Reprint.

UNDULANT FEVER IN SOUTH AFRICA.1

By P. D. STRACHAN, M.A., M.B., Ch.B.

In the title of this paper the least fashionable designation of the disease, which is commonly called Malta or Mediterranean fever, is used because it has no local significance. Undulant fever is now believed to be endemic, not only in numerous localities surrounding the Mediterranean, but also in India, China, North America, South America, the West Indies, and South Africa.2 The local significance of the terms Malta fever and Mediterranean fever may be responsible for the fact that the disease has remained generally unrecognised for many years in South Africa, going under other names, and probably complicating the elucidation of anomalous diseases. It is true that a few medical men in the past, as I shall show further on, have raised their voices in favour of the view that undulant fever is endemic in South Africa; but their efforts have not secured the general recognition of the fact. Even at the coast, where the fever is probably not endemic, cases invalided from the high veld may sometimes be met with. If such cases are not always correctly diagnosed at the coast, the mistake is neither surprising nor inexcusable. In very chronic cases the physical appearance and the character of the pyrexia are strongly suggestive of tuberculosis. If a diagnosis of tuberculosis be made, the advice which would be given at the coast is obvious. One of my patients was advised to return to the high veld immediately, after he had been only a few days at the coast. To obviate such mistakes in the future, it is advisable that patients suffering from undulant fever should not be sent away without an open note on the diagnosis, whether the names of their next medical attendants are known or not.

My experience of South African fevers began in the Concentration Camp, Springfontein, August 1st, 1901. There I acted for thirteen months. During the summer months there was a sharp epidemic of true typhoid fever in the camp. Among the cases of typhoid fever there were many in which the fever was prolonged and irregular, and these were seldom fatal. Nevertheless, among these the characteristic complications and sequelae of undulant fever were so rare that one would not be justified in placing them as a whole in the latter category.

1 Reprinted from The South African Medical Record, December 10th, 1906.

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Undulant fever was not thought of at the time, but I feel justified in retrospectively diagnosing six cases as undulant fever. Five were in one family. These were returned again and again to the hospital for many months suffering from what appeared to be a relapsing fever with neuritis. The remaining case was that of a middle-aged man, who was laid up in his tent for several months with lumbago and sciatica and an irregular low fever. I have recently tested three sera from cases of prolonged irregular fever in three separate districts of Cape Colony. These gave marked positive reactions with the Bacillus typhosus, negative with the Micrococcus melitensis. It seems therefore probable that most of the cases of this type which occurred, at least in my practice, during the war, were cases of typhoid or para-typhoid infection. On the other hand, it must be noted that many cases of undulant fever are symptomless (with the exception of the pyrexia) throughout. It would therefore seem to be almost impossible to diagnose such cases with certainty without the agglutination test, where typhoid and undulant fever are endemic together.

In the end of August, 1902, I began to practise in the town and district of Philippolis. In October, 1902, I came across the first case of undulant fever, and diagnosed it "typhoid." This case was the most prolonged in my experience, the pyrexia lasting with intermissions for two years. None of the more characteristic complications and sequelae of undulant fever occurred in this case. A daughter of this patient suffered from a continued fever in January and February of 1904. In her case there was effusion into one ankle joint towards the end of the illness. Towards the end of 1903 it was noted that a considerable proportion of the cases presented the characteristics of undulant fever, and in the beginning of 1904 a paper was read before the Orange River Colony Medical Society, recording seventy-two cases which I believed to be cases of undulant fever. In March, 1904, blood samples from six typical cases were tested for typhoid fever by Dr. Edington at Grahamstown; reaction negative. Since that date the sera of nearly all fresh cases of undulant and typhoid fever, as well as sera from many cases that had recovered, have been tested by Dr. Edington, Dr. G. W. Robertson, Lieutenant-Colonel C. Birt, R.A.M.C., Major Buist, R.A.M.C., and myself. Most of the results thus obtained have already been published by Lieutenant-Colonel Birt and myself. They will be summarised in another portion of this paper.

During the past four years 138 cases of undulant fever and 30 cases of typhoid have occurred in my practice. The disparity between the

1 Lieutenant-Colonel C. Birt, R.A.M.C., Journal of the Royal Army Medical Corps, January, 1906
2 Ibid.
3 Ibid.
numbers is striking because its sign is the reverse of what might have been expected in South Africa, where the endemicity of typhoid is regarded as a serious problem, while the presence of undulant fever has received little attention until recently.

