MALTA FEVER IN SOUTH AFRICA.

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AND
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Paper by Dr. Strachan.

The following introduction to Lieutenant-Colonel Birt's paper on Mediterranean fever in South Africa is intended to serve as a brief summary of the advances made by the writer in the study of this disease since September, 1906, and as a supplement to a paper on "Undulant Fever in South Africa," published in the *South African Medical Record* of December 10th, 1906, and reprinted in the Journal of the Royal Army Medical Corps, July, 1907. In that paper all the aspects of the subject which seemed important were treated more or less fully, according to the amount of material at the writer's disposal. Here only those aspects will be considered in which subsequent experience has rendered modifications necessary or additions possible. The bacteriological section, in which the greatest progress has been made, will be left almost entirely to Lieutenant-Colonel Birt, to whose efforts this progress is mainly due.

Symptomatology and Semeiology.

In September, 1906, an analysis of 138 cases of the disease was made with a view to finding the case percentages of the various symptoms, complications, and sequelæ. It was found that these, with few exceptions, agreed very closely with the statistics of Hughes. The number of cases that have come under observation in this district since September, 1906, is 99, in all of which the serum test was applied. Little or no change would be made in the statistics by incorporating these later cases in them. There is reason to believe that the percentage of ambulatory or almost symptomless cases recorded ought to be higher; for in the summer season, 1907 to 1908, a severe epidemic broke out in the town of Philippolis for the first time, and many ambulatory cases came under observation. It is safe to say that at the outlying farms a large proportion of the ambulatory cases are not seen by medical men.

Hughes says that sexual potency is not diminished during the

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course of the disease, and that pregnancy is not interrupted. The writer knows of one case in which a healthy child was begotten by a male during a severe and protracted attack of Mediterranean fever. This gentleman lost 80 lb. in weight in six months. Needless to say he could afford the loss. On the other hand, abortion occurred in two cases during the course of the disease, and in another during convalescence. In six other cases, four white and two negro, the patients were found to be suffering from Mediterranean fever immediately or shortly after parturition. The babies apparently did not suffer from the disease. The sera of two of the babies, one white and one negro, were tested by Major J. E. McNaught and found to contain the specific agglutinins. Milk from the mothers of these two contained the specific agglutinins, but *Micrococcus melitensis* was not recovered, contaminations being present. Where Mediterranean fever complicates the puerperal state grave apprehensions of septicæmia, or pelvic suppuration are apt to arise, unless the correct diagnosis is made. Often this can be done with certainty only by means of the agglutination test, or by cultural experiments.

Several cases of Mediterranean fever occurring in children only 2 years old were noted. In such young subjects the early stage of hip-joint disease is apt to be simulated.

Among the ninety-nine cases here recorded the mortality was three. One married woman, aged 36, and another, aged 63, died of broncho-pneumonia. A man, aged 49, died during apparent convalescence after a chronic attack lasting eight months. He suddenly began to suffer from shortness of breath, which he attributed to a fright. The breathing continued to be abnormally rapid (40 to 60 per minute) for eight days without pyrexia or physical signs of disease in the lungs. On the eighth day the temperature went up to 103°, and fine crepitations were audible at the bases of both lungs. He died cyanosed at 4 a.m. on the ninth day. This condition was perhaps due to some irritation of the respiratory centre. Bromides and iodides were given without effect. Chloral hydrate might have proved more useful.

Epidemiology.—As has been stated above, during the season 1907-08 there was a severe epidemic of the disease in the town. The cases in the western half of the district, where the disease was first observed, were fewer than usual, while there was an increase in the number in the eastern half. There were abundant opportunities for working out the epidemiology of the disease, but unfortunately the severity of the epidemic, and the exigencies of

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private practice consequent thereon, left little time for epidemiological work, or even for a proper clinical study of the disease. The work which was undertaken, over and above that inseparably connected with the duties of a medical practitioner, was therefore meagre in the extreme.

