T H E S I S

on

Undulant or Malta Fever in South Africa

by

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The object of this thesis is to prove that the disease known under the names, Malta Fever, Mediterranean Fever, and Undulant Fever, Septicaemia of Bruce, and Melitensis Septicaemia, is endemic in South Africa, and somewhat widely distributed in that country, where it has been present (undiagnosed) and going under other names during an indefinite time in the past. It is also the writer's intention to give an account of his experience of the disease in all its bearings in South Africa.

It seems a pity that there should be so much confusion about the nomenclature of this disease. With the exception of "Undulant Fever" proposed by Hughes in his classical monograph, and "Septicaemia of Bruce", all the names are vitiated by their Geographical references. The name, "Malta Fever", although the narrowest in a Geographical sense, appears to be the one most widely used. "Septicaemia of Bruce", the name proposed by the Italians is a graceful tribute to the insight of our distinguished countryman, the discoverer of the specific organism.

(/) "Melitensis Septicaemia" has been proposed by Dr. Eyre, and has the merit of suggesting the aetiology, the infecting organism, being called "Micrococcus Melitensis". However, the geographical reference is not concealed under the/

the adjective, "Melitensis", and the literary form of the term is bad.

In a paper published in the South African Medical Record of December 10th, 1906, and entitled "Undulant Fever in South Africa", the writer expressed a preference for the name "Undulant Fever". In 1907 the existence of the disease in Cape Colony was officially recognised, and it was made a notifiable disease under the title "Undulant Fever". Nevertheless, the Synonym, "Undulant Fever", is not to be found in the nomenclature of the Royal College of Physicians and Surgeons. The undulating temperature curve is not a constant characteristic of the disease, but in many cases it is sufficiently well marked to establish the diagnosis in the absence of other signs and symptoms. The geographical significance of the terms "Mediterranean" and "Malta" Fever, may be responsible for the fact that the disease remained for many years unrecognised in South Africa.

In December, 1906, Dr. John Muir of Sterkstroom, Cape Colony, sent the writer a copy of a report on the Public Health of Gordonia, a district in the North West of Cape Colony, written by a certain Dr. Simon Fraser in 1898. In this report Dr. Simon Fraser stated that he had seen during the year 1898 about forty cases of a fever which, he believed, would yet be proved to be due to infection with the Micrococcus Melitensis. In 1907 Dr. Darley-Hartley, Editor of the South African Medical Record, tried to trace Dr. Simon Fraser, but failed to do so.

(2)
In the British Medical Journal, 1901, p. 941, the late Dr. Washbourne described two cases which he had met with/

with in South Africa, and which he believed to resemble Malta Fever more than any other disease. The fever in one case 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 illness. In one the tongue was for the greater part of the time clean. In the writer's experience a clean tongue is an important feature in many cases of Undulant Fever. Dr. Dodgson found the serum of both patients negative to typhoid, and positive to Malta Fever. If a reliable strain of micrococcus was used with a moderately high dilution of the serum, and if the experiments were properly controlled, there can be no doubt that the diagnosis of Malta Fever was correct.

(3) In the South African Medical Record of October 15th, 1903, p. 127, there appeared a paper by Dr. J. B. MacKenzie of Kimberley, on Camp Fever, a disease which had been prevalent in and about Kimberley for many years. Dr. McKenzie recognised the closeness of the analogy between this disease and Malta Fever, and stated that it was prevalent over the most of the Karoo, as well as in Kimberley. His description of it would serve as a good clinical description of Malta Fever.

The writer's experience of South African fevers began in the concentration camp, Springfontein, Orange River Colony, in August 1901. During the Summer months, 1901-1902, there was a severe epidemic of typhoid fever in the camp, and in many of the cases the fever was prolonged, and the symptoms were anomalous, but in the vast majority of such cases the characteristic signs and symptoms of Undulant/

Undulant Fever were absent; they were probably cases of typhoid or para-typhoid fever. The writer, however, owing to subsequent experience, now believes that at least six of these were cases of Undulant Fever. Five children from one family were admitted to Hospital over and over again during a period of four or five months suffering from a relapsing fever with neuralgic affections of the limbs. These, at the time, were believed to be anomalous forms of typhoid fever with neuritis. The sixth case was that of a middle-aged man, who was laid up for several months with lumbago and sciatica, and a low pyrexia. A few families in the Camp kept goats for their milk.

During 1906 the writer tested, among others, three samples of blood obtained from patients suffering from prolonged irregular fever, and supposed to be suffering from Undulant Fever, in three separate districts of Cape Colony. They agglutinated the B. Typhosus and failed to agglutinate the M. Melitensis. It is therefore probable that even after an anomalous case of Typhoid fever, or of Undulant Fever, has been under observation for a long time, the diagnosis may be difficult or impossible without recourse to an agglutination or cultural test.

The writer began to practice as District Surgeon and private practitioner in the town and district of Philippolis in the end of August, 1902. Philippolis is situated in the South of the Orange Free State Province, about sixteen miles North of the Orange River, which here runs in a North West direction, and forms the Southern and Western boundary of the district.

The first case of Undulant Fever was met with in the/

the village of Waterkloof, four miles South of Philippolis, in October 1902. This case, that of Mrs. N., whose temperature curve during a part of the time is shown on chart II, was a prolonged one, the pyrexia lasting, with intermissions, for two years. Beyond pyrexia, anaemia, general weakness, and bronchial catarrh, there was no other sign characteristic of Undulant Fever. During her illness, the patient went twice to Cape Town for a few weeks, and derived some benefit from the change, but had a relapse on her return. For a long time the writer regarded this case as one of typhoid fever.

During the Summer months, 1902-1903, many cases of continued fever were observed, and many were found to present the characteristics of Malta Fever described in text-books. In January, 1904, the writer presented to the Orange River Colony Medical Society a paper in which seventy-two cases of this disease were recorded, and a clinical comparison was made between this disease and Undulant Fever, Typhoid Fever, and Malarial Fever. On clinical grounds alone the conclusion come to was that the disease was identical with Undulant Fever. About the same time, Dr. Edington, Government Bacteriologist at Grahamstown, Cape Colony, was requested by the writer to test the serum of six typical cases for Malta Fever and for Typhoid Fever. The tests were carried out for Typhoid Fever only, and the reaction in every case was negative. Dr. Edington was unable to obtain a culture of M. Melitensis in South Africa for the purpose of carrying on the test, but he signified his intention to obtain one from over-sea. On 1st June, 1904, he/

he intimated to the writer that he had obtained a culture, and was prepared to carry out the tests. Since that date, the serum of nearly every patient with whom the writer hashad to deal has been tested by one or more of the following gentlemen:- Dr. Edington, Dr. G. W. Robertson, Dr. Targett Adams, Lieu-Colonel Birt, Major Buist, Major Stathans, Major J. E. McNaught, and the writer. The bacteriological work which each of these gentlemen did will be recorded in another portion of this paper.

The writer now proposes to deal with each of the following branches of the subject:- Clinical Characteristics, Differential Diagnosis, Treatment, Serum Reactions and Cultural Experiments, Mode of Transmission, Prophylaxis, Seasonal and Geographical Distribution.

CLINICAL CHARACTERISTICS.