The following is a statement of the number of the cases of undulant and typhoid fever which were observed in the district of Philippolis during each of the past four years:

<table>
<thead>
<tr>
<th>Year</th>
<th>Undulant fever</th>
<th>Typhoid fever</th>
</tr>
</thead>
<tbody>
<tr>
<td>1902-3</td>
<td>17</td>
<td>13</td>
</tr>
<tr>
<td>1903-4</td>
<td>75</td>
<td>10</td>
</tr>
<tr>
<td>1904-5</td>
<td>21</td>
<td>4</td>
</tr>
<tr>
<td>1905-6</td>
<td>25</td>
<td>3</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>138</strong></td>
<td><strong>30</strong></td>
</tr>
</tbody>
</table>

The seasonal distribution of the two fevers has been as described in a former paper, viz.—Fresh cases of undulant fever are generally met with during the spring and early summer months, i.e., September to January. Cases of typhoid fever have generally occurred in the late summer and autumn months, i.e., January to April.

To my former statements regarding the age and sex incidence, nothing need be added except that undulant fever appears to occur not infrequently in the very young. Two patients at 3, and one at 2½, were among the number of the sufferers. The serum of the last gave a positive reaction in my hands, and the reaction was confirmed by Lieutenant-Colonel Birt.

Before the writing of this paper was undertaken, it was hoped that a clinical comparison between undulant fever in South Africa and in the Mediterranean might be made. I regret to say that I have been unable to lay hands upon the classical work of Hughes, which is out of print. Lieutenant-Colonel Birt, however, has kindly supplied me with some notes from Hughes. The actual and percentage numbers of what appeared to be leading symptoms, complications and sequelae have been worked out in the above 138 cases. Doubtless the value of such statistics is considerably impaired by the smallness of the number of cases.

Number of cases = 138.

(Continued fever in every case.)

<table>
<thead>
<tr>
<th>Symptom</th>
<th>Number</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lumbago</td>
<td>67</td>
<td>63%</td>
</tr>
<tr>
<td>Other neuralgias</td>
<td>6</td>
<td>4·3%</td>
</tr>
<tr>
<td>Paresplia</td>
<td>4</td>
<td>2·9%</td>
</tr>
<tr>
<td>Joint effusions</td>
<td>27</td>
<td>19·5%</td>
</tr>
<tr>
<td>Pulmonary complications</td>
<td>26</td>
<td>19%</td>
</tr>
<tr>
<td>Orchitis</td>
<td>8</td>
<td>5·8%</td>
</tr>
<tr>
<td>If females are not counted</td>
<td>8</td>
<td>9·4%</td>
</tr>
</tbody>
</table>

2 Ibid.
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<table>
<thead>
<tr>
<th>Symptom/Complication</th>
<th>Frequency</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Severe typhoid state</td>
<td>12</td>
<td>8.7%</td>
</tr>
<tr>
<td>Symptomless</td>
<td>30</td>
<td>21.7%</td>
</tr>
<tr>
<td>Gastro-intestinal disturbance</td>
<td>6</td>
<td>4.3%</td>
</tr>
<tr>
<td>Deafness</td>
<td>3</td>
<td>2.17%</td>
</tr>
<tr>
<td>Obstinate epistaxis</td>
<td>1</td>
<td>0.7%</td>
</tr>
<tr>
<td>Endocarditis</td>
<td>2</td>
<td>1.4%</td>
</tr>
<tr>
<td>Cold lumbar abscess (post-febrile)</td>
<td>3</td>
<td>2.17%</td>
</tr>
<tr>
<td>Acute nephritis</td>
<td>1</td>
<td>0.7%</td>
</tr>
<tr>
<td>Intracranial disease</td>
<td>2</td>
<td>1.4%</td>
</tr>
<tr>
<td>Enlarged liver</td>
<td>3</td>
<td>3.6%</td>
</tr>
<tr>
<td>Enlarged spleen</td>
<td>4</td>
<td>2.9%</td>
</tr>
</tbody>
</table>

A few remarks may now be made upon the above statistics.

The percentage of joint effusions seems lower than one would expect, considering the prominence given to this complication in the usual descriptions of undulant fever. Hughes has put them at some 40 per cent. In only three cases were the joint effusions multiple. The joints affected were, in order of frequency: the knee, ankle, wrist, elbow. Joint effusions were most common in children and adults.

