt fever commenced with rigor, headache, diarrhoea, abdominal pain and general aching.

ON ADMISSION:- Scattered maculo-papular eruption over scapulae. Marked conjunctivitis and photophobia. Calf tenderness. Spleen palpable $1\frac{1}{2}$ " below costal margin. Left inguinals enlarged and tender. Apathetic. Scattered rhonchi and rales both lungs. Heart N.A.D.

- 11.11.31. Severe headache and deafness, rash spread to chest, abdomen, flanks, thighs and face.
- 12.11.31. Chest pains. Stools loose.
- 13.11.31. Stools watery. Frequent loose cough.
- 14.11.31. Tympanites with abdominal tenderness, no rigidity.
- 15.11.31. Rash faded. Frequent cough. Lungs:- Moist rales still present, bases particularly affected. Heart regular sounds of good quality.
- 16.11.31. Deafness clearing, headache less.
- 17.11.31. Conjunctivae clear, glands subsiding. Specimen of blood taken for Widal and Weil Felix reactions.
- 18.11.31. Cough less frequent, lungs clearing.
- 19.11.31. Stools normal.
- 20.11.31. Temp: normal. General improvement. Lungs clear.
- 24.11.31. Convalescent.
- 30.11.31. 2nd specimen of blood taken.

Discharged from hospital.

10.11.31. Urine
React. Acid. Sp.Gr. 1028.
No albumen.

Haemoglobin 60%.
No malarial parasites.

Widal
15th Day 28th Day
Negative

Weil Felix
15th Day 28th Day
between between
"K" - 1/85 - 1/280 "K" - 1/140 - 1/380
"W" - 0 "W" - 0

CASE NO. 19 (CONTINUED)

URINE.

20-11-31. React. Acid. Sp.G. 1028.

Haemoglobin 50%

24-11-31. Trace of albumen.

No Malarial parasites.

30-11-31. " " "

Blood count.

4-11-31. " " "

Leucocytes 15,000
Polymorphs 80%
Lymphocytes 15%
Monocytes 4%
Eosinophiles 1%

WIDAL REACTION.

15th Day

T - o

A - o

B - $\frac{1}{25}$

C - $\frac{1}{75}$

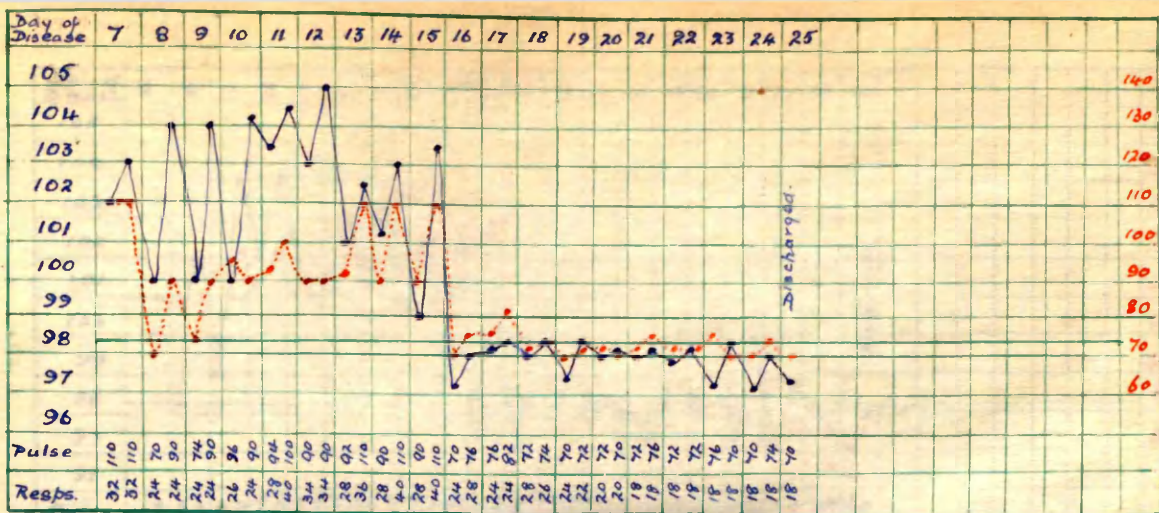
T(o) - 3 units.

WEIL FELIX REACTION.

15th Day.

"K" - $\frac{1}{1000}$

"W" - $\frac{1}{17}$



CASE NO. 20.

AGE 35 YEARS.

MALE.

HARVESTER.

ESTATE "A".

ADMITTED 12.12.'31.

COMPLAINT :- Fever, headache, backache and aching of body for six day's duration.

ON ADMISSION :- Scattered papules on face and back, conjunctivae injected. Both inguinal glands enlarged and tender. Lungs clear. Heart N.A.D. Abdomen N.A.D. Tongue coated.

13 - 12 - '31. Scattered papules and a few macules on chest, abdomen and Flanks. Frontal headache. Pain in chest, and calf tenderness.

14 - 12 - '31. Headache severe with giddiness. Slight cough, lungs clear.

15 - 12 - '31. Irritable and anxious, insomnia troublesome.

16 - 12 - '31. Headache severe, irritable and anxious.

17 - 12 - '31. Rhonchi and moist rales both lungs, loose cough.

18 - 12 - '31. Slight deafness. Rash fading.

19 - 12 - '31. Rash faded.

20 - 12 - '31. Conjunctivae clearing. Cough less.

21 - 12 - '31. Specimen of blood serum sent for Weil Felix and Widal reactions.

22 - 12 - '31. General improvement, appetite good.

25 - 12 - '31. Convalescence established

29 - 12 - '31. 2nd Blood serum sent for Weil Felix and Widal reactions. Discharged from hospital.

12 - 12 - '31. Haemoglobin rate 70%. Urine. Acid. Sp G.1020. No albumen present.

Widal Reaction.

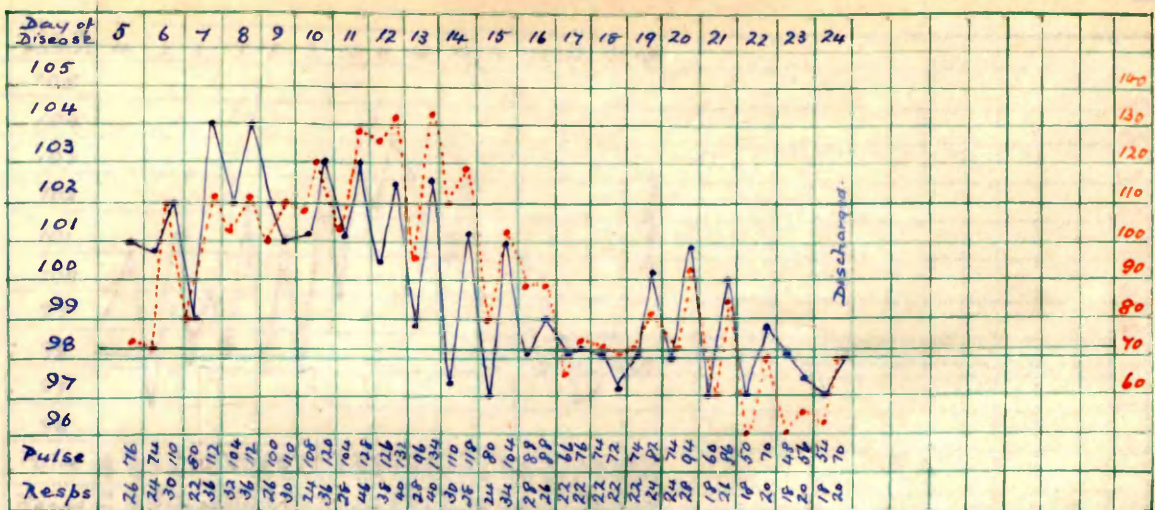
Weil Felix Reaction.

16th day.
 T - $\frac{1}{340}$
 A - $\frac{1}{340}$
 B - $\frac{1}{440}$
 C - $\frac{1}{340}$
 T(o) - o

24th day.
 T each
 A over
 B $\frac{1}{250}$
 C
 T(o) - o

16th day.
 "K" - $\frac{1}{170}$
 "OXK" - $\frac{1}{250}$
 " - o

24th day.
 "K" - $\frac{1}{375}$
 "W" - o



CASE NO. 21.

Age 25 years.

FEMALE.

WEEDER.

ESTATE "A"

ADMITTED. 22-12-31.

COMPLAINT :- 4 days ago fever commenced suddenly with rigor, headache, and pain in abdomen.

ON ADMISSION :- No rash, slight conjunctival injection. Heart and lungs N.A.D. Pain in abdomen, no tenderness.

23-12-31. Severe pain in back of neck, and general aching.

24-12-31. Severe headache, giddiness and deafness.

25-12-31. Vomited. Deafness marked.

26-12-31. Insomnia. Apathy. Frequent dry cough.

27-12-31. Vomiting. Marked giddiness. Few scattered rhonchi and râles both lungs.

28-12-31. Severe headache, insomnia marked.

29-12-31. Frequent dry cough.

30-12-31. Heart regular. Conjunctivae clear. Specimen of blood taken for Widal and Weil Felix reactions.

31-12-31. No giddiness or pain in back of neck.

1-1-32. Several hour natural sleep.

2-1-32. General improvement. Deafness cleared.

5-1-32. Sore throat, pharyngitis, coryza, dry cough.

7-1-32. Productive cough.

8-1-32. Throat improving.

11-1-32. Cough less, 2nd specimen of blood sent for Weil and ^{Felix}Widal reactions.

13-1-32. Convalescent.

16-1-32. Discharged from hospital.

URINE.

22-12-31. React. acid. Sp.Gr. 1016

Haemoglobin 55%

Trace of albumen.

No Malarial parasites.

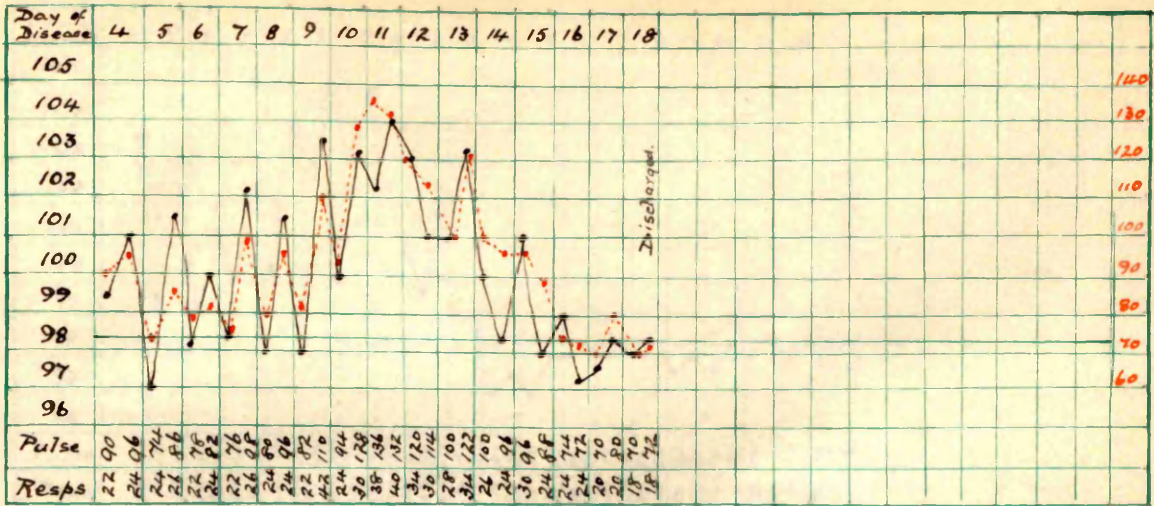
28-12-31. No albumen.

WEIL FELIX REACTION.

WIDAL REACTION.

12th Day.		24th Day.		12th Day.		24th Day.	
"K"	- 1/260	1/470	T	- 0	T	- 0	
"W"	- 1/65	0	A	- 1/120	A	- 1/1000	
			B	- 0	B	- 0	
			C	- 0	C	- 0	
			T(o)	- 15 Units.	T(o)	- 0	

Cultures negative.



CASE No. 22.

AGE 40 years.

MALE

HARVESTER

ESTATE "A".

ADMITTED 28-12-31.

COMPLAINT:- 3 days ago abrupt fever commenced with rigor, headache, giddiness and severe muscular pains.

ON ADMISSION:- No rash. Conjunctivae injected, slight photophobia. Heart, lungs and abdomen, N.A.D.

- 29.12.31. Dull, apathetic. Severe general aching and calf tenderness.
- 30.12.31. Right inguinal glands enlarged and tender.
- 31.12.31. Severe headache with marked giddiness.
- 1. 1.32. Few indistinct scattered dusky papules over scapulae.
- 2. 1.32. Rash distinct on back, fading on pressure.
- 3. 1.32. Dry cough, lungs clear. Heart sounds good, regular in rhythm and action.
- 4. 1.32. Rash faded.
- 5. 1.32. Marked apathy.
- 6. 1.32. Conjunctivae clearing, headache less.
- 7. 1.32. General improvement.
- 8. 1.32. Inguinal glands subsided.
- 9. 1.32. Specimen of blood sent for Widal and Weil Felix reactions.
- 11. 1.32. Discharged from hospital.

Urine

28.12.31. React. Acid. Sp.Gr. 1.012.
No albumen.

Haemoglobin 70%.

No malarial parasites.