In October, 1907, at a small holding on the commonage, about a mile to the north of the town, two members of a family, S——, were found to be infected. This family had a numerous herd of goats. They drank the milk themselves and also sold it in the town. Subsequently two other members of this family became infected. In the town fresh cases continued to appear from October, 1907, to March, 1908, a period which coincides fairly closely with the usual seasonal distribution of the disease here. Most of the infections in town could be traced to milk supplied by the S. family. A few were traceable to goat's milk from other sources, and a few could not be traced to goat's milk at all. In one family, B——, the father, the mother, and two sons, in fact the whole household, became infected. They drank no goat's milk, and kept no goats on the premises, but they had two milch cows kept by the S. family, and milked in a kraal adjoining the goat kraal. It was not until April, 1908, that the writer examined one of these cows, the other having disappeared, and nine of S.'s goats. The cow's serum gave a positive reaction almost complete in 1—10, Major McNaught found it complete in 1—10 and well marked in 1—20. Of the goats, two Angoras and one hairy goat (called Boer-bok) gave positive reactions in 1—10. In another family in town one member only, a girl, aged 19, became infected. They owned no goats and bought no goat's milk. They used the milk of one cow kept on the premises. This cow's serum gave a negative reaction.

In the natives' location three members of one family, J——, his wife, and his child were found to be suffering from Mediterranean fever. They kept one milch goat. This goat's serum was found to react in high dilutions. The writer using dead cultures, obtained a well-marked reaction at 1—40; but Major McNaught and Major Statham got as high as 1—200 with living cultures. After a delay of nearly three months, over which the writer had no control, Major Statham received the goat alive at Pretoria. He failed to get cultures of *M. melitensis* from the blood and milk, but on slaughtering the animal he got a culture from the spleen.

S., J.'s brother, had two goats kept in the same enclosure as J.'s. The writer found the serum of these negative. Major

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McNaught found one positive in low dilutions. S.'s wife became infected in November, 1907.

In December, 1907, Dr. D. M. Macrae found a native youth in the location infected. This youth suffered from aphasia for a month just before convalescence. His father kept ten milch goats. The sera of all these were examined by the writer. Four were found to give complete clumping of *M. melitensis* in dilutions of from 1—10 to 1—40.

Dr. E. W. Robertson, of Cape Town, and Major McNaught, using living cultures, got six positive reactions, three doubtful, and only one absolutely negative out of the ten. The goat giving the strongest reaction was sent alive to Dr. Robertson at the Cape Government Laboratory in January, 1908. At the time of writing no report on this goat had been received from Dr. Robertson. Lieutenant-Colonel Birt, however, got a culture of *M. melitensis* from a small blood sample from the same animal. The writer asked Dr. Robertson to publish his own results, which may appear at a later date, if anything positive has been achieved.

From the researches of the Malta Fever Commission, and the striking result of preventive measures carried out at Malta, it would appear that, so far as man is concerned, the swallowing of infected milk is practically the only mode of infection. Experiments on monkeys with naturally infected dust were negative. How do goats and cows become infected? If man can be infected naturally by inhaling or swallowing dust, such a mode of infection must be more common among a pastoral people than among troops or seamen.

The seasonal distribution here is easily explained. The kidding season begins at the end of July. By September all the female goats are in full milk. By December they begin to dry up, but those milked by hand can be kept in milk many months longer. In the winter months the animals are pregnant and dry.

Here the same incredulity prevails which is found among the civil population at Malta. The posting up of warning notices had no effect. The writer received the whole credit of the fantastic notion that the goat, "een van de gezondste van dieren" (one of the healthiest of animals), "could cause slepende koorts." Were not its excrements used as medicine and its bowels as poultices with the best results. Compare such remarks with Colonel Bruce's dramatic paper, "The Extinction of Malta Fever." The class incidence of the disease here is the reverse of what it used to be in the garrison of Malta. Social distinctions, if they exist here at

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all, are a matter of riches and poverty. Among the Boers the spoken and unwritten language of rich and poor is the same, and where elevations are impossible there can be no depressions. Malta fever is pre-eminently the poor man's disease, as the goat is his stock. Natives and poor whites appear to be equally liable, the rich seldom contract the disease.