In the four cases recorded, paraplegia followed very severe neuralgia, and affected the legs below the knee. The extensors of the feet were most severely affected, and were the last set of muscles to recover. The patellar tendon reflexes were for a time abolished. There was no ankle clonus. Pulmonary complications took the forms of bronchitis and atypical pneumonia. The typhoid state was found only in association with severe pulmonary complications. Orchitis occurred only in adults. Hughes has put the percentage incidence of orchitis at 4 or 5, but I am not aware whether females were counted or not. The symptomless cases were for the most part ambulatory. Although constipation was the rule, it did not, when properly dealt with, lead to troublesome gastro-intestinal disturbances. The three cases of deafness were associated with a severe typhoid state. Sweating was a prominent symptom in many of the cases, but in the majority it was not seriously complained of. It may be suggested here that in countries where the atmosphere is exceedingly dry, perspiration tends to become less sensible and at the same time more efficient as a heat regulator. Acute nephritis and endocarditis have been noted among Mediterranean cases. Bassett-Smith has recently recorded cases of the latter. According to Hughes, renal disease is a serious complication in some prolonged cases. Intracranial disease, in the two cases recorded above, was post-febrile. Such complications

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4 Birt, ibid.
must be regarded as the gravest possible. It seems well to give notes on the two cases:—

Case I.—A child, aged 9, living at a distance of twenty-seven miles from Philippolis, and convalescent from undulant fever, developed symptoms of meningitis. About ten days after a diagnosis of meningitis had been made, the child was seen again. It was reported by the parents that after a copious discharge of pus from the nose the child began to recover. On this occasion both pupils were dilated, and there was at least object blindness. Objects shown could not be named until they had been handled. There was some mental obtuseness, which made it difficult to ascertain whether there was any kind of visual sense left. The fundus presented a normal appearance in both eyes. Perfect vision was restored in about two months.

Case II.—A man, aged 38, presented himself on September 22nd, suffering from constant headache and partial paralysis of the left leg. He gave a history pointing to undulant fever in May, 1904. His two brothers with their families, living on the same farm had had the disease some months previously. His serum was tested by Dr. Edington against the \textit{M. melitensis} in a dilution of 1 in 50, and gave a positive reaction. He was seen at his farm on three occasions subsequently by Dr. D. M. Macrae and myself. On the occasion on which I saw him last, there was complete left hemiplegia, and both pupils were dilated. A view of the fundus could not be obtained, because the patient, owing to intense headache, was unable to keep his head still. A diagnosis of intracranial tension from abscess or tumour was made. He died on October 6th. Operation and \textit{post-mortem} examination were refused. Possibly this was a case such as Hughes describes, p. 124, Case 15, of which the following are notes¹:—

"Cerebro-spinal irritation with fatal intracranial pressure, high fever twenty-five days, then delusions for four days, ‘rheumatic’ pains nerves of legs, remittent fever till forty-fifth day, then intermittent. Exacerbation one hundred and second day. Mentally irritable, sleepless, shooting pains in head. One hundred and twelfth day, headache very severe, reflexes exaggerated, hyperaesthesia, rambled in conversation. One hundred and thirteenth day, unconscious for most part. One hundred and fifteenth day, blind left eye, left pupil enlarged, ptosis and divergent strabismus. One hundred and sixteenth day, coma deepened; died; no past syphilis. \textit{Post-mortem}.—Brain much congested, soft and oedematous at base. Excess of cerebro-spinal fluid. Lymph on choroid plexus. \textit{M. melitensis} from brain."

A third cerebral case very similar to the above has not been inserted in the above statistics, because at the time of framing them I believed

that the condition was not secondary to undulant fever. Before death this case passed into the hands of a medical practitioner in another part of South Africa, who attributed the fatal issue to arterio-sclerosis, which I had failed to observe. Lieutenant-Colonel Birt, on receiving notes of the case from me, expressed the opinion that death was due to M. melitensis meningitis, and furnished me with the above notes from Hughes.

It is a remarkable fact that enlargement of the spleen was detected in only four cases. Perhaps this was due to the incompetency of the diagnostician. Even in typhoid fever, I have in the majority of cases failed to detect enlargement of the spleen. This condition receives so much prominence in classical descriptions of both undulant fever and typhoid fever, that I have grave doubts as to my own ability to exclude enlargement of the spleen. When a positive conclusion has been come to, one is usually on safer ground.