Widal Reaction

17th Day		24th Day	
T	- 0	T	- 0
A	- 1/17	A	- 1/4400
B	- 0	B	- 0
C	- 0	C	- 0
T(o)	- 10 $\frac{1}{2}$ units	T(o)	- 0

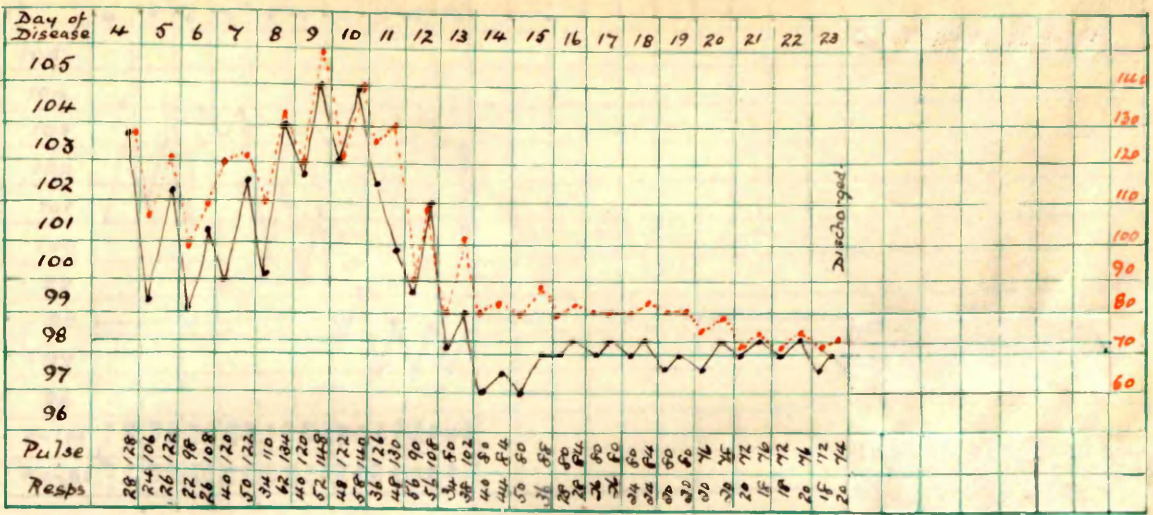
Cultures negative.

Blood count

White cells	6,500
Polymorphs	63%)
Lymphocytes	33%)
Monocytes	3%)
Eosinophiles	1%)

Weil Felix Reaction

17th Day	24th Day
"K" - 1/192	"K" - 1/770
"W" - 1/44	"W" - 1/17



CASE No. 23.

AGE 12 years

MALE WEEDER ESTATE "A".

ADMITTED 16-1-32.

COMPLAINT:- 3 days ago fever started suddenly with headache, rigor, giddiness, vomiting, and pain all over body.

ON ADMISSION:- No rash. Slight conjunctival injection.
Heart, lungs and abdomen N.A.D.
Spleen $\frac{1}{2}$ " below costal margin. B.T. parasites in blood.

- 17.1.32. Severe headache, with giddiness and slight photophobia.
 - 18.1.32. Loose cough. Rhonchi and moist rales both bases.
 - 19.1.32. Scattered maculo-papular eruption on back, chest, and abdomen.
 - 20.1.32. Frequent cough, respirations 62 at 8 p.m. Heart regular.
 - 21.1.32. Irritable. Insomnia. Stools loose.
 - 22.1.32. Stools frequent and watery.
 - 23.1.32. Rash faded.
 - 24.1.32. Stools improved.
 - 25.1.32. Temperature normal. Lungs clearing.
 - 27.1.32. General improvement.
 - 30.1.32. Convalescent.
 - 4.2.32. Specimen of blood sent for Widal and Weil Felix Reactions.
- Discharged from hospital.

Urine

16.1.32. React. Acid. Sp.Gr. 1020.
No albumen.

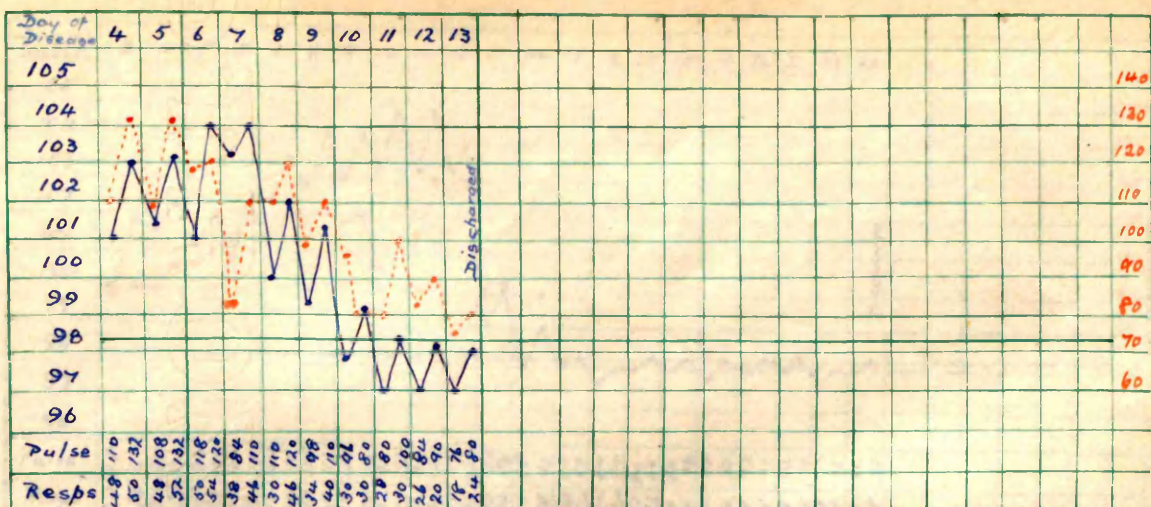
Haemoglobin 65%.

B.T. Malaria parasites in blood
23.1.32. No parasites.

Widal Reaction
23rd Day
T - 1/1000
A - 0
B - 0
C - 0
T(o) - 4 units.

Weil Felix Reaction
23rd Day
"K" - 1/4000
"W" - 0

Differential blood count.
White cells 5,000
Polymorphs 65%)
Lymphocytes 32%)
Large mononeuclears 2.5%)
Eosinophiles .5%)



CASE NO. 24.

Age 35 years.

FEMALE.

WEEDER.

ESTATE "A"

ADMITTED. 16-1-32.

COMPLAINT :- 3 days ago fever commenced suddenly with rigor, headache, giddiness, vomiting, diarrhoea and joint pains.

ON ADMISSION :- Indistinct scattered, slightly raised papules on face, chest, back and abdomen. Slight conjunctival injection. Inguinal glands enlarged and painful. Heart, lungs, abdomen, N.A.D.

- 17-1-32. General aching, severe backache, calf tenderness.
- 18-1-32. Severe headache. Joint pains in knees and ankles.
- 19-1-32. Slight loose cough, few moist râles left base.
- 20-1-32. Dull, listless. Backache severe. Slight deafness.
- 21-1-32. Rash fading.
- 22-1-32. Rash faded, joint pains less.
- 23-1-32. Lungs clear, no cough.
- 24-1-32. Temperature normal. Inguinal glands subsiding.
- 25-1-32. No joint, or muscular pain.
- 27-1-32. Specimen of blood sent for Widal and Weil Felix Reactions.
- 30-1-32. Convalescent.
- 3-2-32. 2nd Specimen of blood sent for Widal and Weil Felix Reactions.
- 4-2-32. Discharged from hospital.

16-1-32. URINE.
React. acid. Sp.G. 1020
No albumen.

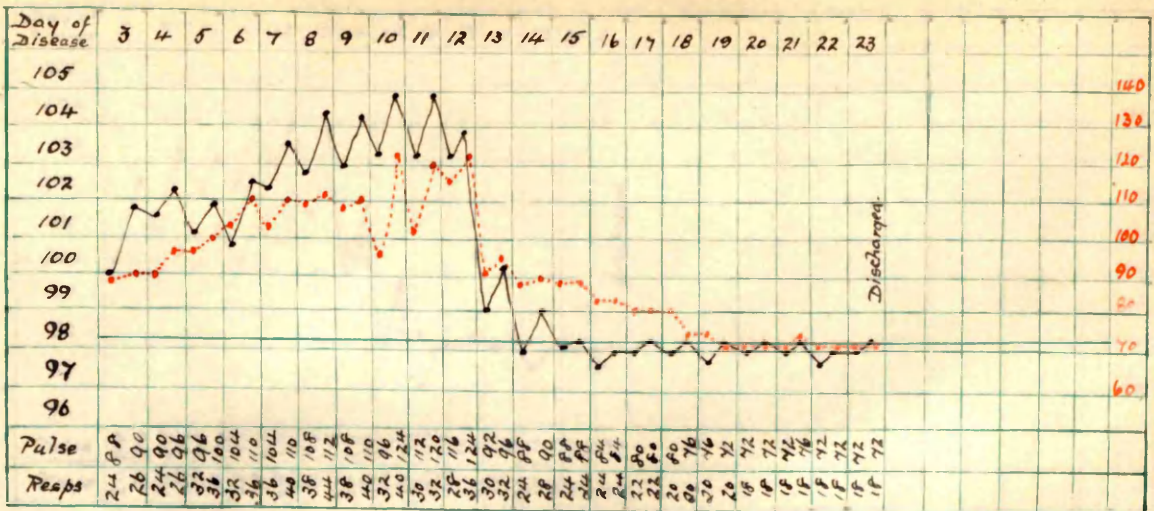
Haemoglobin 50%
26-1-32. 45%
No Malarial parasites.

WIDAL REACTION.

	15th Day.	23rd Day.
T	0	0
A	0	0
B	$\frac{1}{125}$	$\frac{1}{85}$
C	$\frac{1}{140}$	$\frac{1}{85}$
T(o)	0	0

WEIL FELIX REACTION.

	15th Day.	23rd Day.
"K"	$\frac{1}{200}$	$\frac{1}{200}$
"W"	$\frac{1}{25}$	$\frac{1}{13}$



CASE No. 25.

AGE 27 years

FEMALE

WEEDER

ESTATE "A".

ADMITTED 15-1-32.

COMPLAINT:- 2 days ago fever started with rigor, headache, vomiting, and backache.

ON ADMISSION:- No rash. Conjunctivæ injected.
Scattered rhonchi and moist rales both lungs.
Heart and abdomen N.A.D. Knee jerks decreased.

- 16.1.32. General aching and severe backache. Vomiting. Loose cough.
- 17.1.32. Severe headache. Giddiness. Vomiting.
Scattered maculo-papular eruption on face, chest, back, abdomen and thighs. Stools loose.
- 18.1.32. Slight deafness. Stools watery.
- 19.1.32. Dull, apathetic. Slight photophobia.
- 20.1.32. Frequent loose cough. Congestion of pharynx, no exudation on tonsils.
- 21.1.32. Rhonchi and rales both lungs. Heart regular.
- 22.1.32. Dull, apathetic, frequent productive cough.
- 23.1.32. Several watery stools.
- 24.1.32. Rash faded. Throat clear.
- 25.1.32. Lungs clearing. Headache less.
- 26.1.32. Temperature normal. No headache. Cough less.
Specimen of blood sent to I.M.R. for Widal and Weil Felix reactions.
- 30.1.32. Convalescent.
- 4.2.32. 2nd specimen of blood taken.
Discharged from hospital.

15.1.32. Urine. React. Acid. Sp.Gr. 1012.
No albumen.

Haemoglobin 65%.

No malarial parasites.Widal Reaction

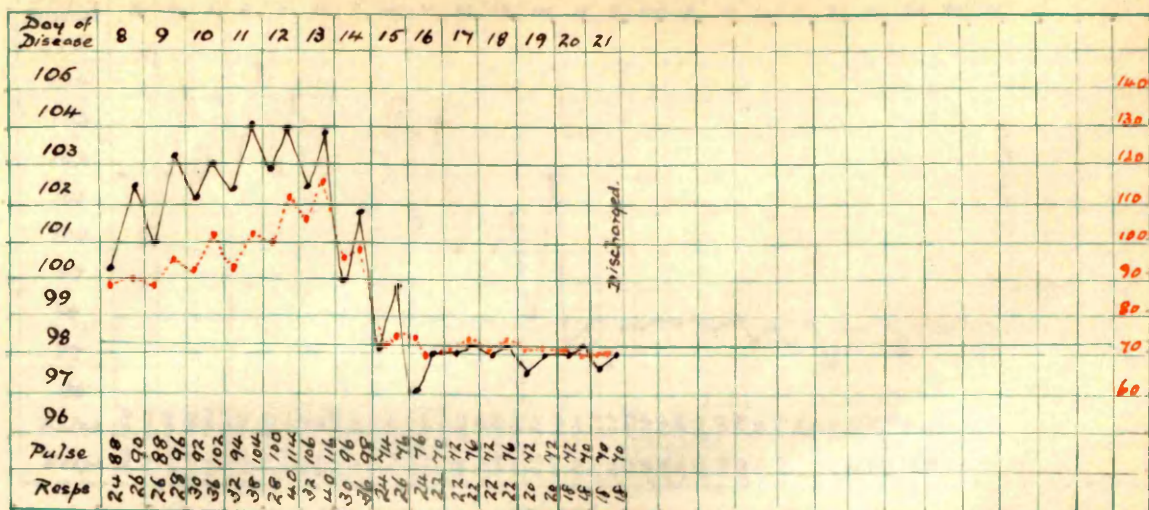
14th Day

T -)
A -)
B -) Negative.
C -)
T(o) -)

Weil Felix Reaction

14th Day

"K" - 1/630
"W" - 0.