Geographical Distribution. — Mediterranean fever has been proved by clinical evidence and the agglutination test to be present in the following places in addition to those enumerated in 1906: Hanover, Beaufort West, and Steytlerville (Cape Colony), Gaberones (Bechuanaland). The medical men who have diagnosed the disease and proved its existence in these places are the following in order: Drs. Broadhust, Bensby, A. Garrow, and D. M. Macrae. In the report by the Medical Officer of Health for Cape Colony, Dr. Gregory, on the Public Health for the year 1906, are included summaries of the District Surgeon's Annual Reports. From these it appears that Mediterranean or undulant fever occurs in many parts of Cape Colony, including Kimberley. Dr. William W. Stoney, District Surgeon of Kimberley, states that undulant fever undoubtedly exists in Kimberley, and has been recognised as such for many years. He has confirmed his diagnosis by the agglutination test in various cases since 1900.

Treatment.—On treatment the less said the better. Perhaps therapeutics is the least exact of all the inexact sciences on which medicine is based. Certainly the therapeutics of general practice in a South African country district are anything but exact. Patients are seen at such irregular intervals that no scientific inductions can be made.

In 1906 to 1907 injections of *M. melitensis* vaccine were tried on several cases, from 500 to 1,000 million dead germs being injected into different sites at intervals of a week. Three chronic cases recovered rapidly. On the acute or early stage cases no effect was observed. In 1907 to 1908 a paper by Fleet-Surgeon McNabb on the use of cyllin in Mediterranean fever came under the writer's notice. This substance is manufactured by the Jeyes' Sanitary Compounds Company, and put up in 3-minim capsules for stomach or intestinal use. Presumably, the intestinal capsules are not soluble in the stomach. Cyllin is said to be an almost non-toxic, powerful antiseptic, the whole of which is recoverable from the fæces. It is difficult to explain the beneficial action in Mediterranean fever of an intestinal antiseptic which is not absorbed into the blood-stream, unless it be on the ground that physiological

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antiseptics, which are naturally used up in fighting the intestinal flora, are set free to be absorbed into the blood-stream and there to fight the *M. melitensis;* or on the assumption that the products of the intestinal flora hinder in some way the production of antibodies.

The writer used cyllin intestinal capsules (or palatinoids as they are called by their makers) in doses of from three to six daily on a large number of cases: very irregularly, it must be confessed. If a chronic case be defined as one which lasts more than four months, then there were four chronic cases during the season 1907 to 1908. Of these, three refused the capsules after taking a few, on account of a burning sensation which they produced. The fourth lived at a distance and did not report himself or apply for more medicine after he had taken two dozen. One man, who misunderstood the directions, took a bottle of one hundred at the rate of twelve daily. He felt so well at the end of a week that he thought he was cured; but he had a severe relapse some weeks later.

Three children in one family, aged 9, 10, and 11, were kept in bed and treated continuously with cyllin at the rate of three at first and later six daily. All three had a typically undulant acute pyrexia, the temperature often going above 104°. There were no other signs except slight wasting in two and extreme wasting in the third. Their tongues were perfectly clean, red and moist, and their spleens were slightly enlarged. The serum of all three reacted in high dilutions, and from the blood of one Lieutenant-Colonel Birt grew a culture of *M. melitensis.* The duration of the pyrexia was twenty-six, forty-four, and forty-one days respectively, from the beginning of the treatment. The numbers of waves were respectively 2, 3½, and 4. In all three the pyrexia terminated rather suddenly with a subnormal morning temperature for a week or more.

On February 11, 1908, a young lady at a distant farm was found to have acute pyrexia with pain in the left iliac fossa. Here a somewhat large fluctuant tumour was made out. Her serum was found to agglutinate the *M. melitensis* in a dilution of 100. In a few days the tumour was found to be enlarging rapidly. On February 21 the patient was operated upon by Dr. Flockemann, of Bloemfontein, assisted by the writer, Dr. Ross, of Fauresmith, acting as anæsthetist. Both ovaries were found to be cystic, and had to be removed. The patient remained in hospital for a month, during which the cyllin treatment was given. The temperature curve was complicated by the presence of a deep-seated stitch

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abscess. After this was healed there was no pyrexia, and the patient returned to the farm cured. On the day on which she left a sample of her blood was taken. Lieutenant-Colonel Birt found a marked falling off in the agglutinins. Nevertheless, there was no relapse. Indeed, the lady contemplates matrimony at an early date.