Pyrexia:- In a paper read before the South African Medical Congress, October, 1910, Dr. A. Garrow, of Steytlerville, Cape Colony, made the statement that for several years he had failed to diagnose cases of Undulant Fever occurring in his district, although he now felt convinced that he was justified in making a retrospective diagnosis of many cases. Dr. Garrow complained that the text-book descriptions of the disease are inadequate, in as much as they do not take sufficient account of the numerous cases which present few or none of the more characteristic signs and symptoms. Dr. Garrow expressed the opinion that even pyrexia is not a constant feature, and that in many cases there is nothing to be found except anaemia, dyspepsia/

dyspepsia, and general dyscrasia, so that the diagnosis in such cases must depend upon an agglutination or cultural test. Dr. Garrow's opinion is supported by the result (4) of researches of the Mediterranean Fever Commission on the existence of ambulatory and apyretic cases among the dock labourers in Malta. Some of these appeared to act, like the goats, as mere carriers of the germ. It is probably true that in some of the ambulatory cases, pyrexia is never present, but the statement cannot be proved, because ambulatory cases are not constantly under the eye of a trained observer. It is, however, true that numerous cases may be met with, especially if they be seen in the forenoon only, in which no pyrexia is found. Such patients may come into town from a far distant farm to consult a medical practitioner on account of general debility and, perhaps, neuralgia of the back and legs. The temperature may be found to be normal or sub-normal. A few years ago the majority of such cases were not diagnosed in South Africa.

The following case will serve as an illustration:- One day in November, 1905, at 10 a.m., a boy, K., aged eleven years, was brought by his father to the writer's consulting room. The complaint was of lameness from pain in the right thigh. The temperature was normal, but the patient had an anaemic and somewhat wasted appearance. The tongue was clean, moist, and red. The right leg was held in the position which is characteristic of early hip-joint disease, i.e. slightly flexed at the knee, inverted, and adducted. The gluteal muscles on the right side were wasted, the gluteal fold being almost obliterated/

ated. Dr. David Campbell, a friend and guest of the writer's, who had lately come from Scotland, was asked to make a diagnosis. As might have been expected, his diagnosis was"tuberculosis of the hip-joint."

The writer then took a blood sample from the boy's ear, and requested the father to remain in town till the afternoon, and to bring the boy again at 5 p.m. In the meantime, the serum was tested against a killed culture of M. Melitensis, and was found to cause complete agglutination in dilution of 10, 30, and 60. When the patient came back at 5 p.m., his temperature was found to be 104 F. This boy returned to the farm and was not again seen by the writer until two months afterwards, when he was convalescent, and nearly all trace of the hip affection had disappeared. His father stated that he had not been confined to bed for a single day. In addition to the absence of pyrexia in the forenoon, the above case illustrates the simulation of hip-joint disease, as well as the frequently high evening temperature without other severe symptoms in children suffering from Undulant Fever. These points will be referred to again.

It is impossible to estimate what percentage of cases belong to the afebrile type, both because medical advice is seldom sought by the patients, and because the diagnosis of Undulant Fever is seldom made in such cases. The text-book descriptions of the disease are probably based upon data furnished by hospital cases.

The majority of patients seeking medical advice will be found to have pyrexia at some time or other. The name "Undulant Fever" was given to the disease by Hughes to/

to indicate a characteristic of the temperature curve which is present in many cases. Owing to the conditions under which the writer has to practice, only eleven continuous charts have been collected by him. Of these Nos. I., III., VI., VII., VIII., exhibit the undulatory character of the curve.

There are morning remissions and evening elevations, daily minima and maxima, becoming progressively higher each succeeding day for an indefinite number of days, and then progressively diminishing to a minimum . The Wave may be repeated an indefinite number of times. The fever may end with the first wave (acute one wave type), but such a termination is rare. Usually several waves succeed one another, and in any given case the number of the waves and the duration of the illness cannot be predicted.

The undulatory type of pyrexia is seen most often in children and in young adults, and in them the disease tends to run a shorter course, and to terminate somewhat abruptly with a temperature which may be subnormal for a week or more. The length of a single wave varies from one to four weeks.

Dr. Garrow has divided cases into various types, viz:- Acute One Wave, Acute Undulatory, Sub-acute, and chronic. Such a classification is useful in practice, but it must not be forgotten that the patients are all suffering from the same specific disease, and, although cases conforming to types are common, transition forms are often seen. Dr. Garrow has recorded one case of the fulminating type, in which the patient dies early of hyperpyrexia. The writer has not met with one.

In/

In the above classification, the word "chronic" is not used in its etymological sense; it really describes a condition the reverse of acute, in which there seems to be no defensive response such as is indicated by high pyrexia and the presence of strong agglutinins in the serum. A case which begins acutely may become chronic with low pyrexia and ill-marked undulations. Such cases tend to run a prolonged course of indefinite duration.

The following are short notes on the charts appended:-

I. Chart of Miss M. N., aged 16 years, January 13th to March 31st, 1904. Chart begins in middle of first wave. Undulations fairly well marked. An acute case with five undulations, daily excursions large. Tongue almost clean throughout. No delirium. Effusion in right ankle during convalescence.

Serum tested by Dr. Edington on 4th July, 1904, when patient was convalescent.

To M. Melitensis - 1-20 - a marked reaction. No higher dilutions used.

II. Mrs. N., aged 49, mother of the above. Chart from February 25th to April 8th, 1904. Patient had been ill from October 1902. No undulations, unless the portion February 25th to March 28th, be regarded as part of a very long wave. Morning remissions extreme. The patient did not recover until October, 1904. Neuralgic affections of back and legs slight, not disabling. Anaemia, general debility, lassitude during whole course of illness, and at times severe bronchial catarrh. Tongue moist/

moist and flabby, with greyish white fur. A prolonged chronic case with acute exacerbations.

Serum reaction to M. Melitensis:-

By Dr. Edington, 4th July, 1904.

1-20 - Marked. No higher dilution.

B Lt.-Col. Birt, 10th October, 1905, i.e. a year after convalescence.

10 - complete

30 - a trace

90)
300) - nil.
600)

III. Boy, aged 6 years. S. F. case seen by writer on only one occasion during the illness, viz:- on 25th November, 1904, at the writer's consulting room. Acute two wave case. Morning remissions slight. The boy's father, who kept the temperature record, reported that there were no symptoms and no delirium. Tongue clean and red, appetite good. Chart discontinued before the end of pyrexia, owing to temporary absence of the father. General wasting, enlargement of the spleen, and effusion in the Knee found by the writer after convalescence was established. Dr. Edington reported serum strongly positive to M. Melitensis.

IV. Chart of Wm. W., a man aged about 40 years. December 17th, 1904, to March 13th, 1905. Up to February 20th record kept by patient's guardian. From February 20th to March 13th, record kept at National Hospital, Bloemfontein, to which the patient was sent for the purpose of cultural experiments. Dr. Targett Adams, of the Government Laboratory, Bloemfontein, got a pure culture of M. Melitensis from his blood, - the first in South Africa. Severe and disabling neuralgia of back and legs/

legs, fever, sweating, and wasting. An acute case of not more than average duration, without obvious undulations in the temperature curve.

The serum was not tested before the patient was sent to Bloemfontien. It agglutinated the patient's own germs at Bloemfontein.

V. Miss B., aged 24 years. February 27th, 1907, to 24th September, 1907. This chart was begun about five weeks after the commencement of the illness, which began in Cape Town. The disease was probably contracted at the farm near Philippolis. It was not diagnosed in Cape Town, although the patient was seen by a medical practitioner. First, influenza, and then enteric fever was suspected, and the patient was allowed to travel North during a temporary lull in the fever.

Pyrexia acute till middle of May. Undulations ill-marked, with the exception of three short waves in July, August, and September. No delirium. Tongue moist, with light silvery fur at first, later, clean, red, and dry. Appetite fair. Constipation yielding to enemata. Spleen much enlarged and hardened, reaching the level of the umbilicus, from middle of May until convalescence was established. Perspiration profuse. Purpuric eruptions on legs and abdomen in July. Lumbago, pain in hips and legs not acute, but more troublesome during convalescence. Record of temperature kept by patient's step-mother and discontinued shortly before convalescence was fully established. The patient was a stout subject. There was some wasting, but no real emaciation. A prolonged acute case, becoming chronic.