CASE No. 26.

AGE 16 years.

FEMALE

WEEDER

ESTATE "A".

ADMITTED 20-1-32.

COMPLAINT:- 7 days ago fever started suddenly with headache, rigor, and body pains.

ON ADMISSION:- No rash. Slight conjunctival injection. Heart, Lungs and abdomen N.A.D.

- 21.1.32. Severe headache and general aching.
- 22.1.32. Slight photophobia. Dry cough.
- 23.1.32. Slight deafness.
- 24.1.32. Dull and listless. Severe headache and marked deafness.
- 25.1.32. Dry cough, lungs clear. Heart sounds good, rhythm and action regular.
- 26.1.32. Deafness cleared. Specimen of blood taken for Widal and Weil Felix Reactions.
- 27.1.32. No headache. Conjunctivae clear.
- 28.1.32. Temperature normal. General improvement.
- 3.2.32. 2nd specimen of blood taken.
- 4.2.32. Discharged from hospital.

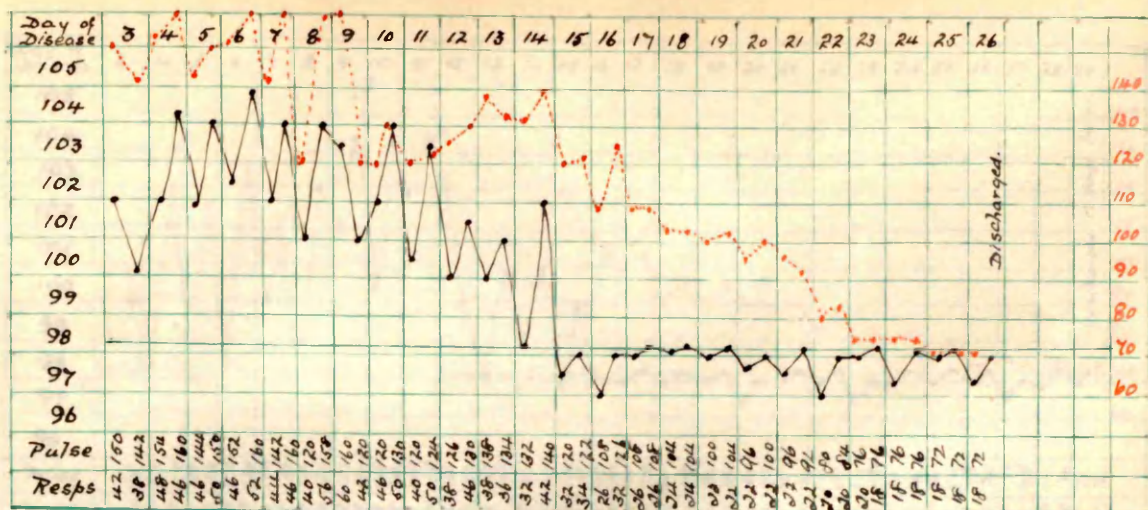
Urine
20.1.32. React. Acid. Sp.Gr.1014.
No albumen.

Haemoglobin
20.1.32. 45%
26.1.32. 40%
4.2.32. 45%

No malarial parasites.

Widal Reaction
14th Day 21st Day
T - 0 T - 0
A - 0 A - 0
B - 0 B - 1/17
C - 1/30 C - 1/17
T(o) - 5 units T(o) - 4 units.

Weil Felix Reaction
14th Day 21st Day
"K" - 1/100 1/343
"W" - 1/22 1/13.



CASE No. 27.

AGE 15 $\frac{1}{2}$ years.FEMALEWEEDERESTATE "A"ADMITTED 30-1-32.COMPLAINT:- 2 days ago fever commenced suddenly with rigor, nausea, headache and diarrhoea.ON ADMISSION:- No rash. Conjunctival injection.

Heart, lungs and abdomen N.A.D. Knee jerks decreased.

- 31.1.32. Severe headache with giddiness, pain in chest. Rhonchi and rales left lung. Pulse rapid, regular, low tension.
- 1.2.32. Scattered, irregular, dusky macules, and slightly raised papules over scapulae. Pain in calf muscles. Stools loose.
- 2.2.32. Eruption spread to face, chest, abdomen, thighs, calves, and upper arms. Slight deafness.
- 3.2.32. Photophobia. Fine crepitations both lungs. Several watery stools.
- 4.2.32. Insomnia. Apathy. Loose cough. Watery stools.
- 5.2.32. Scattered moist rales both lungs. Heart regular.
- 6.2.32. Deafness marked. Frequent watery stools.
- 7.2.32. Rash faded. Total deafness. No headache.
- 8.2.32. Total deafness. Stools improved.
- 9.2.32. Hearing returned in left ear.
- 10.2.32. Free expectoration with cough. Deafness clearing both ears. Specimen of blood taken for Widal and Weil Felix Reactions.
- 11.2.32. Temperature normal. General improvement.
- 16.2.32. Convalescent.
- 22.2.32. Discharged from hospital.

30.1.32. Urine
React. Acid. Sp.Gr. 1022. Trace of albumen.Haemoglobin 60%.

3.2.32. " " "

No Malarial parasites.

10.2.32. " " "

16.2.32. No albumen.

Widal Reaction.

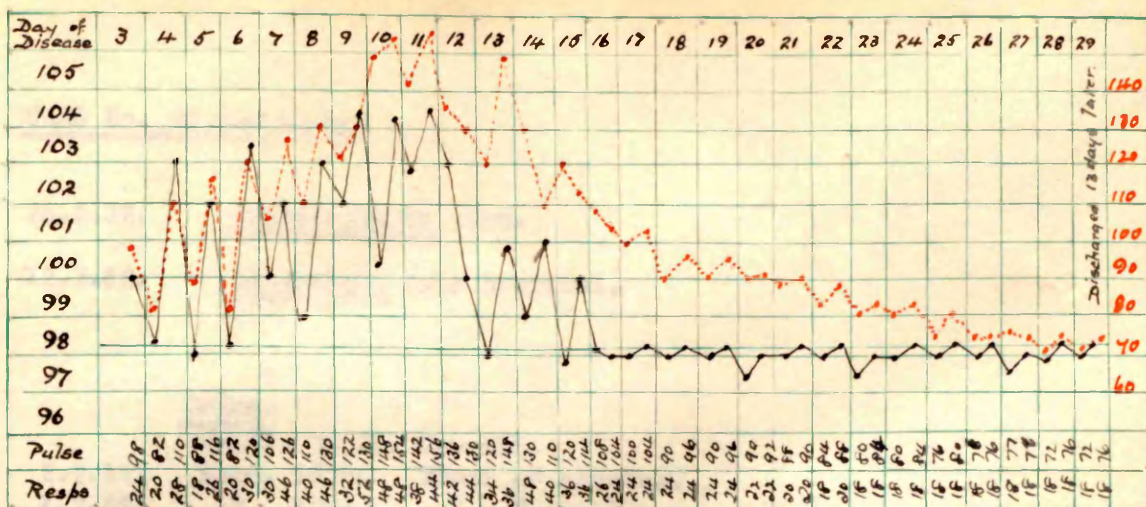
14th Day

T -)
A -)
B -) Negative
C -)
T(o) -)

Weil Felix Reaction.

14th Day

"K" - 1/5500
"W" - 1/55



CASE No. 28.

AGE 25 years.

FEMALEWEEDERESTATE "C"ADMITTED 2-2-32.

COMPLAINT:- 2 days ago fever started abruptly with rigor, headache, giddiness, and vomiting.

ON ADMISSION:- No rash conjunctivae injected. Heart, lungs, and abdomen N.A.D. Spleen palpable $\frac{1}{2}$ " below costal margin.

- 3.2.32. S.T. malaria rings in blood. General aching, pains in chest. Vomiting.
- 4.2.32. Severe headache with giddiness. Apathy.
- 5.2.32. Scattered dusky slightly raised papules over scapulae. Photophobia. Right inguinal glands enlarged and tender.
- 6.2.32. Rash on face, chest, abdomen, thighs, flanks, and backs of legs. Profuse on abdomen.
- 7.2.32. Slight deafness. Pulse occasionally irregular. Heart:- action and rhythm occasionally irregular, 1st sound indistinct. Scattered moist rales both bases, loose cough.
- 8.2.32. Stools loose and frequent. Deafness marked (? Quinine).
- 9.2.32. Tympanites of abdomen, no rigidity. Quiet delirium at night. Rapid low tension irregular pulse. Heart:- 1st sound indistinct and shortened, irregular in action and rhythm.
- 10.2.32. Rash faded. Stools watery, tympanites less.
- 11.2.32. No delirium. Deafness clearing. Heart improving, more regular in action and rhythm. 1st sound improved.
- 12.2.32. Lungs clearing.
- 13.2.32. Giddiness and slight deafness still.
- 15.2.32. T. normal today. General improvement. Heart regular in rhythm and action.
- 16.2.32. Specimen of blood taken for Widal and Weil Felix Reactions.
- 18.2.32. Lungs clear. Heart regular.
- 20.2.32. Marked asthenia. Bowels regular. Appetite improved.

CASE No. 28 continued.

- 26.2.32. Convalescence slow.
 12.3.32. Discharged from hospital.

Urine.

	React.	Sp.Gr.	Deposit.
2.2.32.	Acid.	1020.	Trace of albumen.
7.2.32.	"	1024.	" " "
14.2.32.	"	1022.	No albumen.

Blood.

2.2.32. Haemoglobin 55%.

S.T. Malaria rings on admission.

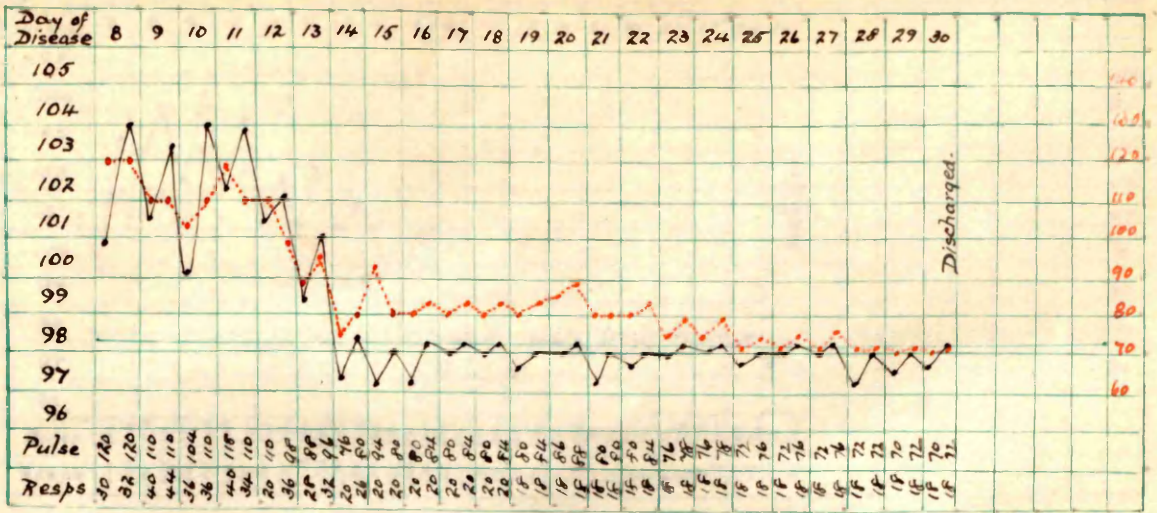
<u>Count:</u>		
	White cells	5500
	Polymorphs	60%
	Lymphocytes	35%
	Monocytes	4%
	Eosinophiles	1%

Widal Reaction

	16th Day	
T	-	0
A	-	0
B	-	1/34
C	-	1/15
T(o)	-	0

Weil Felix Reaction

	16th Day	
"K"	-	1/2900
"W"	-	1/19.



CASE No. 29.

AGE 20 years.

FEMALE

WEEDER

ESTATE "A".

ADMITTED 23-3-32.

COMPLAINT:- 7 days ago fever commenced suddenly with rigor, headache, and vomiting.

ON ADMISSION:- Few indistinct dusky papules on face, and over scapulae, fading on pressure. Inguinal glands enlarged and painful. Heart, lungs and abdomen N.A.D.

24.3.32. Severe headache, general aching, dry cough. Chest pains.

25.3.32. Dull, listless. Stools frequent and watery.

26.3.32. Headache severe. Stools less frequent.

27.3.32. Rash faded.

28.3.32. Headache less.

29.3.32. Temperature normal. Specimen of blood taken for Widal and Weil Felix Reactions.

30.3.32. Inguinal glands subsiding.

4.4.32. Convalescent.

14.4.32. Discharged from hospital.

2nd specimen of blood taken.

23.3.32.