It may be mentioned that the large ovarian cyst was full of dark altered blood. Perhaps it acted as a reservoir of agglutinins.

In no case was a rapid specific effect observed to follow treatment with cyllin. All that can be said is that the duration of the pyrexia appeared to be shortened.

Aspirin in doses of 5 to 10 grains was found very useful in combating the neuralgic pains, the only objection to its use being its powerful antipyretic and diaphoretic effects when given during pyrexia.

In conclusion, the writer has to express his thanks to his partner, Dr. D. M. Macrae, who supplied him with notes on his cases, to Major Statham, Major McNaught, and Dr. E. W. Robertson, who did some of the bacteriological work, and lastly, to Lieutenant-Colonel Birt, whose contribution follows.

Paper by Lieutenant-Colonel Birt, R.A.M.C.

To Dr. P. D. Strachan will remain the credit of being the pioneer in the differentiation of the fevers of South Africa. He has been the first to make a serious study of Malta Fever as it exists there. His clinical acumen pointed out its probable prevalence and he was quick in taking bacteriological measures to confirm his suspicions. He has resolved what was an ill-defined nebular into a sharply cut image. His paper, to which the foregoing is a sequel, was reproduced in the Journal of the Royal Army Medical Corps of July, 1907, vol. ix., p. 83. It is of abiding merit.

His partner, Dr. D. M. Macrae, also has given an excellent description of the fever drawn from his own observations (*South African Medical Record*, February 25, 1908). He lays stress on the frequency of the ambulatory type. The clean tongue, or one coated with thin silvery fur, he recognised as an important guide to diagnosis. Pulmonary congestion, in some cases with intense intercostal pain, may suggest pneumonia; in others he has seen appendicitis simulated. He remarks that rheumatism, either acute or chronic, is a rare ailment in the Orange River Colony, hence articular pains are indicative of Malta fever. In infants an erroneous diagnosis of hip-joint disease may be made.

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Dr. Strachan has been unwearied in supplying material for research. He has sent between 200 and 300 specimens of blood, pus, serum, milk, &c., most of which he himself has tested. Our results throughout have been almost invariably concordant. As 63 per cent. of the samples have arrived in London free from contamination, Dr. Strachan's method of collection is instructive.

While making the glass capsules for the reception of the blood, he has sealed the ends, which he has broken off with sterile instruments at the moments of using. After washing the lobe of the ear with alcohol, and drying with sterile absorbent cotton-wool, he has withdrawn $\frac{1}{50}$ to $\frac{1}{10}$ cc. of blood from a puncture produced by a needle or the broken end of the glass capsule. On arrival in London the blood capsules have been opened with the usual precautions, the clot has been removed and placed on a glucose-nutrose-agar slope. A fivefold dilution of the serum in physiological salt solution has then been made. One part of this has been mixed with one of salt solution, and so on, till a series of dilutions, $\frac{1}{5}$, $\frac{1}{10}$, $\frac{1}{20}$, $\frac{1}{40}$, $\frac{1}{80}$, $\frac{1}{160}$, $\frac{1}{320}$, $\frac{1}{640}$, $\frac{1}{1280}$, &c., has been obtained. Hence, if one part of each of these be mixed with an equal volume of the emulsion of *M. melitensis* the amount of serum will have been reduced to $\frac{1}{10}$, $\frac{1}{20}$, $\frac{1}{40}$, $\frac{1}{80}$, $\frac{1}{160}$, $\frac{1}{320}$, $\frac{1}{640}$, $\frac{1}{1280}$, $\frac{1}{2560}$, &c. These have been drawn into glass tubes of about 1 mm. calibre, or, for the sake of convenience, have been sucked into one long pipette with the aid of an india-rubber teat, beginning with the highest dilution, with an air-bubble to separate it from the next, and so on. The results have been recorded at the end of twenty-four hours. There is, however, little change in the sedimentation after this interval. In the higher dilutions in which no clumping has occurred there is still even turbidity for a week or more.