The appearance of the tongue is worthy of remark. During the first few weeks of fever it was generally clean and red at the edges and tip, and elsewhere covered with a light silvery fur. In the worst cases it was thickly coated with white, was large and flabby, showing indentations. In only one case, in which pneumonia was present, was the coating brown. In the vast majority of the cases the tongue was clean and red during the later and greater period of the illness. In a few, although clean and red, it was dry, shining and cracked.

Children seemed to suffer least, notwithstanding that in them the pyrexia was most acute. One girl, aged 10, was seen four times in succession at intervals of a week. On these occasions the temperature ranged between $103^\circ$ and $105^\circ$ F. Nevertheless the tongue was clean, red, and moist, the appetite was good, and nothing was complained of except the hardship of being kept in bed. A boy, aged 11, was found going about with an evening temperature of $104^\circ$ F. In this case there was slight lameness from pain in one hip.

The character of the pyrexia corresponded in all respects to that usually described in the literature of Mediterranean fever. Among the few continuous charts which one was enabled to obtain, some show distinct undulations, others are extremely irregular. The pyrexia varied in duration from a few weeks (in children) to eighteen months or two years (in some adults). In cases lasting under three months it was usually continuous. In those of much longer duration there were intermissions and relapses.

The serum reactions may be briefly summarised as follows: tested by Dr. Edington and Dr. G. W. Robertson:

- 34 sera in dilution 1 in 10 to 1 in 50.
- 25 positive with M. melitensis.
- 3 positive with B. typhosus.
- 5 negative with both.

By Lieutenant-Colonel Birt 54 sera from Philippolis and other dis-
districts in the Orange River Colony and in Cape Colony have been found to give positive reactions since August, 1905. Of these thirty were from cases that had recovered, and had been well for periods varying from a few months to eighteen months. The average dilution for a complete or almost complete reaction in this series was 1 in 37. The remaining twenty-four sera were taken from cases during the progress of the disease. In this series the average dilution for a reaction complete or almost complete was 1 in 242. If the figures of the agglutination limits are taken, a much higher average is obtained. I was enabled to test all the latter myself through the kindness of Lieutenant-Colonel Birt and Dr. G. Dean, of the Lister Institute, who have kept me supplied with reliable emulsions of M. melitensis and B. typhosus. During the year, September, 1905, to 1906, only three sera reacted positively with the B. typhosus in my practice.

All of the tests recorded above were efficiently controlled, sera from normal individuals and from cases of typhoid fever and rheumatic fever being used on various occasions as controls in dilutions 1 in 10, with uniformly negative results.

The testing of sera to their agglutination limits naturally involves more trouble and a larger expenditure of the emulsion used. For diagnostic purposes it appears to be quite sufficient to test a serum against the M. melitensis in dilutions of 10, 30 and 60, provided a reliable emulsion is used. By a reliable emulsion is meant one which is not agglutinated or sedimented in a dilution of 1 in 10 in twenty-four hours by serum from an individual who is not suffering, or has not suffered, from undulant fever, and which is not auto-agglutinable. According to Birt and Lamb, a complete reaction in 1 in 10 is diagnostic of undulant fever past or present. This they proved by finding the result negative in 150 sera taken from as many individuals, forming a group representing fifty cases of normal health and 100 cases of various diseases other than undulant fever. Fleet-Surgeon P. W. Bassett-Smith, R.N., more recently, working with a dilution of 1 in 30, found absolutely negative results in 150 cases, representing forty-one different diseases other than undulant fever, with four exceptions, which, on further investigation, were found to prove the rule.

If too high a dilution be used the reaction may be missed altogether, especially in chronic cases, as pointed out recently by Captain Crawford Kennedy, R.A.M.C., and Fleet-Surgeon Bassett-Smith, R.N. There seems to be a rooted prejudice against the use of low dilutions, based perhaps upon the findings of some who have worked with unreliable

1 Birt and Lamb, Lancet, September 9th, 1899.
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I have seen two reports from two separate government laboratories in south africa, in which this attitude is shown. the first was on a sample of blood sent by Dr. D. Campbell, at Johannesburg, from a case which had been sent down from Pietersburg (transvaal) diagnosed malaria. Dr. Campbell requested that the blood should be tested for typhoid and for Malta fever, because there was a history of two months' fever with muscular pains and no rigors.

the following is a copy of the report: "this serum does not give the Widal enteric reaction. M. melitensis was agglutinated in a 5 per cent. dilution, but not in a 1 per cent. this is probably not diagnostic."

the last statement can be based only upon a want of confidence in the culture used. there is no mention of controls. unfortunately the patient passed out of Dr. Campbell's hands into one of the hospitals, and Dr. Campbell, who left south Africa shortly afterwards, was unable to give me the further history of the case.

the other report was on a sample from a very chronic case from Barkly West, Cape Colony. Here 1 in 60 was the lowest dilution used, and the diagnosis was pronounced doubtful, owing to the feebleness of the reaction. Lieutenant-Colonel Birt's report on this patient's serum was as follows:—

to "native David" M. melitensis.