Serum/

Serum reaction - by Birt.

Blood sent 4/2/07, tested 27/2/07.

To "Ferreira" Stock M.M.		To "Fourie" Stock M.M.	
10, 20, 40, 80	Complete	160, 320	nearly complete
100	complete		
200	nearly complete		
400	trace.		
		800, 1600, 3200, 6400	nil.

Culture:- Sterile permanently.

Ferreira and Fourie were patients of the writer's.

VI., VII., VIII. Andrew, Alice, and Annie L., aged 11, 10, and 9 years. These were so similar in all respects that they may be described together. All three show typical undulations. No. VI., 42 days long, shows 4 complete waves, varying from 8 to 13 days in length. It terminates with a period of about 7 days of subnormal temperature, a fairly certain indication that convalescence has become established.

No. VII., 45 days, begins in the middle of a wave. The second wave is 15, and the third, and last, 17 days long.

No. VIII., 26 days, appears to begin at the end of a wave, which is followed by two waves of 9 and 11 days' duration. It terminates with the characteristic period of subnormal temperature indicating convalescence. The evening temperature in all three is high (102-104.6), and the morning remissions are marked. These children were all ill at the same time, having become infected with goats' milk supplied by a man who kept an infected herd on the town commonage. All three had clean, red, and moist/

moist tongues, and good appetites, and complained of nothing. Andrew and Alice had slightly enlarged spleens. They were all extremely emaciated. Recovery was perfect and uninterrupted. These three belong to the acute undulant type, probably a common type in children and young adults.

Serum reactions and cultural experiments by Birt.

Andrew Lindsay:- Blood sent 15/12/07. Exd. 22/1/08.

To "Native David" M.M.

10 20 40 80	complete.	160 nearly complete, 320 trace, 640 nil.	

Culture:- White Staphy lococcus.

Annie Lindsay:- Blood sent 23/12/07. Exd. 31/1/08.

To "Native David" M.M.

10 20 40	complete.	80	marked.	160 320 640	nil.

Culture:- <u>Micrococcus Melitensis</u>.

Alice Lindsay:- Blood sent 23/12/07. Exd. 31/1/08.

To "86 Suyman" Stock M.M.

10 20 40	complete.	80	trace.	160 320 640	nil.

Culture:- 31/1/08. Sterile to 5/2/08.

IX. F. S., an Englishman, aged 27, took ill in the beginning of January, 1909, while working at a farm ten miles west north-west of Philippolis, and on the 9th January was admitted to the Liefmann Hospital, Philippolis, under the care of Dr. A. F. Van Dijk.

The writer was asked by Dr. Van Dijk to examine the patient/

patient, and to test his blood for Malta Fever. The fever was moderate - 101 - 102 F., light silvery fur on the tongue, weakness, no signs of abdominal or pulmonary mischief, and no delirium.

Serum reaction to M. Melitensis.

By writer:- 1-10) 1-100) complete.

By Birt:-

Blood sent 11/1/09. Examined 30/1/09.

To 119 "Native Sarah" M.M.

10) 20) 40) 80) complete. 160 nearly complete. 320 marked.

To Living B. Typhosus:-

10) 20) 48) 80) 160) 320) nil.

Culture:- Sterile permanently.

Blood sent 17/5/09. Examined 14/7/09.

To 262 "Dora Vander Walt" M.M. Living.

10) 20) complete. 40 nearly complete. 80) 160) trace.

320 nil.

Culture:- 14/7/09. Micro-coccus Melitensis.

To 266 "Sharpe" Living (Own germ).

10) 20) 40) 80) 640) complete. Control:- Normal serum. 10 nil.

The patient remained in much the same condition for ten days, and then returned to the Farm. He was sent back/

back to the Hospital on May 13th, 1909, as a Government patient to be put under care of the District Surgeon, the writer. Condition on 13th May:- Extreme emaciation and weakness, causing inability to walk. Light silvery fur on tongue. Appetite fair. Hair thinned. Temperature 102 F. Profuse sweating. Appearance suggestive of Phthisis Pulmonalis, but no symptoms or physical signs of pulmonary mischief. Enlargement of spleen never detected. Lumbago and sciatica slight. This patient was put on a course of vaccine treatment, which will be referred to again. There was a very gradual fall in the temperature until the middle of July, when convalescence began. No marked undulation. For a time only the evening temperature was recorded. Effusion in right hip-joint on 3rd July, and in right ankle on 20th July, both transitory and not very painful. This might be called a prolonged acute case,

X. Mrs. P.V., aged 53 years. Seen first on 28th December, 1909, in the afternoon. Temperature 103 F. Tongue coated with dirty white. Muscular tremors, diarrhoea, and slight delirium. Supposed at first to be in early stage of typhoid fever. Serum tested by writer for Malta Fever on 18th January, 1910.

Result:- 1-10 } Complete.
1-100 }

By Birt:- Blood sent 24/1/10. Examined 3[illegible]/3/10.

To 262 B.M.

10 }
20 }
40 }
80 } complete. 1280 nearly complete.
160 }
320 }
640 }

Culture/

Culture:- M. Melitensis on 4th day.

To B. Typhosus 10 - nil.

Vaccine treatment began on January, 20th. Lumbago and Sciatica severe and prolonged. Spleen enlarged and hard. No joint effusion. Pyrexia low, of the chronic type with undulation absent or ill-marked. Convalescence in middle of May.

XI. Mrs. De S., aged 35 years. This patient was seen by the writer at a farm 20 miles north of Philippolis on 17th May, 1909. She was reported to have been ill from November, 1908. Emaciation, sweating; temperature 103. Apnoea of a hysterical type at intervals, without dyspnoea. After May, 1909, she had many medical attendants, and took much quack medicine in addition without improvement. Seen again by the writer at the farm at 8 a.m. one morning a year later. Temperature 98 F only, but great debility, spleen much enlarged and hardened, reaching below level of umbilicus. She came in to town to be treated with vaccines on 16th June, 1910, on which date the record of the temperature begins. She returned to the farm on 17th July after having obtained six vaccine injections. There was little change in her condition, although she expressed a feeling of greater well-being. On 31st August, when the record was discontinued, there was still a little fever, but she became convalescent shortly after that date. This was probably an acute case which became chronic. The pyrexia curve is a dead low level in which undulations are ill-marked.

Serum reactions of Mrs. De S. by Birt:-

Blood sent 17/5/09. Examined 13/7/09.

To 262. Dora Vander Walt M.M. (Living)

30 complete.

Culture:- Sterile permanently.

In South African practice patients often live at great distances from their medical attendants, and may be seen only once or twice during the whole course of a long illness. Undulant fever has come to be recognised as a disease which is rarely fatal, and, when there is no acute suffering, frequent journeys and visits are looked upon as a needless and expensive luxury, Consequently, it was not possible to record all the signs and symptoms which appeared in every case. During nearly nine years the writer observed 298 cases of Undulant fever, and in 231 of these the diagnosis was confirmed by agglutination or culture. For the purpose of making an analysis of the symptomatology and semeiology only 268 cases have been selected, the remainder not having furnished sufficient data.

The following is a statement of the leading symptoms, signs, complications, and sequelae in addition to pyrexia and the numbers of cases in which each occurred:-

Total Number of Cases:- 268 - 151 males 117 females.