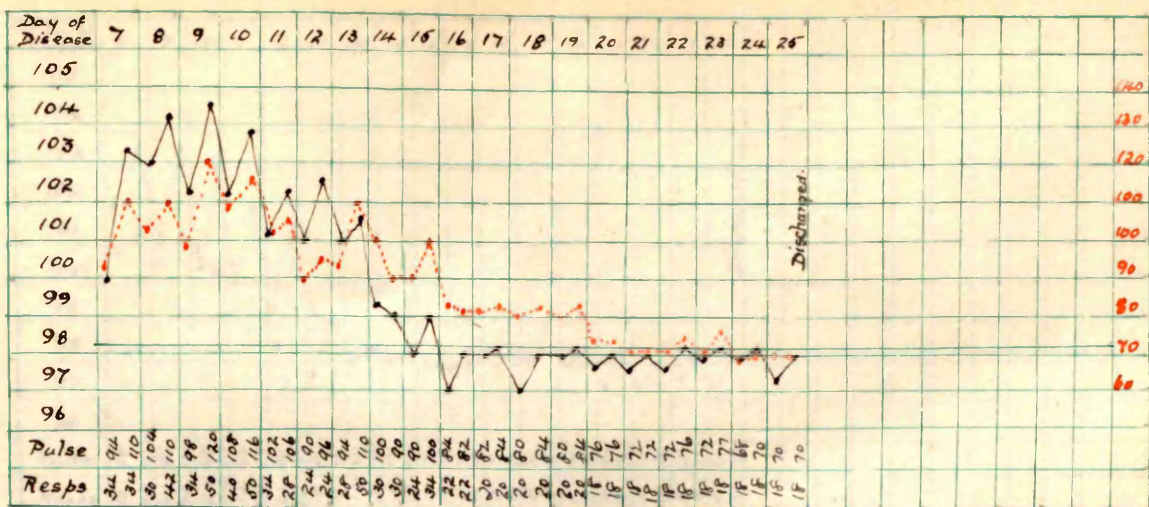
Urine. Acid React. Sp.Gr. 1.016
No albumen.

Haemoglobin 55%.

No Malarial parasites.

14th Day		Widal Reaction		30th Day	
T	- O	T	- O	T	- O
A	- O	A	- O	A	- O
B	- O	B	- O	B	- O
C	- O	C	- O	C	- O
T(o)	- 7 units	T(o)	- 5 units		

14th Day		Weil Felix Reaction		30th Day	
"K"	- 1/125	"K"	- 1/96	"K"	- 1/96
"W"	- 0	"W"	- 0	"W"	- 0



CASE No. 30.

AGE 20 years.

FEMALE

WEEDER

ESTATE "A".

ADMITTED 30-3-32.

COMPLAINT:- 2 days headache and malaise; 3rd day fever started with rigor and has continued for 3 days.

ON ADMISSION:- Irregular slightly raised dusky papules on back, chest, face, abdomen, thighs, and backs of legs. Conjunctivae injected. Knee jerks decreased. Heart, lungs and abdomen. N.A.D.

31.3.32. Severe headache, giddiness. Chest pains, dry cough.

1.4.32. Photophobia. Deafness. Scattered rhonchi and moist rales both lungs.

2.4.32. Dull and listless. Occasional quiet delirium.

3.4.32. Marked giddiness, severe headache and deafness.

4.4.32. Frequent loose cough. Marked conjunctival injection.

5.4.32. Deafness clearing. No delirium.

6.4.32. Rash faded.

7.4.32. Lungs clearing, cough less.

8.4.32. Temperature normal. Conjunctivae clear.

12.4.32. Lungs clear. Hearing normal.

14.4.32. Convalescent. Specimen of blood taken for Widal and Weil Felix Reactions.

17.4.32. Discharged from hospital.

30.3.32.

Urine. React. Acid. Sp.Gr. 1024.
Trace of albumen.

5.4.32. " " "

8.4.32. No albumen.

Haemoglobin 65%.

Blood Count.

White cells	6500
Polymorphs	66%
Lymphocytes	30%
Monocytes	3.5%
Eosinophiles	.5%

Widal Reaction

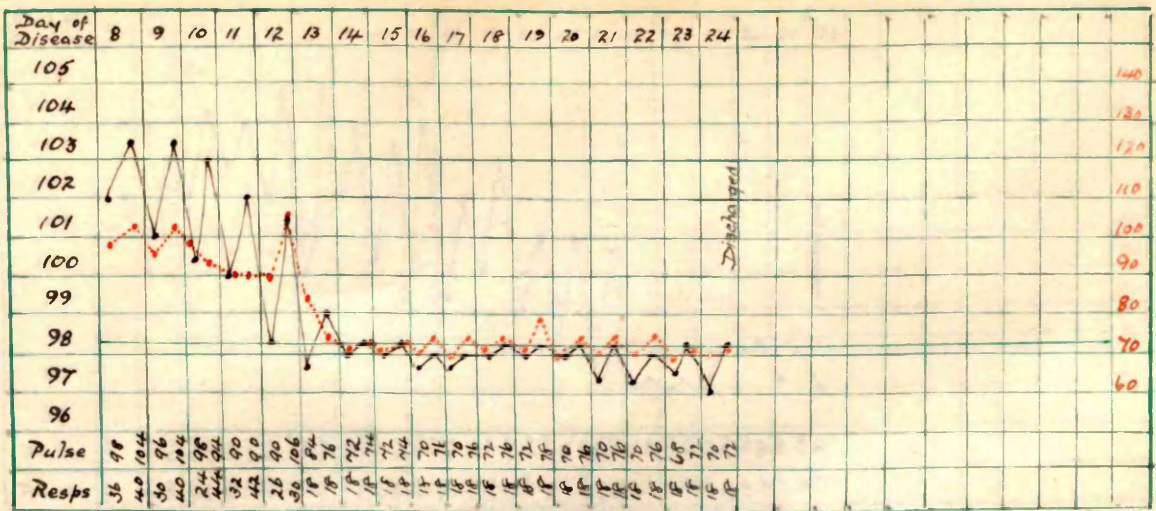
22nd Day

T	-	0
A	-	1/85
B	-	1/44
C	-	1/25
T(o)	-	10 units.

Weil Felix Reaction

22nd Day

"K"	-	1/890
"W"	-	1/17



CASE No. 31.

AGE 25 years.

FEMALE

WEEDER

ESTATE "B".

ADMITTED 4-4-32.

COMPLAINT:- 7 days ago headache commenced with malaise and fever, later rigors and giddiness.

ON ADMISSION:- Maculo-papular eruption on face, back, chest, and abdomen. Heart, lungs, and abdomen N.A.D.

- 5.4.32. Right inguinal glands enlarged and tender. Conjunctivae injected.
- 6.4.32. Headache severe. Deafness. Slight photophobia. Dry cough.
- 7.4.32. Rash faded.
- 8.4.32. Conjunctivae clear.
- 9.4.32. Temperature normal. Deafness cleared.
- 10.4.32. Inguinal glands subsided.
- 14.4.32. Specimen of blood taken for Widal and Weil Felix Reactions.
- 17.4.32. Convalescent.
- 20.4.32. Discharged from hospital.

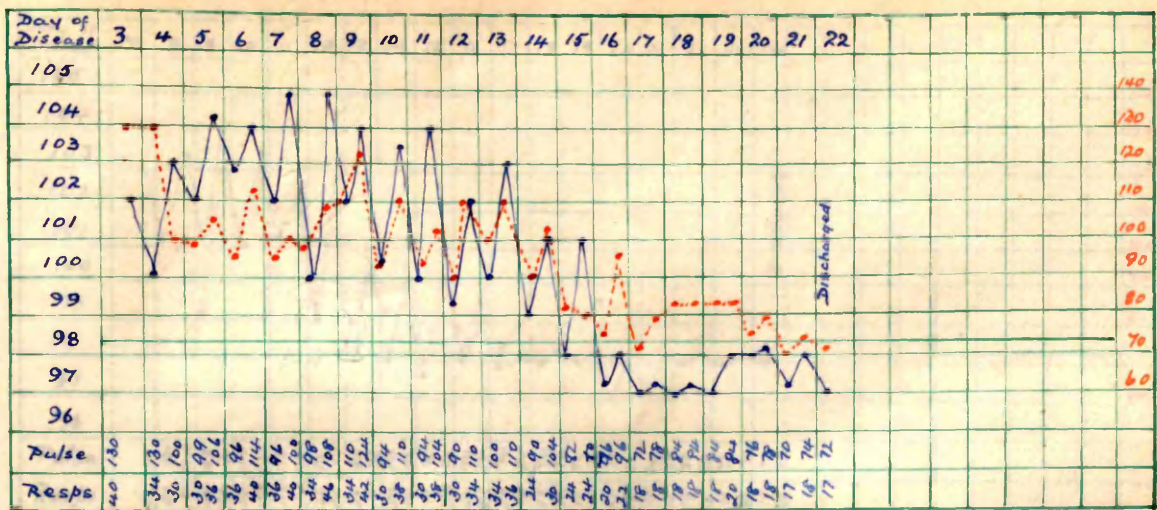
4.4.32. Urine.
React. Acid. Sp.Gr.1.012.
No albumen.

Haemoglobin 60%.
No Malarial parasites.

Blood Count.
White cells 5,500
Polymorphs 62%
Lymphocytes 34%
Monocytes 3%
Eosinophiles 1%

Widal Reaction
18th Day
T -)
A -)
B -) Negative
C -)
T(o) -)

Weil Felix Reaction
18th Day
"K" - 1/785
"W" - 0.



CASE NO. 32.

Age 15 years.

FEMALE.

WEEDER.

ESTATE "A"

ADMITTED. 16-4-32.

COMPLAINT :- 5 days ago headache started with aching of limbs. On the 5th day rigor, fever, severe headache and deafness.

ON ADMISSION :- Face flushed, slightly raised papules on left cheek and scapular region. Right inguinal glands enlarged and tender knee jerks normal. Heart, lungs and abdomen N.A.D.

- 17-4-32. Rash present on face, back, chest, abdomen and thighs.
- 18-4-32. Severe headache. Conjunctivæ injected. Chest pains.
- 19-4-32. Dull, apathetic. Slight deafness. Specimen of blood taken for Widal and Weil Felix reactions.
- 20-4-32. Loose cough. Lungs clear. Stools relaxed.
- 21-4-32. Rash fading. 3 Watery stools.
- 22-4-32. Tympanites. 4 Watery stools. Heart regular.
- 23-4-32. Rhonchi and moist râles both lungs, loose cough.
- 24-4-32. Rash faded. Stools less frequent.
- 25-4-32. No deafness. Conjunctivæ clear.
- 26-4-32. Lungs clearing. Bowels regular.
- 28-4-32. Temperature normal this morning. Inguinal glands subsiding.
- 30-4-32. Lungs clear. General improvement. 2nd Specimen of blood taken for Widal and Weil Felix reactions.
- 3-5-32. Convalescent.
- 5-5-32. Discharged from hospital.

URINE. 16-4-32.

React acid. Sp.Gr. 1024.

Trace of albumen.

21-4-32. Trace of albumen.

25-4-32. No albumen.

Haemoglobin 45%

No Malarial parasites.

Blood count.

White cells - 9000

Poly-morphs - 67%

Lymphocytes - 20%

Monocytes - 2.5%

Eosinophiles - 2.5%

WIDAL REACTION.

9th Day. 20th Day.

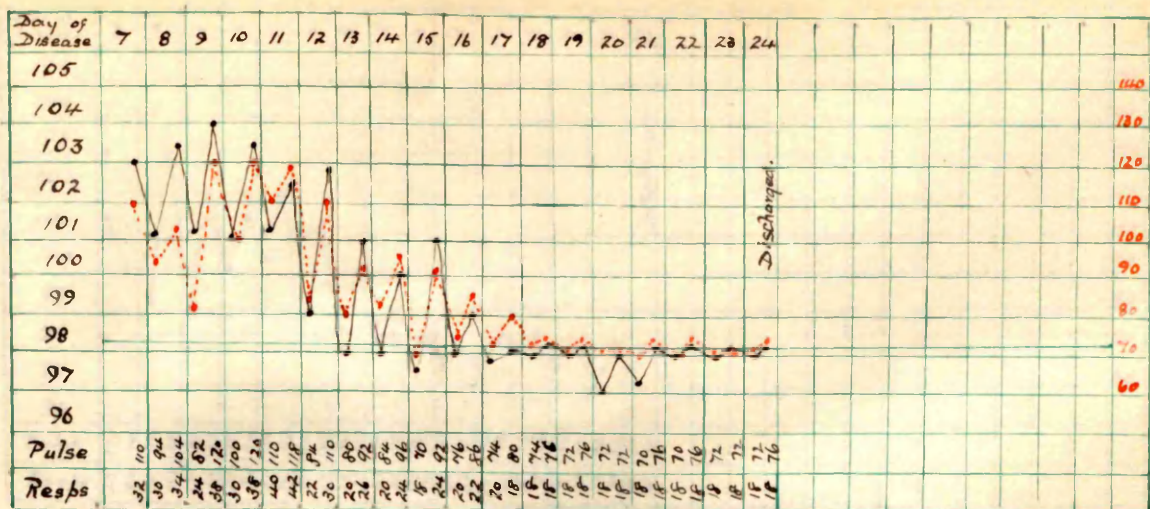
Negative. Negative.

WEIL FELIX REACTION.

9th Day. 20th Day.

"K" - $\frac{1}{250}$ - $\frac{1}{450}$

"W" - 0 - 0



CASE No. 33.

AGE 27 years.

MALEHARVESTERESTATE "A".ADMITTED 11-5-32.

COMPLAINT:- 6 days ago fever started abruptly with rigor, headache, vomiting, aching of limbs.

ON ADMISSION:- Scattered dusky irregular papules on face, back and chest, fading on pressure. Conjunctivae injected. Heart, lungs and abdomen N.A.D.