Ten complete, 20 nearly complete, 40 marked, 50 marked, 80 trace, 160 nil.

control. Normal human serum.

\[
\begin{array}{c}
10 \\
20 \\
40 \\
80 \\
160 \\
\end{array}
\]

"Native David," resident in Philippolis District, was the individual from whose blood the culture used was grown.

the following quotation from Dr. F. M. Sandwith's "medical diseases of Egypt," on the value of the Widal reaction in enteric fever, is applicable almost without qualification to the analogous test for undulant fever: "A good clinician will soon learn to believe its positive results without putting too much faith in negative reports."

Birt and Lamb have shown that the information which can be gained by testing a serum periodically to its limits is of great prognostic value. This means of prognosis is probably second only to the ascertaining of the opsonic index, and can be much more easily used by the general practitioner.

Stronger evidence than the results of serum testing can now be brought to the support of my present thesis. In February, 1905, Dr.

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1 Birt and Lamb, Lancet, September 9th, 1899.
Targett Adams,\footnote{Strachan, Brit. Med. Journ., July 15, 1905.} of Bloemfontein, reported to me that he had isolated the \textit{M. melitensis} from the blood of one of my patients, and in March, 1906, Lieutenant-Colonel Birt, at London, succeeded in isolating cultures of \textit{M. melitensis} from two blood samples sent from Philippolis; one was taken from a white youth, the other from a native. These cultures were found to be identical with the \textit{M. melitensis} in kind, the only difference being a somewhat higher degree of agglutinability than that exhibited by the Mediterranean strain when tested against serum from South African cases of undulant fever.

**MODE OF THE TRANSMISSION OF THE DISEASE.**

Although in many instances whole families became infected, the mode of transmission was probably not by direct contagion. There is abundant evidence to show that in undulant fever this mode is a rare one. Owing to the recent discoveries in Malta, one's attention was naturally turned to the goat as a probable factor in the spread of the disease. In the district of Philippolis there is a strip of mountainous country about ten miles wide bordering the Orange River. It was thought that the greater prevalence of undulant fever in this portion of the district might be explained by the fact that here grazing is unsuitable for sheep and the stock consists principally of goats. It was found that the vast majority of those who suffered from the fever had been in the habit of drinking goats' milk in their coffee. The milk was not usually boiled in the coffee, but was added to it unboiled.

In October, 1905, blood samples from fourteen goats were collected at a farm 29 miles north-west of Philippolis, and a few hundred yards from the Orange River, where a whole family had been infected. These were sent to Pretoria to Lieutenant-Colonel Birt, who was on the point of leaving for England. They were tested by him in England, and only one gave a positive reaction, complete in 1 in 20.

In February, 1906, one case of undulant fever was encountered at the farm, Hottentotspoort, about seven miles west of Philippolis. The duration of the illness could not be determined accurately from the history given. It was ascertained that only twenty goats were being milked. A blood sample from each of these was tested in dilution 1 in 20. The serum of only one goat gave a positive reaction. The following day I went to the farm and took two more blood samples and two milk samples from this goat. The milk was collected in the house with somewhat rigid aseptic precautions. Samples of the blood and milk were sent to Lieutenant-Colonel Birt, London, and to Major Buist, Pretoria. Major Buist reported: Serum positive in 1 in 100; milk sterile. Lieutenant-Colonel Birt reported: Serum positive up to 1 in 40; milk sterile.

About three miles west of Hottentotspoort is the farm Kleinpaarden-
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fontein, on which live three families. Between the end of December, 1905, and February, 1906, I came across seven cases of undulant fever on this farm distributed as follows: Family P., five cases. Family B., senior, none. Family B., junior, one case; native servant, one case. All three families had herds of goats numbering several hundred. Family P. was said to be using milk from seventeen goats. Blood samples from all of these were found to give negative reactions in dilution 1 in 20.