Neuralgia of the back and legs	166	or 61.9	per cent
Other Neuralgic affections	35	or 13	" "
Paraplegia	5	or 1.86	" "
Pulmonary complications	37	or 13.8	" "
Joint Swellings and effusions	41	or 15.3	" "
Orchitis	12	or 7.95	" " of males
Severe Gastro-intestinal	10	or 3.73	" "
Severe Typhoid State	12	or 4.47	" "
Deafness	3	or 1.12	" "
Acute Nephritis	1	or 0.37	" "
Endo-carditis 1-	3	or 0.37-1.12	"
Intra-cranial Disease	3	or 1.12	" "
Severe Epistaxis	4	or 1.49	" "

Purpura/

Purpura	3 or 1.12	per cent.
Cold Abscesses	5 or 1.86	" "
Enlargement of Spleen 11	or 4.1	" "
Enlargement of Liver	6 or 2.24	" "
No characteristic signs or symptoms 71	or 26.5	" "

Discussion of the above analysis:-

Although pyrexia was present in all the cases which furnished the data for the above statistics, many other cases seen only on one or two occasions were free from pyrexia at the time, but such cases have been rejected for reasons already given. The diagnosis was made by the agglutination test only.

Among the many manifestations of this disease neuralgic affections of the back and legs (lumbago and sciatica chiefly) are by far the most common, occurring in 61.9 per cent of the cases. Other neuralgic affections are pleurodynia, which may simulate pleurisy, brachial neuralgia, and neuralgia pains in the neck; headache and neuralgia of the face are uncommon. It is chiefly the neuralgic affections which make the disease in the majority of cases so exceedingly painful and prostrating. The reflexes are exaggerated, but in the majority of cases there is no paralysis or paresis. Six cases were observed in which after a very prolonged illness (8 months - 2 years) with disabling pain in the legs, extreme wasting of the muscles of the legs with paralysis occurred. The patients suffered from foot-drop during convalescence, and the extensors of the foot were the last set of muscles to recover. Dr. J. W. H. Eyre (5) made an analysis of the symptomatology of 1000 cases. He/

(6)
He found peripheral neuritis in 52 per cent, neuritis of special nerves in 42 per cent, and intercostal neuralgia in 14 per cent. On the other hand he records headache in 54 per cent, which is contrary to the writer's experience in South Africa.

Joint swellings and effusions occurred in 15.3 per cent. (7) Eyre found arthritis and tenosynonitis in 21 per cent. In the writer's experience the joints affected were in order of frequency the knee, the ankle, the elbow and wrist, and the hip. It is a debatable point whether severe pain in the hip is due to neuritis or to arthritis in many cases. The same remark applies to pain in the sacroiliac and lumbo-sacral regions. In five cases the joint affections were multiple, the following combinations being affected:- Knee elbow, both knees both ankles, both knees, knee ankle, hip ankle. In the remainder they were single, with the exception of those possibly affecting the hip and lumbo-sacro-iliac joints the effusions were not acutely painful, and were transient, lasting no longer than ten to fourteen days. There was generally oedema or inflammatory induration of the neighbouring soft tissues, tendons, bursae, fascia, and skin. In April, 1904, Dr. D. M. Macrae, who had just come to act as the writer's partner, and who had never seen a case of Undulant Fever, was consulted by a youth aged eighteen years suffering from a severe inflammation of the elbow and surrounding soft tissues. The elbow presented the classical signs and symptoms of inflammation, being swollen, hot, red, and painful. Dr. Macrae, believing the condition to be due to a pyogenic infection, was about to make incisions, and had his scalpel and surgical dressings prepared. He, however/

however, consulted the writer before using the knife. The patient was recognised as one who had been suffering from Undulant fever for about three months, and had arrived at the convalescent stage. Instead of making incisions Dr. Macrae prescribed fomentations made with a hot solution of perchloride of mercury (1 in 2000). The Cellulitis and synovitis disappeared within ten days.

The writer has invariably found that joint effusions are very late complications, occurring during convalescence, and often in the absence of pyrexia. Indeed they have come to be regarded favourably as a sign that the illness is approaching its termination. They were found in children and young adults only. Probably Eyre's statistics are based upon data furnished for the most part by the cases of young soldiers. This would account for the higher percentage of joint affections found by him.

Pulmonary complications took the forms of bronchial catarrh, congestion of the lungs, and broncho-pneumonia. In two cases pulmonary congestion was the cause of death. A woman, Mrs. V. R., aged 63, died of congestion of the lungs with oedema, after an illness of six weeks, and another woman, Mrs. S., aged 36 years, suffering from obesity, died of pulmonary congestion after an illness of one month. There were subcrepitant rales at both bases, but no consolidation, and no rusty sputum. The signs of deficient aeration were present.

Orchitis was usually unilateral, less painful, more transient, and of a more general kind than that met with in gonorrhoea, in which epididymitis tends to predominate. It usually subsided in from 10 to 20 days, In two cases out of the twelve it was bilateral, one testicle becoming inflamed when the other had subsided. In all cases it

was a late complication. It occurred in adults only. The percentage of orchitis found by the writer among all males was 7.95. Eyre (8) found 8 per cent. He does not state whether females were excluded. Probably there were not many females among his cases. If males under the age of puberty were not counted, the percentage would be much higher.

Adult females sometimes suffered from pain and tenderness in the ovarian region, but enlargement of the ovaries was not detected, and it is doubtful whether the pain, if it were ovarian, could be attributed to a direct action of the M. Melitensis or its toxins. Ovarian pain is too common in the absence of Undulant Fever.

Severe Typhoid State:- If this be defined as a state of a dynamic or adynamic type suggestive of profound intoxication, and having as its cardinal sign delirium or stupor, and as signs of less constancy, muscular tremors, subsultus tendinum, and a foul dry tongue which may be Brown and fissured, then it may be said that the typhoid state is rare in South African Undulant Fever. By the writer it was found, with one exception, only in cases presenting severe pulmonary complications of a pneumonic type, and in such cases it was probably due to secondary infections rather than to the M. Melitensis. Eyre found delirium in 6 per cent.

Gastro intestinal disturbances were not found by the writer to be either serious or intractable. In Undulant Fever constipation is the rule, and it may be obstinate. The auto-intoxication consequent on constipation becomes a factor added to the specific intoxication of Undulant Fever, and it is no inconsiderable factor. Not only is dyspepsia found in association with it, but it enormously increases the general dyscrasia/

crasia, and may aggravate the pyrexia. The history of two cases illustrative of this point will be given under the section devoted to "Treatment". Of all the clinical signs of Undulant Fever, the most important for diagnostic purposes is the appearance of the tongue. The following is a quotation from the writer's paper, "Undulant Fever in South Africa", published in the South African Medical Record of December 10th, 1906:-

"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, 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 cleanand red during the later, and greater period of the illness. In a few, although clean and red, it was dry, shining, and cracked."

To the above quoted description the writer has nothing to add except that the light silvery fur is more commonly found in adults, while the clean red tongue is the more common in children. Either of those two types associated with fever and a history of some weeks of fever is almost pathognomonic of Undulant Fever. The large dirty white tongue is not so valuable as a diagnostic sign.

In a paper on the clinical aspects of Malta Fever in South Africa published in the South African Medical Record of February 25th, 1908, the writer's partner, Dr. D. M. Macrae laid great stress upon the importance of the light silvery fur, and the clean tongue as guides to diagnosis. In his paper read before the South African/

African Medical Congress of October, 1910, Dr. A. Garrow of Steytlerville also wrote at great length upon the importance of the state of the tongue, and referred to the "light silvery fur of Macrae" as a common type.

Profuse and obstinate epistaxis was observed in three cases, in one of which it was the cause of death. A youth, D.P., aged 21 years, consulted the writer at his consulting room in October, 1908. His temperature was 103 F. and his tongue had a light silvery coating. He had been feeling ill for about ten days. His serum completely clumped the M. Melitensis in a dilution of 1-100. A sample of the blood sent to Lt.-Colonel Birt was reported on as follows:-

Blood examined 13/11/08.

To 119 "Native Sarah" M.M.