- 12.5.32. Inguinal glands enlarged and tender. Slight deafness.
- 13.5.32. General aching, Calf tenderness. Severe headache and irritability. Insomnia.
- 14.5.32. Slight deafness. Dry cough. Lungs clear.
- 15.5.32. Rash faded. Photophobia.
- 16.5.32. Apathy. Headache less.
- 17.5.32. Inguinal glands subsiding.
- 18.5.32. Deafness cleared.
- 19.5.32. Specimen of blood taken for Widal and Weil Felix Reactions.
- 21.5.32. Temperature normal. General improvement.
- 24.5.32. Convalescent.
- 28.5.32. Discharged from hospital.

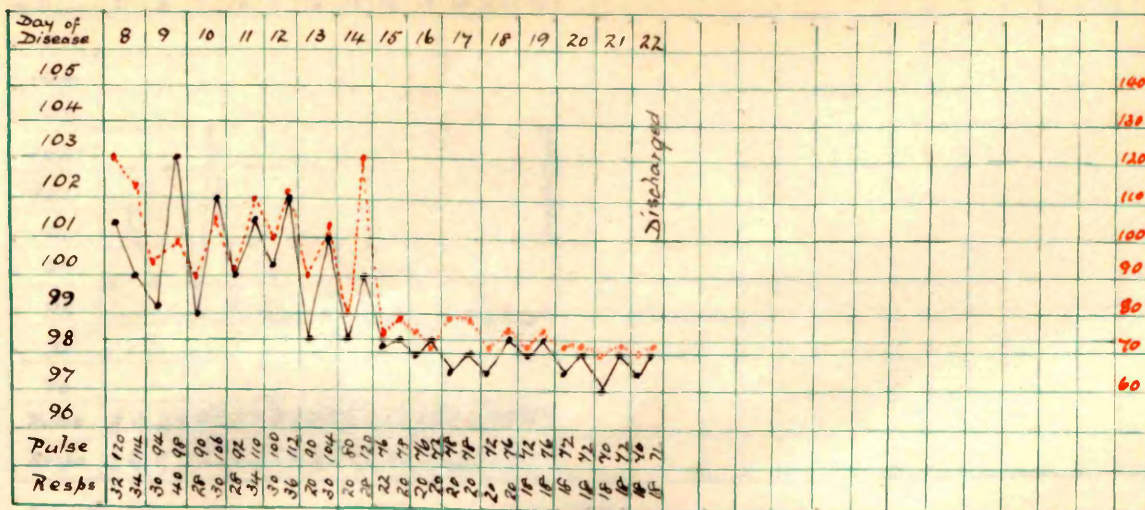
11.5.32. Urine
React. Acid. Sp.Gr. 1018. No albumen.

Haemoglobin 60%.No Malarial parasites.Blood Count.

White cells	7,000
Polymorphs	60%
Monocytes	3.5%
Eosinophiles	5%

Widal Reaction
15th Day
Negative.

Weil Felix Reaction
15th Day
"K" - 1/420
"W" - 0.



CASE No. 34.

AGE 30 years.

FEMALE

WEEDER

ESTATE "D".

ADMITTED 17-5-32.

COMPLAINT:- 7 days ago fever started abruptly with headache, rigor, giddiness, vomiting, and aching of limbs.

ON ADMISSION:- Scattered dusky macules, and slightly raised papules on face, back, chest and abdomen, fading on pressure. Conjunctivae injected. Knee jerks decreased. Heart, lungs and abdomen N.A.D.

- 18.5.32. General aching and calf tenderness.
- 19.5.32. Severe headache. Marked giddiness and deafness.
- 20.5.32. Photophobia. Dull and listless.
- 21.5.32. Deafness marked.
- 22.5.32. Rash faded.
- 23.5.32. Conjunctivae clear.
- 24.5.32. Temperature normal. General improvement.
- 25.5.32. Specimen of blood sent for Widal and Weil Felix Reactions.
- 28.5.32. Convalescent.
- 31.5.32. Discharged from hospital.
2nd specimen of blood sent for Widal and Weil Felix.

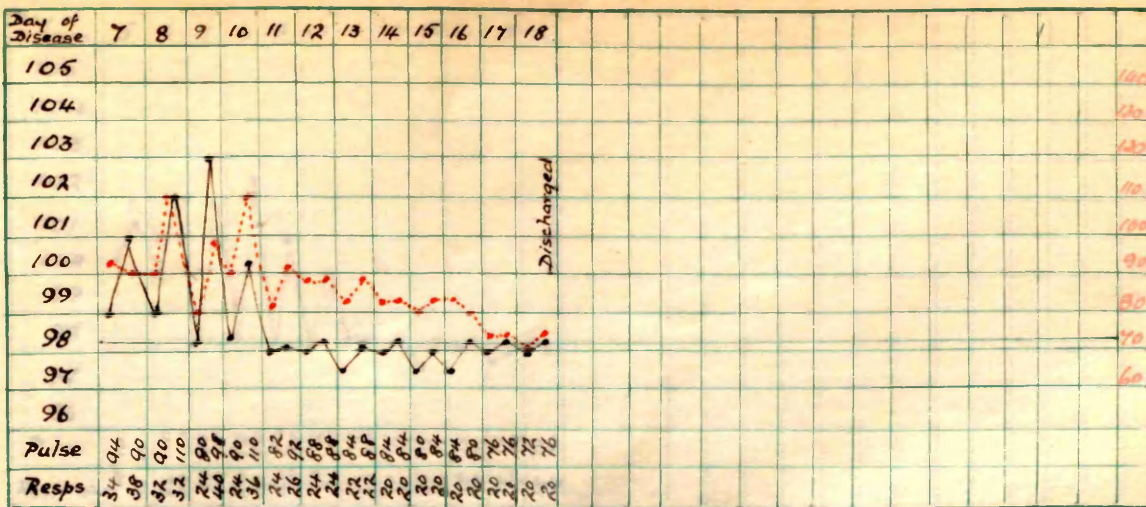
Urine
 17.5.32. React. Acid. Sp.Gr. 1020.
 Trace of albumen.
 21.5.32. " " "
 24.5.32. No albumen.

Haemoglobin 50%.
No malarial parasites.

Blood Count.
 White cells 5,500
 Polymorphs 62%
 Lymphocytes 34%
 Monocytes 3%
 Eosinophiles 1%

Widal Reaction
 15th Day 23rd Day
 Negative Negative

Weil Felix Reaction
 15th Day 23rd Day
 "K" - 1/265 "K" - 1/338
 "W" - 0 "W" - 0



CASE NO. 35.

Age 25 years.

FEMALE.

WEEDER.

ESTATE "A"

ADMITTED. 18-6-32.

COMPLAINT :- 6 days ago headache commenced with malaise and chill.

ON ADMISSION :- Scattered, dusky, indistinct macules, and slightly raised irregular papules on back, chest, and abdomen.

18-6-32. Marked conjunctival injection, and photophobia.
20-6-32. scattered rhonchi and moist rales both lungs.
Heart sounds normal. Severe calf tenderness.

19-6-32. General aching. Chest pains. Deafness.

20-6-32. Frequent loose cough. Headache.

21-6-32. Lungs clearing.

22-6-32. Temperature normal. Rash faded. Conjunctivae clear.
Eyes normal.

23-6-32. General improvement. Lungs clear.

24-6-32. No cough.

25-6-32. Convalescent.

29-6-32. Discharged from hospital.

Specimen of blood taken 5 days later for Widal and Weil Felix reactions.

URINE.

18-6-32.

React. Acid. Sp.Gr. 1022.

Haemoglobin 60%

No Malarial parasites.

WIDAL REACTION.

23rd Day.

Negative

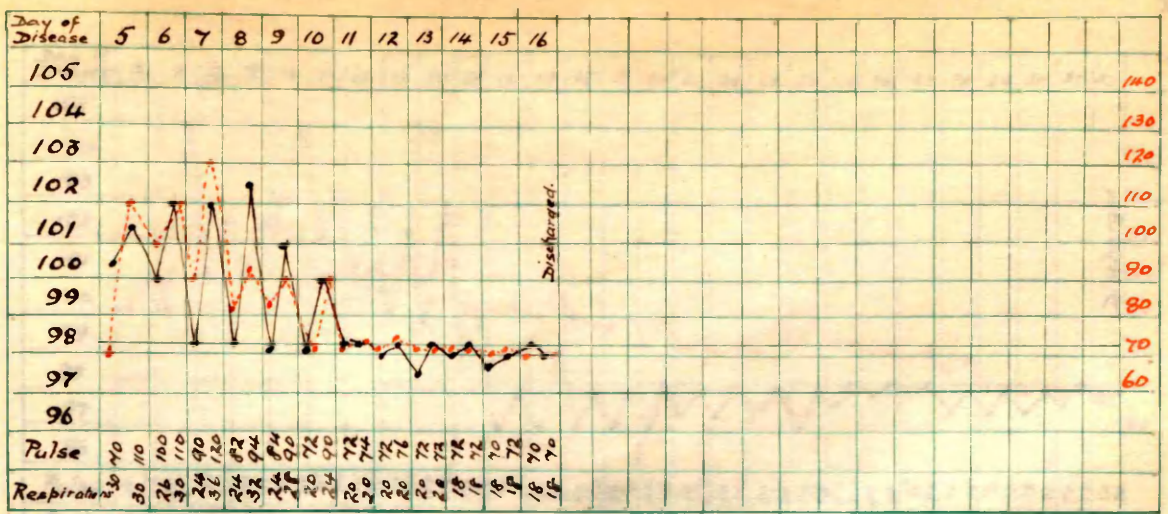
WEIL FELIX REACTION.

23rd Day.

"K" - (alc) (Living)
 $\frac{1}{300}$ $\frac{1}{440}$

"OXK" - $\frac{1}{250}$ $\frac{1}{440}$

"W" - 0 $\frac{1}{38}$



CASE NO. 36.

Age 18 years.

FEMALE.

WEEDER.

ESTATE "A"

ADMITTED. 18-6-32.

COMPLAINT :- 4 days ago abrupt fever started, with vomiting, headache and constipation.

ON ADMISSION :- No rash. Inguinal glands slightly enlarged. Scattered moist rales both lungs. Heart sounds normal.

19-6-32. Chest pains. Loose cough.

20-6-32. No headache. No eye signs. Tongue coated.

21-6-32. No rash. Chest pains and slight loose cough.

24-6-32. Inguinal glands subsiding. Temperature normal.

25-6-32. Convalescent.

29-6-32. Discharged from hospital.

17.8.32. Blood specimen sent to I.M.R. for Widal and Weil Felix reactions 5 days later.

18.8.32.

18-6-32. URINE.

Haemoglobin 60%

React. acid. Sp.Gr. 1020.

No Malarial parasites.

No albumen.

Blood count.

White cells 6500
 Leucocytes 68%
 Lymphocytes 28%
 Monocytes 2.5%
 Eosinophiles 1.5%

22.8.32.

24.8.32.

WIDAL REACTION.

WEIL FELIX REACTION.

27.8.32. 21st Day.

21st Day.

31.8.32. Negative

	(alc)	(Living)
"K"	- $\frac{1}{385}$	$\frac{1}{680}$
"OXK"	- $\frac{1}{250}$	$\frac{1}{680}$
"W"	- 0	0

6.9.32.

5.9.32.

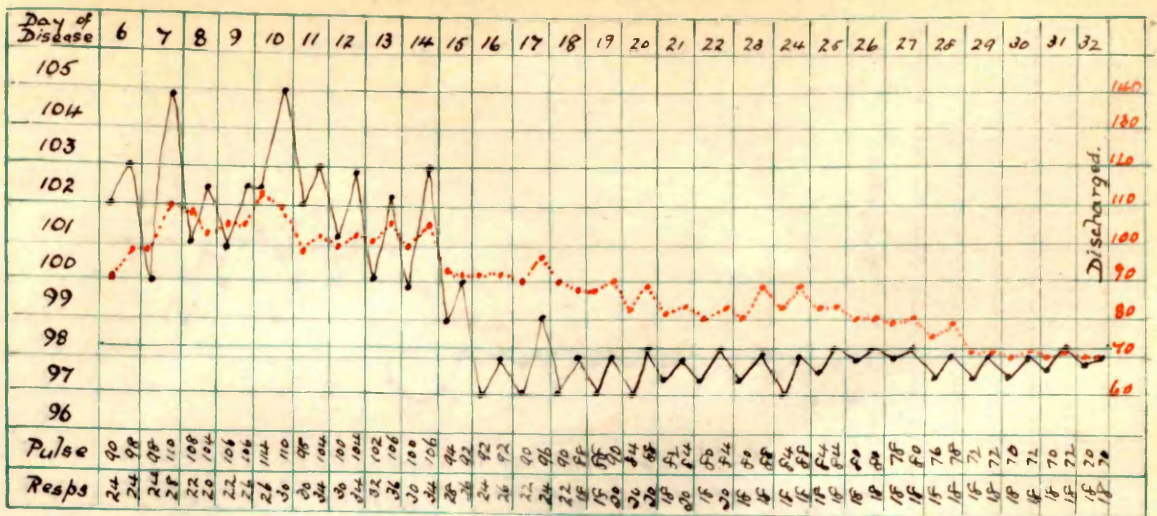
Urine
 React. Acid. Sp.Gr. 1020
 No albumen.

Widal Reaction

17th Day
 Negative

5.9.32

5.9.32

CASE No. 37.AGE 35 years.MALEHARVESTERESTATE "A".ADMITTED 13-8-32.

COMPLAINT:- 5 days ago fever commenced suddenly with rigor, headache, and weakness of limbs.