To prepare the *M. melitensis* emulsions, recently isolated strains, mostly South African, have been grown on agar containing 1 per cent. each of peptone, glucose, and nutrose. The reaction has been such that 25 cc. of normal alkali solution have been required to produce neutrality to phenol-phthalein in 1,000 cc. of the agar. The length of incubation is immaterial; cultures of a fortnight or month give good emulsions. Physiological salt solution has been introduced into the tubes, and the micrococci have been removed from the agar and incorporated with the fluid by means of a glass filament. The *M. melitensis* is remarkable in making evenly turbid suspensions. This ability to emulsify so readily is of diagnostic importance, as has been noted by Horrocks. Sterilisation has been effected by heating to 55° to 60° C. for half

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an hour, after which 0·5 per cent. phenol has been added. Formalin is unsuitable as a preservative. Emulsions containing it become unreliable. The carbolised preparation has been proved to retain its properties unimpaired for two years. On every occasion before use the suspension has been tested with normal or non-specific serum, in a $\frac{1}{20}$ dilution of which no agglutination has been observed, and none, or traces only, in a $\frac{1}{10}$. A reaction, then, in a $\frac{1}{20}$ dilution of a serum is diagnostic of Malta fever, past or present. After long subculture, some strains of *M. melitensis* become agglutinable in saline fluid, or when not so clumped they may react to a mere trace of serum from any source. The necessity of controls with normal blood is apparent. Manipulations with the living microbe are fraught with danger. A large proportion of workers with it have been infected. But apart from the safety and convenience of using sterilised cultures there is another great advantage. Anomalous reactions are suppressed. If living suspensions are employed, it sometimes happens that a specific serum reacts when highly diluted, but may cause no agglutination if more concentrated. In an experience of between 2,000 and 3,000 agglutination tests with dead emulsions, no instance of such an inhibited reaction has come under my notice. The density of the emulsion has been measured by mixing it with an equal volume of water, and drawing it into a glass tube 1 mm. in internal diameter. The opacity should be well marked. This corresponds to about 50,000 million micrococci per cubic centimetre. Since several cubic centimetres of the suspension were prepared at one operation, the estimations of the agglutination were comparable with one another. The ratio of the number of bacteria to the volume of the emulsion is a factor in determining the clumping index of the blood. The simplicity of the sedimentation method with killed cultures, which involves no more apparatus than a few glass tubes and a small amount of a preparation which retains its activity for years, brings the diagnosis of Malta fever within the range of every practitioner.

The agglutinative value of the blood of 146 individuals in the course of the infection has been estimated quantitatively by means of successive dilutions until the limit was determined. In 59 to 40 per cent. this was $\frac{1}{20}$ to $\frac{1}{100}$; in 66 or 45 per cent. it was $\frac{1}{100}$ to $\frac{1}{1000}$; in 21 or 15 per cent. it was $\frac{1}{1000}$ to $\frac{1}{12000}$. The serum of 29 convalescents for two to eighteen months after Malta fever was tested. Twenty of these agglutinated the *M. melitensis* in dilutions of $\frac{1}{20}$ to $\frac{1}{100}$, and nine in dilutions of $\frac{1}{100}$ to $\frac{1}{1000}$. The clumping power of people in health or suffering from any ailment except