10
20
40
80
160 Complete. 400 nil.
200
320

Culture on glucose untrose agar. Micrococcus Melitensis.

He was advised to return to his father's farm, and to remain in bed for a few weeks. During the fifth week of the illness epistaxis began and another medical practitioner, Dr. A. F. Van Dijk was called to the farm. Dr. Van Dijk informed the writer that he succeeded in stopping the haemorrhage by plugging the anterior nares only, but six days later he was sent for again, and found the patient dead. The bleeding had begun again, and had continued without intermission for six days.

Purpura was observed in three cases. In all of these pyrexia had been acute during the first few weeks, and/

and had then subsided to a lower level, at which it remained for several months. The purpura was a late occurrence, and the spots were present on the legs and abdomen only.

Endocarditis indicated by murmurs only was found in three cases. In only one of these, that of a young negro, was the writer certain that a murmur had not been present before the onset of Undulant Fever. In this man a loud rasping mitral systolic murmur became audible during the course of Undulant Fever. After convalescence he disappeared from the district for two years. When the writer saw him at the end of that time he was in perfect health, and the murmur had disappeared. In other three cases of aortic, pulmonic, and mitral murmurs the murmurs were present when the writer saw the patients for the first time. In two of these the murmurs disappeared when the patients had recovered. The third was not seen again.

Cold subcutaneous abscesses indistinguishable from those which are found in tubercular subjects were observed in five cases or 1.86 per cent. (9) Eyre found abscess formation in 5 per cent. Those observed by the writer were late sequelae, being, indeed, post-febrile in all the cases.

A boy F., aged 14 years, whose father, mother, and two sisters were also infected, had suffered from Undulant fever with severe lumbar pain for several months during the Summer 1904-05. After the fever had subsided he began to walk about on the veld, although still suffering from lumbar pain which rendered him lame and bent. He was brought to the writer in March, 1905, on account of a fluctuating subcutaneous tumour in the left lumbar /

lumbar region extending round the flank into the iliac region. The tumour was a large cold abscess. It was opened by an incision about two inches long at its most dependent part. After about three weeks irrigation and drainage it was healed. The fluid was then and greyish white. Under the microscope only a cellular debris was seen. Some of the fluid collected in a sterile glass capsule was sent to Dr. Edington, Grahamstown. He found the fluid sterile, and, therefore, expressed the opinion that it was of tubercular origin. Other two cases treated similarly made a similarly rapid recovery.

A man, E. V. S., aged 56, had been suffering from Undulant fever in a very chronic form for nearly two years. Pyrexia low and sometimes absent, agglutinins feeble, clumping being marked but incomplete in a tenfold dilution; severe pain in lumbar region and in legs, causing lameness for many months. In April, 1907, he presented himself to the writer for treatment. His right thigh was symmetrically swollen, measuring 22 inches in circumference, while the left thigh at the same level measured only 16 inches. The swelling of the thigh seemed to be due to fluid between the muscles, the whole thigh being converted into a fluctuating mass. The temperature was normal. The swelling did not seem to be of an inflammatory nature, being indolent, cold, and free from redness. The writer advised simple aspiration of the fluid, but Mr. V. S. would submit to no operation. He, however, consented to receive vaccine injections, and one dose of 500 million dead germs was injected into each flank at an interval of a week. Cold abscesses formed at the sites of the injections, and, as they

were/

were pointing, they were incised and evacuated. At that time the writer used excessively large doses of vaccine. Mr. V. S. then went to the Caledon baths near Cape Town, and returned in two months convalescent, the fluid in the thigh having undergone absorption.

A man, P. V., aged 38 years, was sent to the writer on 1st February, 1909, with a diagnosis of Malta Fever by Dr. Clarke of Springfontein. His wife was convalscent from the disease. Both had been drinking goats' milk. Mr. P. V. had been ill since September, 1908, with fever, wasting, general debility, and severe pain in the back and legs, which rendered him lame, and had at times been totally disabling. His serum gave the following reaction to M. Melitensis:- 10 complete, 20 nearly complete, 40 nil. He made little progress, and was seen at intervals until November 17th, 1909, when there was no fever, but a cold abscess had appeared in the upper part of the right thigh just below the outer third of Poupart's ligament. This abscess was emptied twice by aspiration, but filled almost immediately on both occasions. A free incision was made, and a drainage tube was inserted on 2nd January, 1910. A probe eight inches long could be passed upwards, backwards, and inwards, but no bare bone could be felt. Caries of the lumbar vertebrae was suspected. The sinus was irrigated twice daily with cyllin (1-160), and a daily injection of glycerine iodoform emulsion was made. Mr. P. V. returned to his farm in the Colesberg District of Cape Colony to carry out the treatment himself. Some of the pus which was first aspirated was sent to Lt.-Colonel Birt. He found it sterile, and no bacteria were visible by microscope. In three months the sinus had healed, and/

and Mr. P. V. presented himself to the writer looking, and feeling well on several occasions during the ensuing winter.

In August, 1910, after Mr. P. V. had been engaged in driving fence posts, a rather severe kind of labour, the pain in the lumbar region returned. He showed himself again on 12th September, when it was apparent that an abscess was present in the old situation. The abscess was opened, the old sinus was dilated, and a drainage tube was inserted. At this time there was an irregular fever, the evening temperature being sometimes as high as 103° F. The serum caused marked clumping of the M. Melitensis in a dilution of 1-10, and a trace only in a dilution of 1-20. The fever was probably due to some other infection. The sinus was treated in the same way as on the first occasion except that the iodoform was introduced in an etherial solution. The sinus did not cease to discharge until the end of February, 1911, when there was again apparent convalescence. In March, 1911, Calmette's opthalmic reaction was tried, human tuberculin being used for the right eye, and bovine for the left. The writer made use of Mrs. V. and himself as controls. The controls gave no reaction, and the subject of the experiment showed no reaction after seventeen hours, just before he returned to his farm. He reported that his left eye had become red and painful two days after the instillation of tuberculin. The experiment was repeated on 5th May, 1911, on which date Mr.. P. V. returned to consult the writer on account of pain in the left lumbo-sacral region. On this occasion the conjunctiva of the left eye became painful and congested at its lower part in four hours. There was a moderate reaction in the right eye/

eye after twelve hours, and the left was purulent. In the writer's eyes, which were used as controls, there was no reaction. On being told that bovine tuberculosis was suspected Mr. V. said that while he was suffering from Undulant Fever, he was drinking the milk of a cow which had a large abscess on the buttock, that the abscess never healed, and the cow became wasted and died. In the beginning of June, just before the writer left South Africa, Mr. V. returned in a bad state of health, suffering from hectic fever, with the sinus again open and discharging. Dr. Lawrence, the writer's locum tenens, was left to carry out a course of treatment with a mixed bovine and human tuberculin.

The question arises whether all cold abscesses following Undulant Fever are not really of tubercular origin. Undulant Fever is often a prolonged and debilitating disease, and it is easy to believe that it may temporarily predispose to tuberculosis by breaking down the defenses of the body against infection. Tuberculosis is relatively a rare disease on the high veld of South Africa, and the opportunities for infection are probably very limited. It is significant that the writer found abscess formation in less than two per cent of the cases, while Eyre (10) found it in five per cent of cases in Malta.

In June and July, 1910, the writer treated by rest in bed with extension a youth, V. D. W., aged sixteen years, who presented well marked signs of hip-joint disease. He appeared to be otherwise in good health, and he was free from fever, but he reported that a year previously he had suffered from "slepende koorts", the name given locally to Undulant Fever. His blood agglutinated/

tinated the M. Melitensis completely in a dilution of 1-10, and the clumping was marked in a dilution of 1-100. He submitted to the treatment for only two months, but he continued to have a limp up to the time when the writer left South Africa.