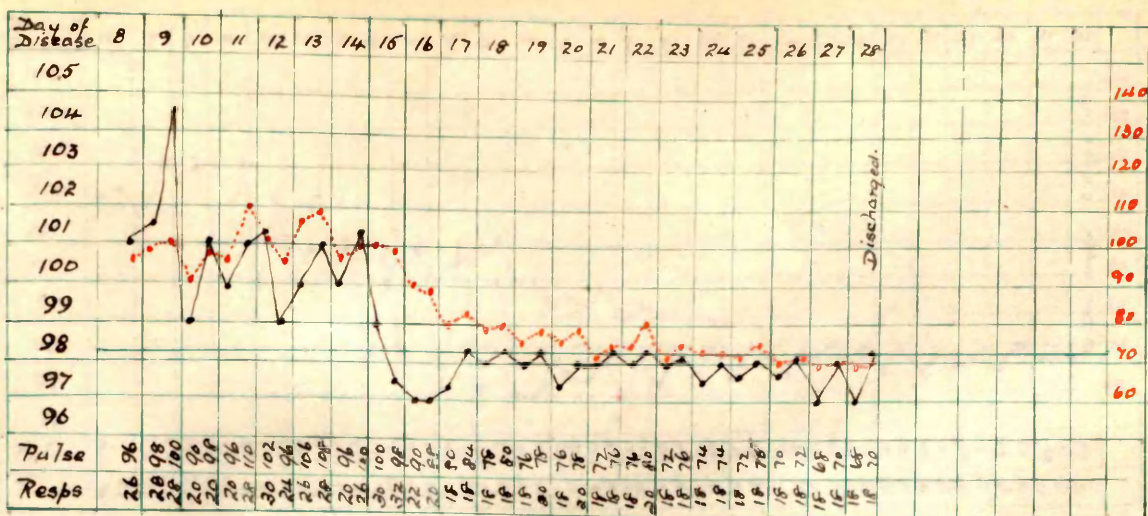
ON ADMISSION:- S.T. Malaria parasites in blood. No rash.
Heart, lungs and abdomen N.A.D.
Spleen enlarged, 1" below costal margin.

- 14.8.32. Inguinal glands enlarged and painful. Severe chest pains. Headache, giddiness and general aching. Calf tenderness.
- 15.8.32. Slight deafness. Fine subcuticular mottling, and scattered, irregular, slightly raised dusky papules, on back, chest, and abdomen. Severe calf tenderness.
- 16.8.32. Apathy. Deafness well marked (? Quinine).
- 17.8.32. Quiet delirium. Few scattered petechiae back and chest.
- 18.8.32. Scattered rhonchi and moist rales both lungs, loose cough. Heart irregular in rhythm and action, 1st shortened and indistinct. Joint pains in knees and ankles.
- 19.8.32. Deafness less.
- 20.8.32. Apathy and dullness. Rash still present. Delirium ceased. Heart:- Occasional irregularity, action weak. 1st sound indistinct.
- 22.8.32. Lungs clearing. No deafness.
- 24.8.32. Specimen of blood taken for Widal and Weil Felix Reactions. Rash fading. Heart improving.
- 27.8.32. Rash faded. Inguinal glands subsided.
- 31.8.32. Convalescent. Heart normal.
- 5.9.32. Discharged from hospital.

5.8.32. Urine
React. Acid. Sp.Gr. 1012.
No albumen.

Haemoglobin 50%.S.T. Parasites on admission

<u>Widal Reaction</u>		<u>Weil Felix Reaction</u>		<u>Blood Count</u>	
17th Day	Negative	"K"	- 1/1065	White cells	5,000
		"W"	- 0	Polymorphs	60%
				Lymphocytes	36%
				Monocytes	3%
				Eosinophiles	1%



CASE No. 38.

AGE 35 years.

FEMALE

WEEDER

ESTATE "A".

ADMITTED 6-9-32.

COMPLAINT:- 7 days ago fever started suddenly with headache, giddiness and dull aching of body.

ON ADMISSION:- Scattered scanty indistinct papules on back and chest. Conjunctivae injected. Inguinal glands enlarged and tender. Knee jerks decreased. Heart, lungs and abdomen N.A.D.

7.9.32. Severe headache, marked giddiness, slight photophobia. Deafness. Apprehensive and irritable, occasional delirium.

8.9.32. Calf tenderness. General aching, severe at back of neck. Scattered rhonchi and moist rales both bases. Dry cough. Heart N.A.D.

9.9.32. Rash faded. Joint pains upper and lower limbs. Oedema of feet and legs.

10.9.32. Headache less. Deafness clearing.

13.9.32. Specimen of blood sent to I.M.R. for Widal and Weil Felix.

14.9.32. Temperature normal. Inguinal glands subsiding.

15.9.32. Lungs clearing. Oedema of feet and legs less.

20.9.32. General improvement. Lungs clear, no cough.

23.9.32. Convalescent.

26.9.32. Discharged from hospital.

6.9.32. Urine
React. Acid. Sp.Gr. 1.014.
No albumen.

Haemoglobin 55%.

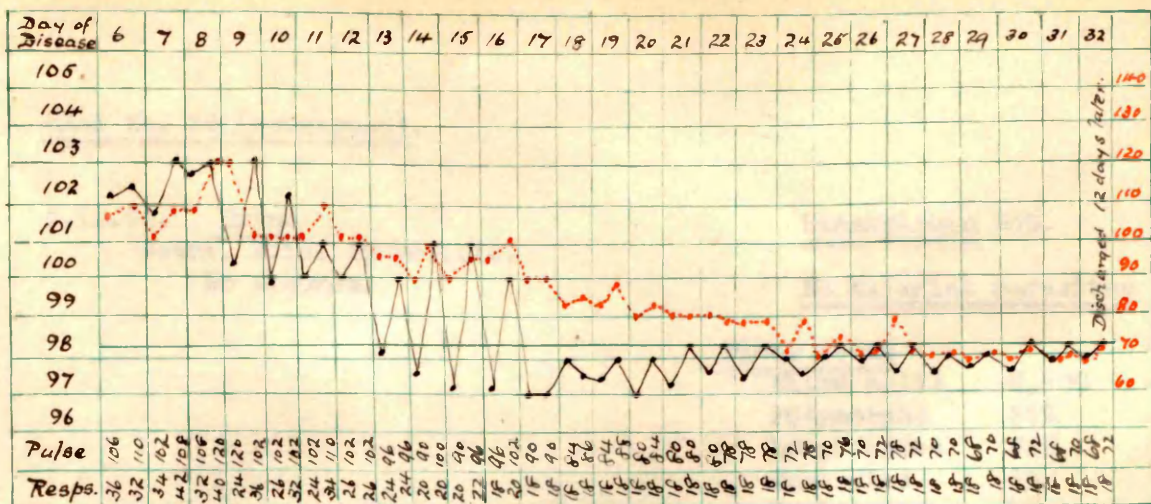
No Malarial parasites.

Blood Count

White Cells 7,500
Polymorphs 68%
Lymphocytes 28%
Monocytes 2%
Eosinophiles 2%

Widal Reaction
14th Day
Negative

Weil Felix Reaction
14th Day
"K" - 1/575
"W" - 0



CASE No. 39.

AGE 35 years.

MALEWEEDERESTATE "B".ADMITTED 2-11-32.

COMPLAINT:- 5 days ago fever commenced suddenly with chill, headache, nausea, pain in chest, and all over body.

ON ADMISSION:- No rash. Conjunctivae injected. Inguinal glands enlarged and tender. Spleen palpable 2" below costal margin. Heart, lungs and abdomen N.A.D.

- 3.11.32. Severe headache with giddiness, general aching and chest pains. Apathy. Insomnia and occasional irritability. Slight photophobia and deafness.
- 4.11.32. Severe headache.
- 5.11.32. Insomnia. Irritability. Deafness.
- 7.11.32. Headache less. Deafness clearing.
- 8.11.32. Specimen of blood taken for Widal and Weil Felix.
- 9.11.32. Sleeping naturally.
- 10.11.32. General improvement.
- 11.11.32. Inguinal glands subsided. Deafness cleared.
- 13.11.32. Temperature normal.
- 17.11.32. General improvement.
- 20.11.32. Blood and mucus in stools, griping abdominal pain.
- 21.11.32. Stools watery, passing blood and mucus.
- 22.11.32. Has amebic dysentery. Emetine injections commenced.
- 23.11.32. Blood and mucus passed, abdominal pain.
- 24.11.32. Stools loose. Blood and mucus less.
- 26.11.32. Less abdominal pain, no blood passed.
- 30.11.32. Stools loose, no blood or mucus, no abdominal pain.
- 5.12.32. Stools formed.
- 10.12.32. Discharged from hospital.

CASE No. 39 (continued).2.11.32. Urine

React. Acid. Sp.Gr.1018.

No albumen.

Haemoglobin 55%.No Malarial parasitesBlood Count

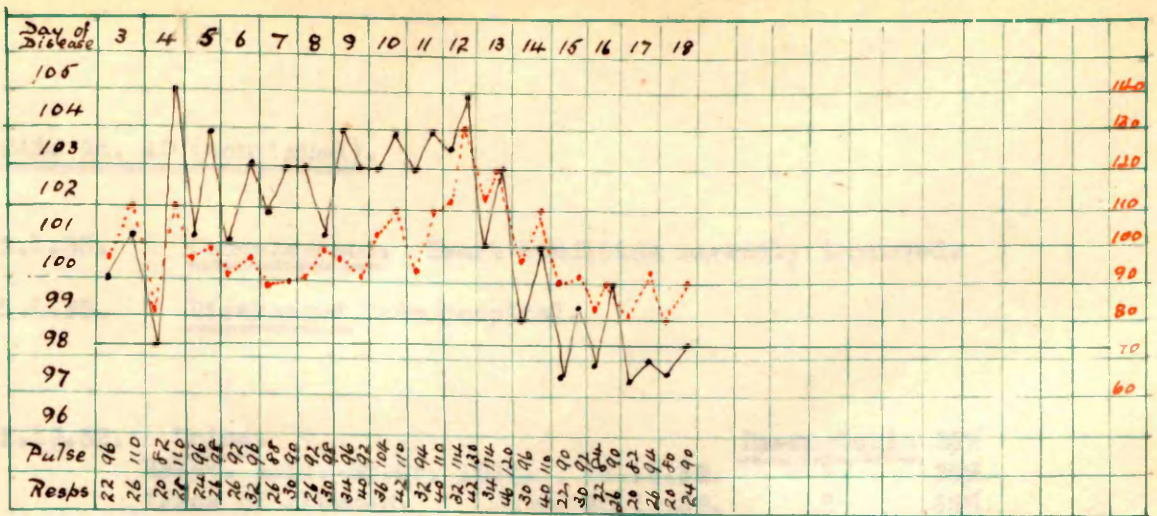
White cells	6,500
Polymorphs	64%
Lymphocytes	32%
Monocytes	3%
Eosinophiles	1%

Widal Reaction

	12th Day
T	- 1/38
A	- 0
B	- 0
C	- 0
T(o)	- 4 units.

Weil Felix Reaction

	12th Day
"K"	- 1/630
"W"	- 1/22



CASE No. 40.

AGE 18 years.

FEMALE

WEEDER

ESTATE "A".

ADMITTED 2-12-32.

COMPLAINT:- 2 days ago fever started suddenly with rigor, headache and vomiting.

ON ADMISSION:- No rash. S.T. malaria rings in blood. Ankylostomiasis. Heart pendulum rhythm, soft blowing systolic murmur at base. Lungs clear.

- 3.12.32. Apathy. Severe headache.
- 4.12.32. General aching and calf tenderness.
- 5.12.32. Scattered indistinct dusky macules and irregular slightly raised papules on face. Inguinal glands enlarged. Insomnia. Loose cough.
- 6.12.32. Rash spread to back, chest, abdomen, thighs, and backs of legs. Heart:- occasional irregularity, haemic murmur.
- 7.12.32. Insomnia. Apathy. Inguinal glands enlarged and tender. Face puffy.
- 8.12.32. Headache severe. Dry cough, lungs clear.
- 9.12.32. Pain in calf muscles. Sleeping better.
- 10.12.32. Drowsy, eyes suffused.
- 11.12.32. Face puffy. Oedema of feet and legs.
- 12.12.32. Specimen of blood taken for Widal and Weil Felix Reactions.
- 13.12.32. Rash fading, conjunctivae clear.
- 14.12.32. Rash faded.
- 16.12.32. Inguinal glands subsided. Temperature normal. Heart regular, rhythm improved, haemic murmur present at base.
- 18.12.32. 2nd specimen of blood taken.
- 24.12.32. Face still puffy.
- 27.12.32. Oedema of feet and legs subsided.
- 29.12.32. General improvement. Face less puffy. Heart regular in rhythm. 1st sound indistinct and muffled.

CASE No. 40 (continued).2.1.33. Convalescent. Heart condition markedly improved.5.1.33. Discharged from hospital.2.12.32. Urine.

	React.	Acid.	Sp.Gr.	1022.
	Trace of albumen.			
9.12.32.	"	"	"	
16.12.32.	"	"	"	
24.12.32.	"	"	"	
31.12.32.	No albumen.			