Now Family B., senior, had hired a portion of the farm from P., in May, 1905. Formerly they had lived at a farm twenty miles north-west of Philippolis, and I found two members of this family suffering from undulant fever in November, 1903. It was therefore decided to examine some of the goats belonging to B., senior. First ten blood samples were tested in dilution 1 in 10. One gave a positive reaction, which on further testing was found to be complete up to 1 in 40. Samples of the blood and milk of this goat were sent to Lieutenant-Colonel Birt and to Major Buist. The milk was thin, serous and very scanty. The blood reaction was confirmed by both officers.

Lieutenant-Colonel Birt tested the milk also against an equal amount of M. melitensis emulsion, and found the reaction positive. He failed to get a culture of M. melitensis from the milk, the plates becoming overgrown with saprophytes. The capsule containing the milk sent to Pretoria broke in transit.

A few days afterwards it was decided to do the milk agglutination test with milk from twenty more of B.'s goats. The method adopted was the hanging drop, an equal amount of milk and emulsion being used, the drops being kept for twelve hours before coming to a negative conclusion. As the emulsion contained 0.5 per cent. phenol, it was not considered necessary to add an antiseptic to the milk. Immediately after my return from the farm I put up ten samples in this manner. No. 10 was a thin, serous milk, and clumping all over was complete in half an hour. Samples of No. 10 were immediately posted to Pretoria and London. After twelve hours only a narrow margin of the other drops could be examined, owing to the presence of oil globules. Clumping round the margin was observed in Nos. 1, 3, 6 and 9. Next day, the cream having separated, all the samples except No. 10 were put up in hanging drops. The following was the result: Nos. 1, 6, 9, 11, 14, 19, positive in half an hour. Nos. 3, 18, positive after twelve hours. No. 12, feeble reaction after twelve hours.

Thus nine out of the twenty gave a positive reaction and one was doubtful.

The positive samples were sent to Pretoria along with two negative controls. They arrived fermented. Major Buist found practically the same results as I did, but expressed doubts as to their value, owing to the state of the milk. Regarding sample No. 10, which was sent first, he had no doubt.
In the "Reports of the Commission on Mediterranean Fever," Part IV.,1 the conclusion is come to that the milk test is reliable. In no case in which the milk test was positive was the blood test found to be negative, although some cases of the converse occurred. On the other hand the probability is that the milk test as applied by me was not reliable; for 50 per cent. of one group gave positive reactions with the milk test, while only 10 per cent. of another group from the same herd reacted positively when the blood test was used. It is to be regretted that the individuals of the former group were not marked so that the behaviour of their sera might be ascertained afterwards.

Although no cultures of M. melitensis have yet been grown from the milk or blood of South African goats, the serum reactions obtained here, coupled with the abundant evidence as to the culpability of the goat collected in Malta, render it probable that the goat is a factor in the spread of the disease in South Africa, and may have been the medium through which the disease was introduced to the country. Some fruitless efforts were made to obtain information from the Agricultural Department of Cape Colony regarding the periods at which goats were imported into South Africa, and the countries from which they were imported.

It has been proved by the Commission on Mediterranean fever that dust infected with the urine of men and animals can act as a carrier of the disease.2 There is also some evidence that mosquitoes can act as carriers of the germ, and it has been proved that they can infect animals.3 There is also some circumstantial evidence tending to show that man can be infected through the bite of a mosquito. In the district of Philippolis mosquitoes are not much in evidence, and can hardly be said to give serious trouble, unless it be during that rainy season which we have yet to see.

Distribution of Undulant Fever in South Africa.

With the object of ascertaining the distribution of undulant fever in South Africa, circulars were sent to medical practitioners in the Karoo portion of the Cape Colony, the Orange River Colony, Basutoland, Natal, and the Transvaal. A brief clinical description of undulant fever (after Birt and Lamb) was given, information as to the presence or absence of this type of fever, and as to the habits of the population in regard to goats' milk was requested, and an offer was made to test blood samples from suspected cases. So far as possible, a circular was sent to at least one practitioner in each district, with a request that it should be brought under the notice of neighbouring colleagues.