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Malta fever has been *nil* in $\frac{1}{20}$ dilution. The transit of the blood capsules from Philippolis to London has occupied about three weeks. The agglutinins may undergo some diminution in this interval, but the loss is not great. A serum six weeks old clumped the *M. melitensis* when diluted to $\frac{1}{12000}$. Eight weeks later its value was reduced below $\frac{1}{500}$. Two years afterwards it was still active, $\frac{1}{640}$. In thirteen samples of blood, the highest agglutinative value of which was determined by Strachan to be $\frac{1}{100}$; three to six weeks subsequently it was found to be the same in four, to have become reduced to $\frac{1}{80}$ in three, to $\frac{1}{40}$ in three, and to $\frac{1}{20}$ in three. In one, the original strength of which was $\frac{1}{50}$, it remained the same. In another it had been lowered from $\frac{1}{50}$ to $\frac{1}{40}$. All the above proved free from contamination on culture. The presence of other bacteria has little effect in impairing the agglutinative power of the blood. Thus a serum, the value of which Strachan determined as $\frac{1}{800}$, reacted in London $\frac{1}{1600}$, though contaminated. Another, of $\frac{1}{2400}$, was reduced to $\frac{1}{1600}$. One of the value of $\frac{1}{1600}$ was found to be $\frac{1}{40}$. Of six with an index of $\frac{1}{100}$, three reacted $\frac{1}{80}$, one $\frac{1}{40}$, and one $\frac{1}{10}$. Of seven with an original power of $\frac{1}{50}$ or $\frac{1}{60}$, six showed no reduction of the agglutinins, and in one the value was $\frac{1}{20}$. From all of the above, bacteria in great variety were grown. Moreover, a sterile specific serum has been inoculated with a staphylococcus. Its clumping power has not been diminished by the micro-organism. Blood in the dry state preserves its specific property for long. On the other hand, blood diluted with physiological saline fluid loses its agglutinins in a few days. A serum gave a complete reaction, $\frac{1}{200}$; the fivefold dilution of it was preserved till the following day, when it was again tested; no trace of agglutination was observed now in $\frac{1}{2000}$. From this it follows that an accurate diagnosis of Malta fever may result from the crudest methods of blood collection. A drop of blood squeezed from a pinprick of an uncleansed finger and dried on any fragment of paper will give infallible evidence of the infection.

Nevertheless, from a scientific standpoint it is desirable to isolate and identify the invading micro-organism. With this object in view, Dr. Strachan has withdrawn the blood under aseptic precautions and has attained sterility in 63 per cent. of his cases, as was mentioned above. Accordingly, it has been possible to obtain cultures of the *M. melitensis* from $\frac{1}{50}$ to $\frac{1}{10}$ cc. of the blood of thirty-three of the febrile cases, that is, in 22 per cent. In all except three instances it has been the only micro-organism present. The more rapid growth of contaminating bacteria suppresses the development

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of *M. melitensis* in the great majority of cases. These extraneous organisms have been *staphylococci*, *M. tetragenus*, *Bacillus coli communis*, *proteus*, *subtilis*, *mycoides*, *prodigiosus*, *torulæ*, and moulds, which have appeared on the surface of the agar twenty-four hours after inoculation. Now the appearance of the colonies of *M. melitensis* on the agar slope may be long delayed. This is shown on the following table:—

Period of incubation at 37° C. required before *M. melitensis* was visible, in days	2	3	4	5	6	7	8	14	17	20	34	41 days
Number of blood samples which gave growths of *M. melitensis*	3	6	7	7	1	2	2	1	1	1	1	1

Hence, though colonies of the *M. melitensis* appeared usually within a week of inoculation, yet it was not exceptional for a much longer interval to elapse, doubtless due to the coccus being buried in the centre of the clot of blood implanted on the agar slope. One of the cases from the blood of which the *M. melitensis* was recovered was complicated with enteric fever. The agglutinative index to the *M. melitensis* determined by both Dr. Strachan and myself was *nil* $\frac{1}{10}$. In another instance the patient had been ill for a long period, and the blood gave a trace of agglutination only in $\frac{1}{10}$ dilution, though the *M. melitensis* was present. Therefore, although a positive clumping reaction predicates the existence of the infection, yet the absence of agglutinins does not necessarily warrant us to exclude Malta fever. Such cases are unusual. Three only have come before my notice. The failure of the blood to react to the invading micro-organism is a sign of evil omen. The agglutinative power of the other specimens of blood which contained the *M. melitensis* was $\frac{1}{20}$ in two, $\frac{1}{40}$ in four, $\frac{1}{80}$ in eight, $\frac{1}{160}$ in two, $\frac{1}{320}$ in eight, $\frac{1}{640}$ in three, $\frac{1}{1000}$ in one, $\frac{1}{2000}$ in two, $\frac{1}{4000}$ in one.