	<u>Haemoglobin</u>	25%
16.12.32.	"	25%
30.12.32.	"	35%
5. 1.33.	"	40%

S.T. Malaria parasites in blood.Blood Count

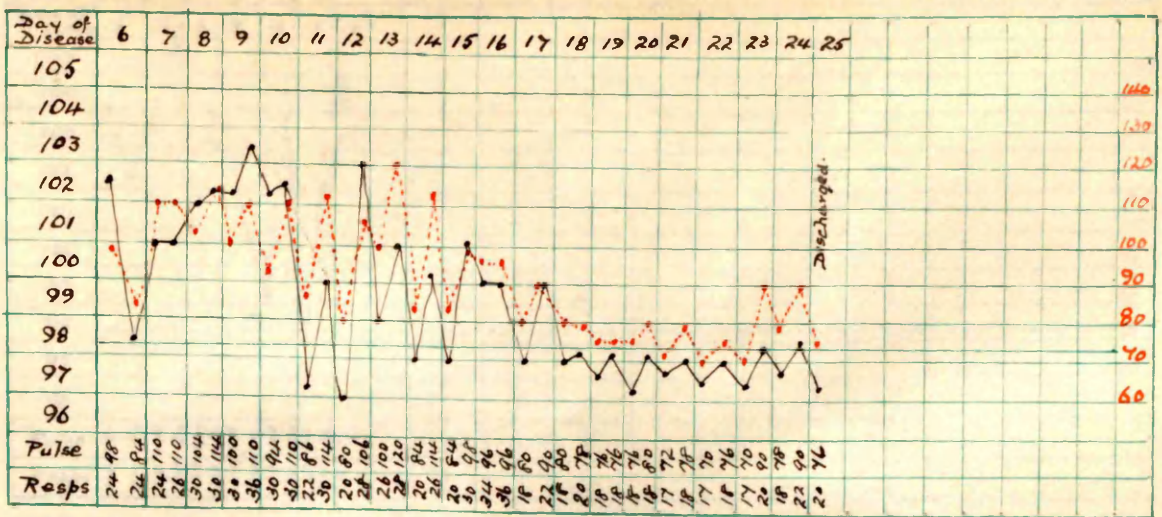
White cells	5,000
Polymorphs	54%
Lymphocytes	33%
Monocytes	2%
Eosinophiles	11%

Widal Reaction

14th Day	20th Day
Negative	Negative

Weil Felix Reaction

14th Day	20th Day
"K" - 1/125	"K" - 1/100



CASE No. 41.

AGE 22 years.

FEMALE

ESTATE "A"

Dependent.

ADMITTED 25-1-33.

COMPLAINT:- 5 days ago fever commenced suddenly with chill, severe headache, and bilious vomiting.

ON ADMISSION:- No rash, no conjunctival injection. Slight deafness. Heart, lungs and abdomen N.A.D. Glands not enlarged.

- 26.1.33. Severe headache. Slight conjunctival injection.
- 27.1.33. Severe headache. Giddiness. Back ache and pains in thighs. Restless and irritable. Frequent stools.
- 28.1.33. Restless, anxious and irritable. Several watery stools.
- 29.1.33. Several watery stools. Heart sounds normal. Lungs clear.
- 30.1.33. Headache less. Stools frequent and watery. Specimen of blood taken for Widal and Weil Felix Reactions.
- 31.1.33. Backache. Anxious expression, less irritable.
- 1.2.33. General improvement.
- 3.2.33. Stools normal.
- 4.2.33. Heart sounds good. Sleeping well.
- 6.2.33. Temperature normal. Mentally brighter.
- 9.2.33. General improvement. 2nd specimen of blood taken.
- 12.2.33. Treatment given for Ankylostomiasis.
- 13.2.33. Discharged from hospital. 3rd Blood taken 3 days later.

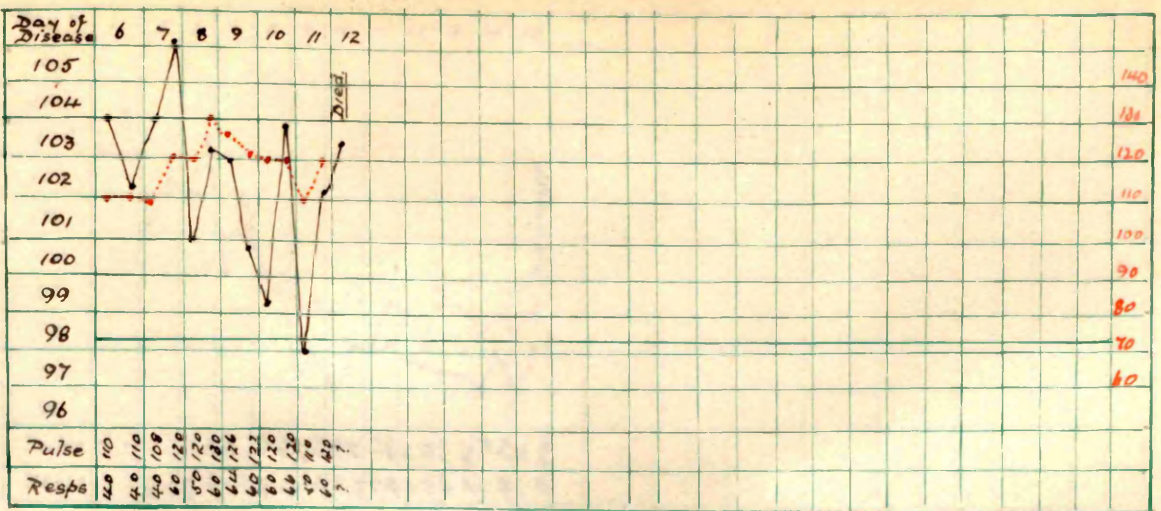
25.1.33. Urine React. Acid. Sp.Gr.1024.
No albumen.

Haemoglobin 60%.
No Malarial parasites

Blood Count
White cells 8,000
Polymorphs 63%)
Lymphocytes 33%)
Monocytes 1%)
Eosinophiles 3%)

Widal Reaction
11th Day 21st Day 28th Day
T)
A)
B)
C)
T(o))
Negative

Weil Felix Reaction
11th Day 21st Day 28th Day
"K" - 1/60 - 1/100 - 1/130
"W" - 0 - 0 - 0



CASE No. 42.

AGE 25 years.

FEMALE

WEEDER

ESTATE "D".

ADMITTED 3-2-33.

COMPLAINT:- 6 days ago headache commenced with pain in back of neck. Next day fever started with chill, severe headache, and pain in back of neck.

ON ADMISSION:- Small, discrete, slightly raised papules on back, chiefly scapular region, flanks, and backs of thighs. Marked conjunctival injection and Photophobia. Slight deafness. Kneejerks decreased. Rhonchi and rales both lungs. Heart and abdomen N.A.D.

- 4.2.33. General aching. Severe pain in back of neck. Headache and giddiness. Delirium. Watery stools.
- 5.2.33. Delirium. Widely scattered Rhonchi and moist rales both lungs, shifting dullness and fine crepitations both bases. Short dry cough. Severe calf tenderness. Frequent watery stools. Heart irregular, 1st sound prolonged and indistinct.
- 6.2.33. Noisy delirium, alternating stupor. Pulse irregular and dicrotic. Frequent dry cough. Specimen of blood taken. Tympanites and abdominal pain.
- 7.2.33. Stuporous, coma vigil, occasional delirium. Frequent cough. Heart irregular, occasional extra systoles, 1st sound muffled.
- 8.2.33. Broncho-pneumonia both lungs.
- 9.2.33. Died.

3.2.33. Urine
React. Acid. Sp.Gr. 1020.
No albumen.

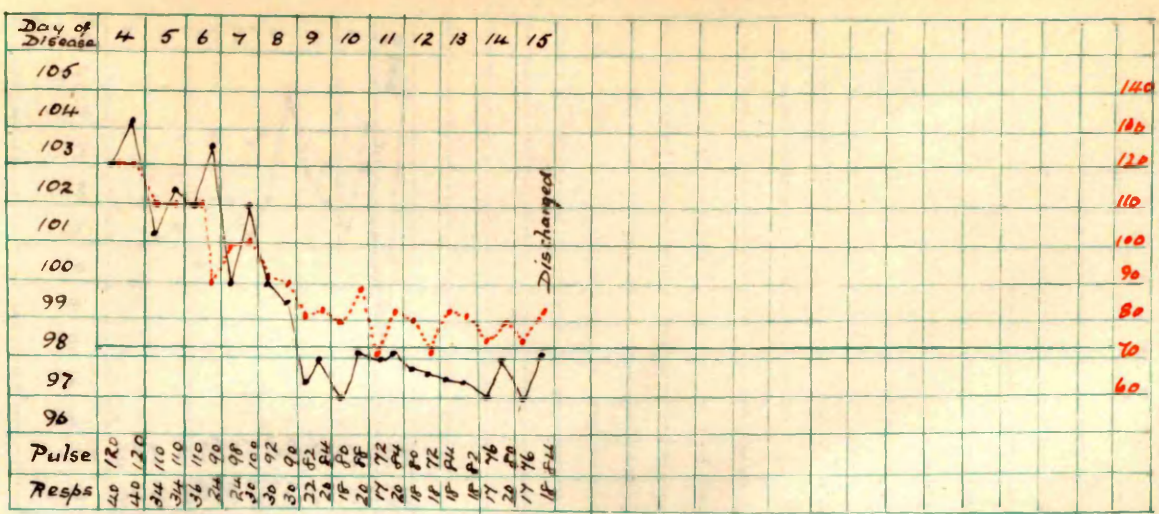
Haemoglobin 65%.
No Malarial parasites.

Blood Count
White cells 10,000
Polymorphs 68%
Lymphocytes 28%
Monocytes 3%
Eosinophiles 1%

Widal Reaction

Weil Felix Reaction

Specimen haemolised. Death occurred before 2nd specimen could be obtained.



CASE No. 43.

AGE 16 years.

FEMALE

WEEDER

ESTATE "A".

ADMITTED 3-3-33.

COMPLAINT:- 3 days ago indefinite fever started with rigors, severe headache, and pain in back of neck. Cough and bilious vomiting.

ON ADMISSION:- Small discrete slightly raised dusky maculo papular rash on back, chest, abdomen, and upper part of thighs. Slight conjunctival injection. Right inguinal glands enlarged and tender. Heart, lungs and abdomen N.A.D.

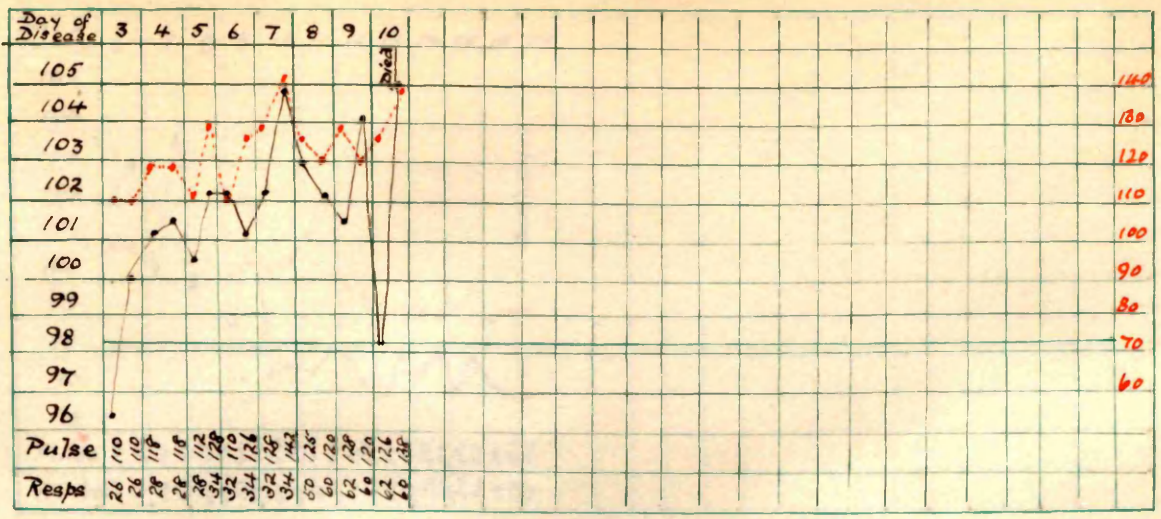
- 4.3.33. Severe headache, general aching and pains in back of neck. Severe calf tenderness.
- 5.3.33. Dry cough. Slight deafness.
- 6.3.33. Rash still present.
- 7.3.33. Headache less.
- 8.3.33. Temperature normal. Inguinal glands subsiding.
- 9.3.33. Rash faded.
- 11.3.33. Specimen of Blood taken for Widal and Weil Felix Reactions.
- 12.3.33. Convalescent.
- 14.3.33. Discharged from hospital.

Urine 3.3.33.
React. Acid. Sp.Gr. 1012
No albumen.

Haemoglobin 70%.
No Malarial parasites.

Widal Reaction
17th Day
Negative

Weil Felix Reaction
17th Day
"K" - 1/780
"W" - 0



CASE No. 44.

AGE 20 years.

FEMALE

WEEDER

ESTATE "A".

ADMITTED 6-3-33.

COMPLAINT:- 2 days ago fever started abruptly with chill headache and cough.

ON ADMISSION:- No rash. Conjunctivae injected. Photophobia and slight deafness. Knee jerks decreased. Heart, lungs, abdomen N.A.D.