Before leaving the subject of a possible connection between Undulant Fever and Tuberculosis it is well to mention that tuberculosis of the hip-joint may be simulated in Undulant Fever. The writer has observed two cases, one of which he has recorded above (page 7-8). In the other case, that of a female child, aged two years, a provisional diagnosis of hip-joint disease was made by the writer's partner, Dr. D. M. Macrae. The serum was tested, at Dr. Macrae's request, and was found to agglutinate the M. Melitensis completely in dilutions of 10, 30, and 60. The child made a perfect recovery in two months.

Acute nephritis with oedema of the face and haematuria was observed in only one case, or 0.37 per cent. (11) Kyre found haematuria in 0.5 per cent. The writer found transient albuminuria in a few cases in which the illness had been severe and prolonged. Kyre found albuminuria in 8 per cent.

Intracranial tension from Meningitis or cerebritis. This grave complication is fortunately a rare one.

The following two cases are quoted from the writer's paper on "Undulant Fever in South Africa" published in the South African Medical Record of 10th December, 1906:-

Case I. "A girl aged nine years living at a distance of 27 miles from Philippolis, and convalscent from Undulant Fever, developed symptoms of Meningitis. About ten/

ten days after the 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."

The above case occurred in February, 1903, before the writer began to have the agglutination test applied. The whole family suffered from Undulant Fever about the same time, and the diagnosis was based upon clinical grounds only.

Case II. "A man aged 38 years presented himself on the 22nd September, 1904, 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" (21 miles north-west of Philippolis)" had had the disease some months previously. His serum was tested by Dr. Mington in a dilution of 1-50, 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 the 6th October. Operations/

tion and post-mortem examination were refused."

The following are notes from a Mediterranean case described by Hughes:-

(12) "Cerebro-spinal irritation with fatal intracranial pressure - High fever 25 days, then delusions for four days - 'Rheumatic' pains nerves of legs - Remittent fever till 45th day, then intermittent. Exacerbation 102nd day - mentally irritable - Sleepless - Shooting pains in head - 112th day headache very severe, reflexes exaggerated, hyperaesthesia, rambled in conversation; 113th day unconscious for most part; 115th day blind left eye, left pupil enlarged, ptosis, and divergent strabismus; 116th day coma deepened - died; no past syphilis. P. M. Brain much congested, soft and oedematous at base. Excess of cerebro-spinal fluid - Lymph on choroid plexus. Micro-coccus Melitensis from brain."

The following are notes of a third case seen by the writer:-

Case III. A man, L.P., aged 27 years, seen at the writer's consulting room at 11 a.m., 3rd February, 1906. Had been ill for a month, but not confined to bed. Unilateral orchitis, temperature normal, serum tested to M. Melitensis 1-30, negative. Temperature at 6 p.m. on the same day 101.6. Not seen again till 9th April at 9 p.m. Still debilitated, temperature 101.6 - reported that the orchitis had become bilateral, orchitis no longer present, thirst and polyuria complained of. Urine - specific gravity 1.020, no sugar, a trace of albumen, serum reaction to M. Melitensis 10 complete, 30 well marked, agglutination limit found later by Major Statham /

Statham, and by Lt.-Colonel Birt to be 1-200. Seen at farm on 9th May at 6 p.m. Temperature 98 F; appetite good, tongue clean, anaemic appearance, reported by his father to be melancholy and irritable. Towards the end of May he went for a change to Bedford, Cape Colony, where he developed hyperpyrexia, delirium, hemiplegia, paralysis of sphincters, and coma. He died on 5th June after an acute illness of twelve days. Dr. G. Pitman, who attended him at Bedford, was of the opinion that he was suffering from arterio-sclerosis, and that the cerebral complication was determined by that condition, not by the micro-coccus Melitensis.

Case IV. The following case is quoted from the writer's paper on Malta Fever in South Africa published in the Journal of the Royal Army Medical Corps, of August, 1909:-

"A man, aged 49, died during apparent convalscence 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 F, and fine crepitations were audible at the bases of both lungs. He died cyanosed at 4 a.m. on the ninth day."

In February, 1911, Dr. A. Garrow, of Steytlerville, suggested to the writer that the above was a case of neuritis of the vagus. Dr. Garrow had once seen a fatal case of alcoholic neuritis of the vagus, proved by post mortem section, in which the symptoms were similar to those described above.

Enlargement of the spleen was sometimes found in the early stage of acute cases, and in such cases the spleen

was/

was soft, and the enlargement was not great. At a late stage in some chronic cases the spleen was greatly enlarged, hard, and tender, and it subsided very slowly during convalescence. In view of the prominence given by others to enlargement of the spleen in Malta Fever the writer has expressed a doubt as to his own ability to exclude it by physical examination. (13) It was found to be present in 41 per cent of the cases collected by Eyre. In only 4.1 per cent of his cases was the writer able to satisfy himself that enlargement of the spleen was present. (14) Eyre found from post mortem records that the weight of the spleen averaged from 57 grammes, in very acute cases, to 250 grammes in those of long duration.

Enlargement of the liver was observed by the writer in cases in which pyrexia had remained at a high level for a long period. The percentage for enlargement of the liver found by the writer, viz:- 2.24 , is also smaller than that found by Eyre, viz:- 8. (15) There is here surely some difference in the personal factors of the examiners. Moderate enlargement of the liver and spleen are objective signs, which would not attract the attention of the patient, or give rise to alarm, hence these signs might have been present in cases after the writer had seen them, although absent at the time of examination.

Dr. Cairns of Pearston, Cape Colony, once sent the writer a blood sample from a patient suffering from fever with great enlargement of the liver. Dr. Cairns was in doubt whether the patient was suffering from Undulant fever, or from a suppurating hydatid cyst of the liver, a common condition in South Africa. The serum reaction was found by the writer, and by Lt.-Col. Birt to be positive to Undulant Fever. On the other

hand/

hand the writer overlooked the presence of a hydatid cyst of the liver in a patient suffering from Undulant Fever, and did not perform the operation for the removal of the cyst until a year after the patient had recovered from the Undulant Fever. This man, W. L. C. aged 38 years, reported himself ill with orchitis and Fever in July, 1908, at a farm 24 miles North-west of Philippolis. The writer saw him for the first time on 11th October, on which date the liver was three inches below the costal margin in the right nipple line. The serum agglutinated M. Melitensis in dilutions of 10 & 100. Birt found the reaction complete in 80, and nearly complete in 160, and got a pure culture of M. Melitensis from the blood. W. L. C. became convalescent in November, but the enlargement of the liver persisted. In October, 1909, he returned to the writer with a tense globular swelling in the right lobe of the liver causing respiratory embarrassment. Echinococcus or Hydatid Cyst was then diagnosed, and treated by marsupialisation of the adventitious sac. Healing of the cavity was complete in three months.

Profuse sweating was present in only a few cases. On the high veld of South Africa the atmosphere is generally very dry, so that perspiration tends to be less sensible, and more efficient as a cooling agent.

The cases presenting no characteristic clinical signs or symptoms were probably far more numerous than those recorded by the writer; for they must be taken to include not only those in which medical advice was sought on account of mild pyrexia, or general debility only associated with constipation, but also those others of the ambulatory and symptomless type

which/

which never come under the observation of a medical man.(16) The existence of such cases in Malta has been proved.