2 Ibid., pp. 76, 81, and 187.
3 Ibid., pp. 76, 81, and 187.
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The following are the dates of sending, numbers sent, and number of replies received from each colony:—

<table>
<thead>
<tr>
<th>Date</th>
<th>Colony</th>
<th>Number sent</th>
<th>Number of replies</th>
</tr>
</thead>
<tbody>
<tr>
<td>March 13th, 1906</td>
<td>Cape Colony</td>
<td>47</td>
<td>25</td>
</tr>
<tr>
<td>June 12th, 1906</td>
<td>Orange River Colony</td>
<td>62</td>
<td>22</td>
</tr>
<tr>
<td></td>
<td>Basutoland</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>July 10th, 1906</td>
<td>Natal</td>
<td>30</td>
<td>8</td>
</tr>
<tr>
<td>July 16th, 1906</td>
<td>Transvaal</td>
<td>42</td>
<td>14</td>
</tr>
</tbody>
</table>

In Cape Colony the disease has been recognised clinically at Clanwilliam, Hopetown, Prieska, Upington, and Griquatown. The diagnosis has been confirmed by the agglutination test applied to two blood samples from Murraysburg, two from Richmond, two from Kenhardt, and one from Barkly West. There was some doubt whether the last case was not imported from the Orange River Colony.

Cases of “camp fever” were reported to have occurred in Kimberley during last season, but there was a difficulty in getting blood samples, because most of the patients had been sent to the coast. The question whether there is a disease, “camp fever,” at Kimberley, which is neither undulant fever nor typhoid, has long remained unanswered. I have reason to believe that it will be investigated on the spot during next season.

In the Orange River Colony the disease has been recognised clinically at Bethulie, Springfontein, Luckhoff, Koffyfontein, Reddersburg, and Vrede. The information regarding Reddersburg was given by Dr. Jones, of Barkly West, who said he had met with many cases at Reddersburg in the early nineties. The coincidence of positive and negative opinions at Koffyfontein requires explanation. Here there was a difference of notions about the same cases. Unfortunately, the gentleman in charge, who gave a negative opinion, could not be induced to send blood samples that the blood might be put to the test, notwithstanding repeated applications.

The diagnosis has been confirmed by the agglutination test applied to sixty-two blood samples from Philippolis, two from Fauresmith, and eight from Senekal.

Considering the prevalence of undulant fever in the south of the Orange River Colony, it is to be regretted that nothing can be said about the neighbouring portion of Cape Colony. Correspondence with Petrusville was broken off before a definite decision could be come to, and no replies were received from Philipstown, Colesberg or Aliwal North.

By the medical officers at Leribe, Maseru and Mohalieshoek, undulant fever is believed to be endemic in Basutoland.

The replies from Natal were all in the negative.

In the Transvaal undulant fever has been diagnosed clinically at Belfast and at Zoutpan.

Negative reactions were found in one blood sample from Boksburg (Transvaal), one from Leribe and one from Mohalieshoek (Basutoland), and one from Pietermaritzburg (Natal).
In concluding this section I have to tender my thanks to those gentlemen who were so kind as to supply me with information and material.

The period during which undulant fever has been endemic in South Africa is very uncertain. I have been informed by Dr. Long, of Maseru, that Dr. M. E. Leister, now practising in Lerryn, Cornwall, England, recognised the presence of undulant fever in the Orange Free State and Basutoland twelve years ago. Dr. Heinrich, Murraysburg, Cape Colony, has been meeting with cases of this type for nearly eight years, i.e., the whole period of his residence at Murraysburg. Dr. Gibbon, of Prieska, reported that he had seen cases of this type many years ago, but that the disease is not endemic at Prieska now.

In the British Medical Journal, 1901, p. 941, Washbourn described two cases which he believed to resemble Malta fever more closely than any other disease. The clinical evidence presented by these cases does not exclude enteric fever, as it is met with in South Africa. Pyrexia in the one lasted only four or five weeks, in the other six or seven weeks. In both there was diarrhoea at the outset, and the motions were occasionally liquid or pultaceous during the course of the fever. In one the tongue was for the most part clean, and, so far as my experience goes, this is an important feature in many cases of undulant fever. Dr. Dodgson found the sera of both these patients negative to typhoid, and positive to Malta fever. Too much importance may be attached to the negative reactions, but if the positive tests were properly controlled, there can be no doubt about the diagnosis.

It is generally believed that several anomalous types of disease exist in South Africa. In the differentiation and assignment of these to their proper places, considerable progress has recently been made. Every step in that direction renders the remainder of the problem simpler. Here it seems advisable to discuss the question as to the identity or non-identity of undulant fever with diseases hitherto regarded as anomalous, whether as types of well-known diseases, such as typhoid fever, or as not being embraced under the established nomenclature of medicine.