- 7.3.33. Right inguinal glands enlarged and tender. Severe headache and marked giddiness. Severe general aching. Calf tenderness.
- 8.3.33. Insomnia. Dry cough.
- 9.3.33. Scattered moist rales, and fine crepitations both lungs. Frequent dry cough.
- 10.3.33. Rapid irregular pulse. Muttering delirium. Heart - Rapid, irregular, 1st sound prolonged and indistinct.
- 11.3.33. Marked tremor and subsultus.
- 12.3.33. Muttering delirium, tremor and subsultus. Heart - Irregular, occasional extra systoles. 1st sound replaced by soft, blowing murmur.
- 13.3.33. Died.

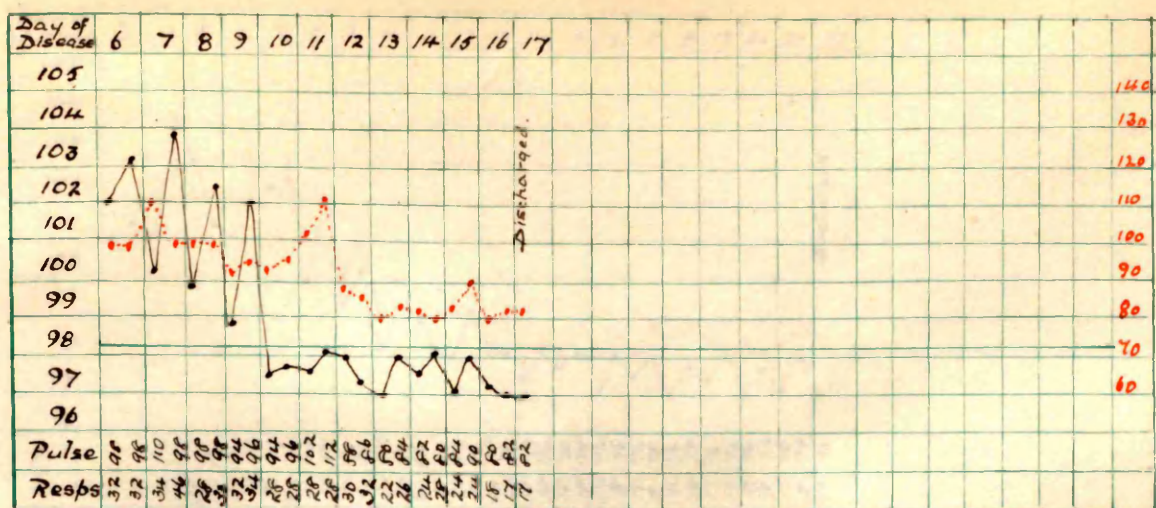
Urine 6.3.33.
 React. Acid. Sp.Gr. 1024.
 Trace of albumen,
 8.3.33. " " "
 11.3.33. " " "

Haemoglobin 25%.
No malarial parasites.

Blood Count.
 White cells 6,500
 Polymorphs 63%
 Lymphocytes 33%
 Monocytes 3%
 Eosinophiles 1%

Widal Reaction
 Not obtained.

Weil Felix Reaction
 Not obtained.



CASE No. 45.

AGE 15 years.

FEMALE

WEEDER

ESTATE "A".

ADMITTED 12-3-33.

COMPLAINT:- 5 days ago headache commenced and aching of limbs with gradually increasing fever.

ON ADMISSION:- Irregular slightly raised dusky papules on face, abdomen, thighs, flanks and legs. Slight conjunctival injection. Deaf from birth. Heart and abdomen N.A.D. Widely scattered rhonchi and moist rales both lungs.

- 13.3.33. General aching. Severe headache. Inguinal glands enlarged and tender. Cough frequent.
- 14.3.33. Calf tenderness.
- 15.3.33. Severe headache and general aching.
- 16.3.33. Headache less.
- 17.3.33. Rash faded. Temperature normal.
- 18.3.33. General improvement. Lungs clearing.
- 20.3.33. Inguinal glands subsided.
- 21.3.33. Convalescent.
- 22.3.33. Blood taken for Widal and Weil Felix reactions.
- 23.3.33. Discharged from hospital.

Urine

12.3.33. React. Acid. Sp.Gr. 1014.
No albumen.

Haemoglobin 75%.No Malarial parasites.Widal Reaction

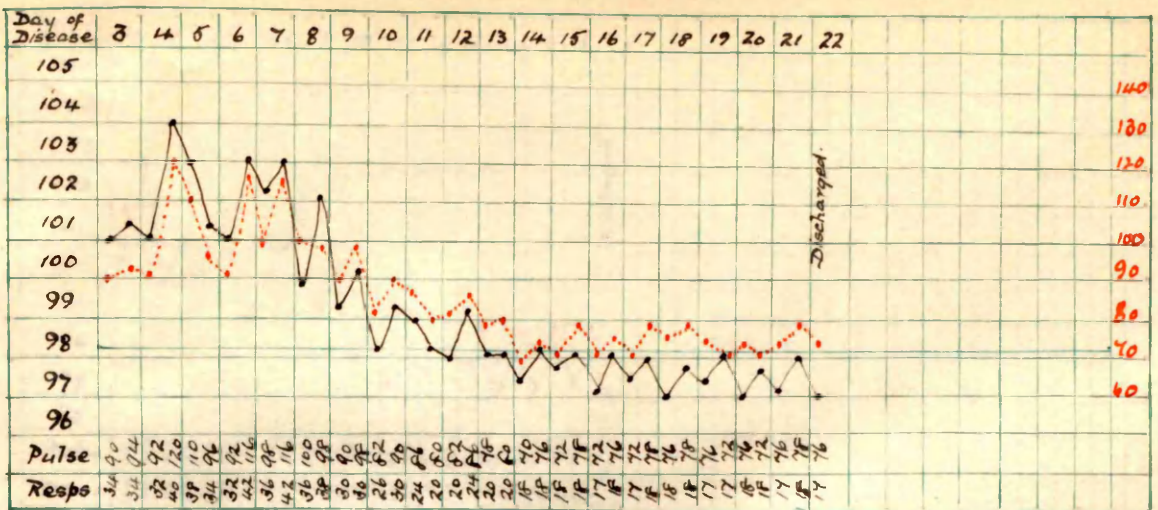
16th Day

T - 1/17
A - 0
B - 0
C - 0
T(o) - 0

Weil Felix Reaction

16th Day

"K" - 1/420
"W" - 0



CASE No. 46.

AGE 28 years.

MALE

HARVESTER and TRUCK LOADER

ESTATE "A".

ADMITTED 6-4-33.

COMPLAINT:- 2 days ago fever commenced abruptly with chill and severe headache.

ON ADMISSION:- No rash. Extreme conjunctival injection. Marked photophobia. Inguinal glands enlarged and tender. Heart, lungs and abdomen N.A.D. S.T. parasites in blood.

- 7.4.33. Generalised joint pains, and pain in chest wall. Intense subconjunctival injection. Frequent stools.
- 8.4.33. Severe headache. Several watery stools.
- 9.4.33. Frequent watery stools. Eyes completely suffused.
- 10.4.33. Muttering delirium. Frequent watery stools.
- 11.4.33. Noisy delirium. Stools less frequent.
- 12.4.33. Injection of 10 c.c. of convalescent serum. Heart regular, lungs clear.
- 13.4.33. Eyes clearing. Stools improved. Generalised joint pains.
- 14.4.33. General improvement. Eyes clearing.
- 15.4.33. Stools still frequent. Eyes improving. Rash faded.
- 16.4.33. Temperature normal. Inguinal glands subsided.
- 17.4.33. Eyes clear. No photophobia.
- 18.4.33. Blood taken for Widal and Weil Felix reactions.
- 19.4.33. Joint pains less.
- 20.4.33. Convalescent.
- 25.4.33. Discharged from hospital.

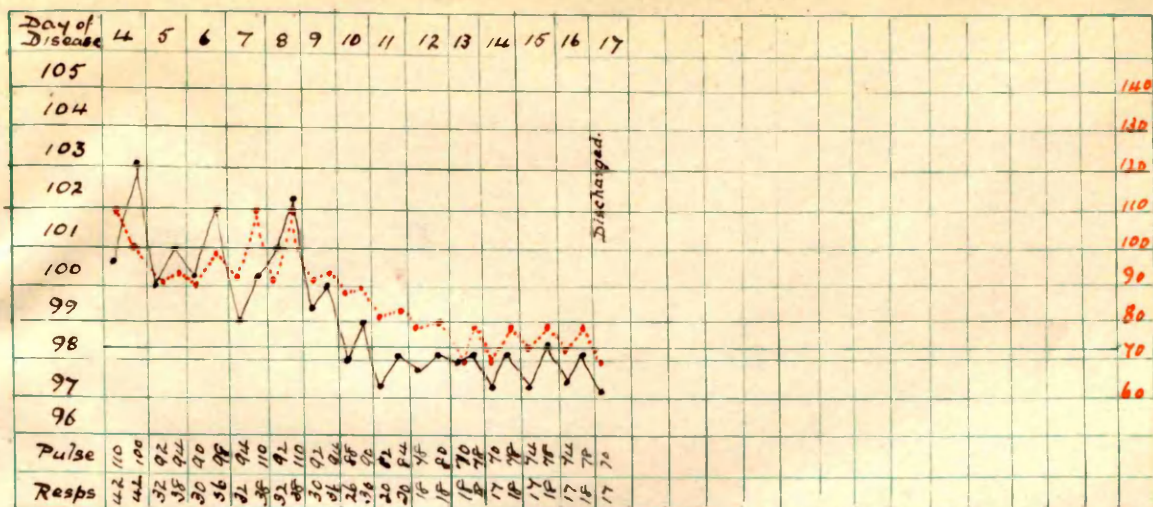
Urine 6.4.33.
React. Acid. Sp.Gr. 1018.
No albumen.

Haemoglobin 60%.

S.T. parasites in blood on Admission.

<u>Widal Reaction</u>	
15th Day	
T	- 0
A	- 1/34
B	- 0
C	- 0
T(o)	- 4 units

<u>Weil Felix Reaction</u>	
15th Day	
"W"	- 1/44
"K"	- 1/560



CASE No. 47.

AGE 35 years.

MALE

HARVESTER

ESTATE "A".

ADMITTED 26-4-33.

COMPLAINT:- 3 days ago fever commenced abruptly with headache, chill, and aching of body.

ON ADMISSION:- Small discrete dusky maculo-papules, on chest, back, and abdomen. No conjunctival injection. Slight photophobia. Inguinal glands enlarged and tender. Heart, lungs and abdomen N.A.D.

- 27.4.33. Rash on forehead and cheeks. Severe general aching. Slight delirium.
- 28.4.33. Noisy delirium. Severe headache and deafness.
- 29.4.33. Injection of 10 c.c. Convalescent Serum given. Delirium at night, not violent.
- 30.4.33. Delirium ceased. 2nd injection of Convalescent Serum given.
- 1.5.33. Slept well last night. Delirium ceased.
- 2.5.33. Rash fading on body.
- 3.5.33. Rash faded.
- 4.5.33. Specimen of blood taken for Widal and Weil Felix reactions.
- 6.4.33. Convalescent.
- 9.4.33. Discharged from hospital.

Urine 26.4.33.
React. Acid. Sp.Gr. 1020.
No albumen.

Haemoglobin 65%.

No Malarial parasites.

Blood Count.
White Cells 5,500
Polymorphs 62%
Lymphocytes 34%
Monocytes 3%
Eosinophiles 1%

Widal Reaction
11th Day
Negative

Weil Felix Reaction
11th Day
"K" - 1/400
"W" - 1/17

Appendix. B.

Appendix C.

A P P E N D I X C.

Louse Typhus.	Tick Typhus.	Mite Typhus.
<p>1. Typhus exanthematicus "W"</p> <p>2. Tabardillo (Mexican Typhus) "W"</p>	<p>1. Rocky Mountain spotted fever (Montana type) "W" & "K"</p> <p>2. Rumreich's rural tick bite fever of South Eastern states U.S.A. - "W" & "K"</p> <p>3. ? Endemic typhus of Sao Paulo. "W", ? "K"</p>	<p>I. Tsutsugamushi disease (Japanese river fever) "K"</p>

Tick Paratyphus.	Mite Paratyphus.	Flea Paratyphus.	Paratyphus. (Vector unknown.)
<p>I. Rocky Mountain spotted fever (Idaho type) "W" & "K"</p> <p>2. South African tick-bite fever "W" & "K"</p> <p>3. Fievre Boutonneuse ??</p> <p>4. Marseilles fever "W" ? "K"</p> <p>5. Toulon fever "W"</p> <p>6. ? Italian fever "W"</p> <p>7. ? Greek fever (Athens) "W"</p> <p>8. ? Megaw's Kamuon Hills fever India ??</p>	<p>I. Pseudo typhoid of Sumatra "K"</p> <p>2. ? Malayan Tsutsugamushi disease. "K".</p>	<p>I. Urban paratyphus of South-eastern states U.S.A. - "W"</p> <p>2. Brill's paratyphus Eastern States U.S.A.- "W"</p> <p>3. ? Manchurian typhus "W", ? "K"</p>	<p>(1. Malayan Paratyphus "W" 2. do do "K"</p> <p>3. Indo-Chinese-do- ??</p> <p>4. Burman -do- "W"</p> <p>5. Adelaide -do- "W" (Australian Urban)</p> <p>6. Queensland -do- "W"</p> <p>7. Mossman -do- ??</p> <p>8. Kenyan -do- "W"</p> <p>9. South African -do- "W"</p> <p>10. Nigerian -do- ??</p> <p>11. Central Indian -do- "K" ? "W"</p>