Certain facts regarding the sexual functions, menstruation, pregnancy, parturition and lactation will now be discussed. The writer has found amenorrhoea in most prolonged cases.(17) Eyre says amenorrhoea is more frequent than dysmenorrhoea, not only during the pyrexia but also during the apyrexia periods.(18) According to Eyre most observers agree that in Malta Fever sexual potency is not diminished, and pregnancy is not interrupted, although lactation is frequently curtailed. The writer has recorded one case in which a healthy child was begotten by a male during a severe and protracted attack of Undulant Fever, two cases of abortion during the course of the disease, and one during convalescence. In South Africa, however, abortions are frequent occurrences in the absence of Undulant Fever. Undulant Fever may be found in women during the puerperal state. If the patient be seen for the first time a few days after parturition, grave apprehensions may arise in the mind of the physician. In South Africa, where a great deal of the midwifery is done by unskilled women, a medical man is often called to attend a woman suffering from pyrexia a few days after parturition. Unfortunately it is often the case that the patient is suffering from sapraemia or even puerperal septicaemia, but on three occasions the writer was relieved to find that the condition was really Undulant Fever.

Undulant Fever is to be distinguished from the various forms of puerperal fever by the absence of rigors and severe local mischief, and sometimes by the characteristic tongue. The serum test settles the diagnosis, and should/

should be applied to all obscure cases of fever wherever Undulant Fever is known to exist.

Dr. Garrow advised that mothers suffering from Undulant Fever should not be allowed to suckle their infants. The writer is of the opinion that such advice should be qualified. If the mother was suffering from the disease before the birth of the child, and if she is not much emaciated and debilitated, and is giving milk of good quality, then the child should not be deprived of its natural food. The writer has never seen an infant under the age of 1 year and 10 months suffering from Undulant Fever; although the specific agglutinins were found in the serum of two apparently healthy infants suckled by infected mothers. As the question seems to be an important one, the following notes on five cases are given:-

In December, 1907, Mrs. S. suffered from Undulant Fever at a farm 18 miles South-east of Philippolis - serum reaction nearly complete in dilution 160; Temperature 102.8; not confined to bed; suckling a male infant. Her husband was also suffering acutely, confined to bed with neuralgia of back and legs - his serum reaction was complete in a dilution of 160, and his blood gave a pure culture of M. Melitensis. Mrs. S. suckled the child for six months, and it remained well until January, 1910. The writer saw the child on 15th February, 1910. There was then a low fever, emaciation, and lameness from pain in the legs - serum reaction complete in 320. It is extremely improbable that this child became infected through drinking the mother's milk; for an incubation period of eighteen months is unknown.

In/

In December, 1907, Mrs. E. was found to have pyrexia a few days after parturition. Her serum gave a complete clumping of M. Melitensis in a dilution of 160. The child was suckled for three weeks, and never suffered from Undulant Fever. The mother's illness lasted about three months. Lactation was curtailed in this case.

On 29th December, 1907, at a farm twelve miles west of Philippolis, where there was a severe epidemic of Undulant Fever among whites and negroes, a negro woman was found to be suffering from the disease, and suckling a healthy infant. The woman's serum reaction to M. Melitensis was complete in dilution 160, and her blood gave a pure culture of M. Melitensis. Major J. G. McNaught found that the milk and the baby's blood also agglutinated the M. Melitensis. The subsequent history of this case is unknown.

Mrs. B. L. at Rowlsfontein, a village close to Philippolis, reported that she had been ill since June, 1909. Her baby was born on 15th July, 1909, and the writer saw her for the first time in the middle of October, when she was suckling a male child. Her serum clumped the M. Melitensis completely in a dilution of 160, and her blood gave a pure culture of the germ. The baby remained healthy, except for an attack of enteritis during the Summer. All the other members, viz:- the father, two daughters, and a son, suffered from the disease.

Mrs. C. reported that she had taken ill with fever on 6th November, 1909, and that her baby, a boy, had been born on 15th November. The writer attended her and her husband for the first time in March, 1910. She would not remain in bed, probably could not, on account of the severe/

severeillness of her husband, and absence of help, although her temperature was sometimes as high as 103 F, and she suffered much from pain in the back and legs. Her serum reaction to M. Melitensis was complete in a dilution of 40. She became convalescent in the beginning of May, and continued to suckle the child until it was thirteen months old. The child remained healthy, and its serum gave negative reactions to M. Melitensis in March and in November, 1910. These reactions were confirmed by Birt on each occasion about three weeks later.

It seems probable that very young animals are insusceptible to the disease, although their blood may contain specific agglutinins for some time after birth, should the mother have been infected before parturition. (19) Major W. H. Horrocks and Captain J. C. Kennedy fed a kid on infected milk from July 13th to October 31st, 1905. No serum reaction appeared until September 26th. On October 31st the kid was killed. No M. Melitensis was recovered from any of its organs. Remark:- "Though a blood reaction was obtained, a true infection does not appear to have taken place."

(20) In another experiment the same gentlemen found that the serum of a kid born of an infected mother on October 25th, gave a positive reaction complete in 1-50, which corresponded exactly to that of the mother's serum on the day the kid was born. On November 4th the reaction of the kid's serum was unchanged, but on November 15th it had fallen to 1-20. The kid was then killed, and an attempt was made to obtain cultures from its organs, but the M. Melitensis was not isolated. (21) At page 60, Pt./

Pt. V. of M. F. Commissions Reports Major W. H. Horrocks writes:- "The transmission of M. Melitensis from mother to kid could not be demonstrated in Malta, and in Gibraltar two apparently affected kids were killed immediately after birth, and cultures were made from the organs. Although more than 80 cultures were made, not a single sign of the Micro-coccus could be discovered.

Mortality:- Among the 298 cases observed by the writer there was a mortality of 8, or 2.68 per cent. (22) The mortality in the army and navy in Malta was 2.3 per cent. In the civil administration 489 out of 4627 cases or 10.6 per cent. The causes of death were:-

Pulmonary congestion in..... 2 cases

Probably
- Intracranial tension in..... 2 "
- Neuritis of the vagus in.... 1 case

Epistaxis in ..... 1 "

Profound weakness and Cardiac Failure in ..... 1 "

Never having made post mortem sections the writer is unable to give any contribution on the morbid anatomy. Owing to the low mortality in Malta also little seems to be known about the morbid anatomy. Eyre has given an account of the morbid anatomy in his second Milroy Lecture delivered on March 10th, 1908.

Sex Incidence:- Out of the 298 cases 180 were males and 118 females.

Age Incidence:- The following table shows the age incidence among 289 cases.

Age/

Age	1-2	2-3	3-10	10-20	20-30	30-40	40-50	50-60	60-70
Cases	1	5	28	84	68	48	29	21	5

Differential Diagnosis:- At the outset of the disease, i.e. during the first five days, a certain diagnosis may be quite impossible. It is often difficult to make the diagnosis between Undulant Fever and some other diseases by means of the clinical signs and symptoms alone. Not a single one of these is a constant feature in all cases, and, with the exception of the characteristic appearances of the tongue already described, not one is patho-gnomonic. In the absence of pyrexia the tongue is no guide. If a temperature chart has been kept, and if it shows typical waves, the diagnosis is rendered practically certain; but the patient demands an earlier diagnosis than that which can be made from a chart.

The diseases for which Undulant Fever has been most frequently mistaken in South Africa in the past are probably typhoid Fever, Rheumatic Fever, and Malaria. For many years it was recognised as a separate entity in Kimberley under the name, "Camp Fever".

Typhoid Fever:- The condition of the tongue, the absence of delirium even when pyrexia is high, the absence of rose spots, and the absence of peasoup diarrhoea may serve to distinguish an acute case of Undulant Fever from one of Typhoid Fever. Of the last two signs the former is frequently absent, and the latter is rare in South African Typhoid Fever. It is the subacute cases of Undulant Fever and Typhoid Fever that are apt to be confounded/

confounded. The writer must confess that in many such cases he has remained quite uncertain of the diagnosis until a serum test had been applied. One case occurred in which there seems to have been a mixed infection. In May, 1908, a woman, Mrs. D. P., suffered from a fever resembling mild typhoid. The tongue was dry, cracked, and coated with a brownish white fur. There was constipation and no delirium. The patient's son, aged 15 years, was convalescent from an attack of Undulant Fever. The writer tested her serum against M. Melitensis and B. Typhosus (a British strain) and found it negative to both in dilutions of 10 and 100. Birt found the reaction positive to B. Typhosus, in a dilution of 10 - nearly complete (South African strain). On plating the blood he got a pure culture of M. Melitensis, which the serum failed to agglutinate in dilutions of 10, 20, 40, and 80.