It may seem remarkable that many of these bloods should have retained their high clumping index. Three or four weeks intervened before cultures were made. In this space of time it might have been supposed that the agglutinins would have been absorbed by the living *M. melitensis*. That this micrococcus was present in no small numbers was proved by the profuse growth obtained in many, including those which had an index of $\frac{1}{2000}$. In the specimen with the titre of $\frac{1}{4000}$, however, the agar tube was incubated forty-one days before growth was observed. It was limited to one colony only. The cultures were identified as being the *M. melitensis* by the late appearance of the colonies on the glucose-nutrose agar, by their characters and tendency to become brown with age, by the production of alkalinity in milk, by their readiness to form

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evenly turbid and permanent emulsions, which were agglutinated by the blood from which they were isolated by other specific serums and by no other; microscopically, by their form of a minute oval coccus or cocco-bacillus, not very receptive of stains which were quickly discharged from the coccus by alcohol, and by their inability to retain the dye under Gram's method. No difficulty has been experienced in the identification, since no other microbe has been encountered which has borne any resemblance to the *M. melitensis*. If the characters of all pathogenic bacteria were as sharply defined as those of the *M. melitensis*, the work of the bacteriologist would be considerably lightened. The South African strains of the *M. melitensis* were usually more sensitive to the agglutinins in the blood of South African cases than to those in the blood of Mediterranean patients. Thus a Philippolis serum clumped a Philippolis culture completely in $\frac{1}{480}$, but produced traces of a reaction only in that dilution when tested with an emulsion of the organism isolated from a man who had been infected in Malta. A Mediterranean serum gave an index of $\frac{1}{8000}$ with a Mediterranean strain, but only one of $\frac{1}{1000}$ with a South African culture. The identity of the growths was also confirmed by means of Castellani's test. The agglutinins of a serum could be absorbed by treating it with an emulsion of *M. melitensis* from either source. Agar slopes freed from the culture of the one failed to afford a suitable medium for the other.

There can be but little doubt that the germ has been introduced into South Africa through the medium of goats infected in the Mediterranean area, so the similarity of the clinical features of the European and African fevers, and of the characters of the respective infecting agents, causes no surprise. The blood of eleven goats has clumped the *M. melitensis* in dilutions of $\frac{1}{10}$ to $\frac{1}{80}$. That of normal goats has given negative results in $\frac{1}{10}$. From one of the former the specific germ has been isolated. The milk of three goats has contained agglutinins.

Dr. Strachan, in his former paper, traced three epidemics in small communities to the use of milk of infected goats. He now reports three more instances. Four members of the household of a farmer who supplied milk to Philippolis were attacked. The *M. melitensis* was recovered from the blood of one. Three of his goats were infected. A widespread outbreak in the town was the consequence. He relates also how the whole of another establishment, including the father, mother, baby, and goat, was stricken with the fever. In the third example of dissemination of the germ

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through the agency of goats four of the flock reacted to the specific test. More recently he has sent the blood of a father and son, and the blood and milk of one of their goats. Agglutinins were found in all the specimens, and the *M. melitensis* was grown from the son's blood. That the goat is the predominant factor in the spread of Malta fever in South Africa must now be accepted as proved. Dr. Strachan, nevertheless, has studied the part played by other agencies. He adduces evidence that some of the cows may propagate the disease through their milk. A capsule of blood which reacted in $\frac{1}{10}$ dilution was sent by him. The serum of a normal animal in this dilution causes no agglutination. The foregoing observations may be thus summarised :—

(1) Examination of the blood of 177 persons resident in South Africa has shown that they have been infected with the *M. melitensis*.

(2) The *M. melitensis* has been isolated from $\frac{1}{50}$ to $\frac{1}{10}$ cc. of blood preserved in glass capsules for three to six weeks in thirty-three cases.

(3) Emulsions of the *M. melitensis* sterilised at 55° C. with the subsequent addition of 0·5 per cent. phenol mixed with the diluted blood serum, and drawn into glass tubes of 1 mm. in diameter, afford a sure and ready method of the diagnosis of Malta fever. This plan can be adopted by any practitioner, though unprovided with laboratory facilities.

(4) Specific blood retains its agglutinating property for weeks or months, even when contaminated.

(5) There is a widespread epizootic of Malta fever among the goats of South Africa. Their milk conveys the infection to man.

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