Typhoid Fever.—That the prolonged symptomless forms of typhoid fever and undulant fever may be clinically indistinguishable throughout, there can be little doubt. That acute forms of both may at the outset be indistinguishable without a bacteriological test, is also extremely likely. That many cases of undulant fever have been returned as typhoids in the past is certain. My certainty is based upon the knowledge of my own erroneous practice for a year, and upon the confessions of others.

Malaria.—Malaria has been called “the refuge of ignorance.” To distinguish undulant fever from malaria we have the bacteriological tests, the absence of rigors, the absence of benefit from quinine. The mistake of failing to make the distinction is more likely to be made in parts of South Africa where malaria is not endemic, than where it is well known.
Rheumatic fever is extremely rare in the district of Philippolis. I know not what its incidence is in other parts of South Africa where the climatic conditions are similar. Cases of undulant fever are diagnosed "rheumatic" in other parts of the world, and it would be strange if the same mistake were never made in South Africa. The Dutch names applied to undulant fever in Philippolis, if similarly applied elsewhere, may have been responsible for some confusion. These are "slepende koorts," and "zinking" or "zinkend koorts." Both are well suited to undulant fever, the former being applied to comparatively symptomless cases, the latter to the neuralgic forms. Now I understand that where malaria is endemic it is called "slepende koorts," and where rheumatic fever prevails it gets the name "zinking koorts."

Beri-beri.—A neighbouring practitioner was disposed to regard the Philippolis cases of undulant fever as beri-beri, until the contrary was proved. Doubtless the diagnosis of beri-beri where there is much neuritis and paraplegia would be a pardonable sin. On the other hand, few can doubt that the cases in Johannesburg described by Turner and Miller were cases of true beri-beri. Certain more obscure cases of neuritis, which they did not feel justified in including in the series, might have been cases of undulant fever.

Epidemic Neuritis.—The cases of this type, described by Dr. John Muir, are extremely puzzling, and seem to belong to no known category. The neuritis appeared several months after an epidemic of a disease resembling ptomaine poisoning, in which there had been a very high mortality.

Camp Fever.—Reference has already been made to the question whether there is an entity at Kimberley which requires to be classified separately. Dr. Mackenzie's paper on "Camp Fever" presents a good clinical picture of undulant fever. Dr. Mackenzie recognised the closeness of the analogy. This disease he stated to be prevalent over the whole Karoo, as well as in Kimberley. Dr. Mackenzie felt convinced that cases of scurvy in the mines were often associated with this fever. A similar association of scurvy with beri-beri has been noted.

Where anomalous types of scurvy occur in the future it is to be hoped that the claims to recognition of undulant fever and beri-beri will receive due consideration.

That primary uncomplicated scurvy has occurred in South Africa has been shown conclusively by Dr. N. McVicar and by Dr. D. M. Macrae, who has recently sent a paper on the subject for publication to the British Medical Journal.
Treatment.—Till quite recently the treatment of undulant fever was purely symptomatic. Dr. Reich,1 of Senekal, has reported very favourably on the intravenous injection of collargol as a remedy in Mediterranean fever. He recommended an injection of 10 cc. of a 2 per cent. solution daily for three or four days. I have received his permission to state that, owing to severity of reactions experienced (vomiting and rigors), he has reduced the dosage and frequency as follows: 5 cc. every second day until four injections have been given. The treatment by injection of vaccines, i.e., killed cultures of the virus, has been favourably reported on by Reid. It is based on the opsonic theory of Wright. The general practitioner would find it difficult to apply this treatment, for it involves the determining of the opsonic index from time to time in order that the effect of the injections may be gauged. If the strength of the agglutinins in the serum bears a direct relationship to the opsonic index, the procedure might be simplified by substituting the determination of the former for that of the latter.

Both the above-mentioned methods of treatment cannot be carried out unless the patient lives within a reasonable distance of his attendant. I have not yet had an opportunity of giving either a fair trial.

In conclusion, the main object of this paper is to show that undulant fever is widely distributed in South Africa, where it has been endemic for many years. That in all probability the importation of infected goats explains its introduction to this country, and that the goat is now one of the agencies through which it is spread.

To Lieutenant-Colonel Birt I owe a deep debt of gratitude for having ungrudgingly examined and reported on all the material sent to him, thus stamping the grounds of my conclusions with the great weight of his authority as a bacteriologist and pathologist.

[Note.—Since writing the above paper I have been informed by Lieutenant-Colonel Birt that he has succeeded in getting pure cultures of M. melitensis from two more blood samples sent by me in August. —P. D. S.]

1 F. Reich, M.D., Transvaal Medical Journal, June, 1906.