Rheumatic Fever, at least in its articular form, appears to be rare on the high veld of South Africa among those who have never had the disease elsewhere. Nevertheless, valvular disease of the heart, and chorea, in young people, are fairly common. In Undulant Fever joint effusions occur in less than 20 per cent of the cases; they have little tendency to be multiple and are less painful than those met with in Rheumatic Fever. They are late sequelae, often post febrile. Salicylate of Soda has no effect on the pains of Undulant Fever, but acetyl - or aceto-salicylic acid (syn. aspirin) has a marked though transient effect on the neuralgic affections. There is no excuse for applying the name Rheumatic Fever to the neuralgic affections of Undulant Fever. The Dutch in South Africa call Rheumatic Fever "Zinkend Koorts", and they have given the same name to the/

the painful forms of Undulant Fever.

Malaria:- The writer has had but little experience of Malaria, which is not endemic in the Free State Province. There was once a tendency to regard as Malarial all obscure fevers occurring in tropical and sub-tropical countries. The absence of rigors and of well marked periodicity and intermissions, and the absence of benefit from quinine serve to distinguish Undulant Fever from Malaria, as also the absence of Malarial parasites from the blood, and the presence of specific agglutinins in the serum.

The painless forms of Undulant Fever are called by the South African Dutch "Slepende Koorts", i.e. "trailing fever". The same name has been applied to Malaria in places where it is endemic. The discussion of serum diagnosis is reserved for a separate section.

Treatment:- It has not been proved that any form of specific treatment hitherto tried has a marked effect on the duration or severity of the illness in all cases. Bassett Smith (23) treated with vaccines 61 cases of Malta Fever, to which 224 infections were given. "These cases comprised all grades in the disease, from the severe Undulant type to the intermittent. The initial dose employed was 50,000,000 organisms, and this was but rarely exceeded, the intervals between the injections being ten days". "Bassett Smith concluded that the vaccine treatment of Malta Fever appears in a certain number of cases to produce a beneficial result, the severity of the symptoms being diminished, the general condition improved/

proved, and the duration of the disease curtailed; but that in the more severe type of case, with high fever and evidence of severe intoxication, the method appears to have a deleterious instead of a favourable action". The above quotations are from R. W. Allen's "Vaccine Therapy". Owing to the fact that most of his patients lived at distant farms the writer has not been able to apply this treatment in a sufficiently large number of cases to reach a definite conclusion. The vaccines used by the writer were not autogenous, but were prepared for each patient from the latest culture obtained by Birt from some other Philippolis patient. Birt was in the habit of sending the writer fresh dead cultures every few months. A thick suspension of killed M. Melitensis in normal salt solution numbering 100,000 million per c.c. was diluted down to form the vaccine. At first a strength of 500 million per dose of 1 c.c. was used: later the strength was reduced to 100 million per c.c. and an initial dose of ½ c.c. was injected, the dose being gradually increased up to 1 c.c.

The following are short notes on cases treated with vaccines:-

Case I:- J. D. P., a man aged 38 years, had been ill for two years at a farm 27 miles North-west of Philippolis. He was seen by the writer or his partner on many occasions at intervals of a month. The pyrexia varied from 100 F. to 103 F., lumbago, sciatica, intercostal neuralgia, extremely severe and disabling. Tongue lightly furred, constipation, orchitis, paresis of the legs below the knees. In April, 1906, he was taken to the town, At this time his temperature was lower, 99 F to 101 F. He received/

received two injections of 500 million, one in each flank, at an interval of a week. At the site of each injection a tender bluish red fluctuating tumour appeared in a few days. The writer refrained from incising these abscesses, believing that if antibodies would be formed at all, they would be formed locally. One of the abscesses (the first formed) pointed and oozed a little, but the bulk of the contents of both became slowly absorbed. The vaccines had no immediate effect upon the temperature, but there was a gradual fall to normal, and in three weeks convalescence was established.

Case II.:- In September, 1906, Mrs. G., a stout florid woman, aged 36, was found to be suffering from Undulant Fever in an acute form, the pyrexia being high and the agglutinins strong. Birt got a culture of M. Melitensis from her blood. She received four injections of 500 million cocci at intervals of a week. The local reactions were slight. The illness was acute for six weeks, and the vaccines had no obvious effect. The fever then became lower, and the disease ran a chronic course for eighteen months, with severe neuralgia of back and legs, spleen much enlarged and hardened, anaemia, emaciation, and movable kidneys. Recovery was ultimately complete.

Case III.:- P. P., a man aged 60 years, whose wife and four children were convalescent from Undulant Fever, became ill in January, 1906. The fever was acute for three months, - severe neuralgia of back and legs came on early - foul tongue with thick greyish white fur - constipation obstinate - liver and spleen enlarged - oedema of legs - no albuminaria. A dose of 500 million injected into each/

each flank at an interval of a week. Cold abscesses similar to those described in Case I. formed at sites of injections. No effect from vaccines beyond a slight rise in the agglutination limit, which might have been due to other causes. The illness lasted nearly two years. Towards its termination there was paralysis of the extensors of the feet, with exaggeration of patellar reflexes. The man is now in excellent health, but his legs and back have never fully recovered. They are sometimes painful still, and his gait is always peculiar. He walks with his back stiff and erect, and takes short jerky steps.

Case IV.:- Miss B., the patient who furnished Chart V. was treated with vaccines in doses of 500 million on four occasions indicated by the letter "V" on the Chart. The local reactions were slight, and the patient expressed a feeling of well-being the day after each injection, whihh might have been due to suggestion. The vaccines were given generally about four in the afternoon. They had no obvious effect, and the ilness, as already recorded, was prolonged and severe.

Case V.:- Miss N., aged 22 years, took ill in November, 1906. Fever high for six weeks - four vaccines of 500 million given during acute stage - local reactions slight - no obvious effect - remained in bed for two and a half months - emaciation and severe neuralgia of back and legs - purpuric eruption on legs and abdomen - convalescence not established for six months.

Case VI.:- Policeman M., aged 27, contracted the disease through taking goats' milk with his porridge at a station/

station 27 miles south-east of philippolis in November and December, 1908. Took ill in the beginning of January, 1909. Pyrexia acute resembling that of Typhoid Fever for three weeks - constipation - no delirium - light silvery fur on tongue - first wave of fever lasted exactly three weeks - Serum negative to M. Melitensis five days after beginning of illness but positive at end of three weeks. Birt found the second sample positive complete in 1000, and got a pure culture of M. Melitensis from it, - A succession of waves of fever until the end of March, 1909, - five vaccines of 50 to 100 million given in February and March, 1909. Effusion in right knee for two weeks after pyrexia had ceased, after which uninterrupted recovery. The temperature chart was unfortunately lost.

Case VII.:- An Englishman, F. S., aged 25 years, whose temperature chart is shown (No. IX. The case has been described in the section devoted to the description of charts. Two series of vaccines were given in May, June, and July, 1909, as indicated by the marks "V" on the chart. The second series was made from a strain derived from the blood of constable M., the preceding case. Recovery in two months after beginning of treatment. Gradual fall in temperature curve but no obvious immediate relationship between the vaccine injections and the temperature.

Cases VIII. and IX.:- Mrs. P. V. and Mrs. D. S., whose charts are shown (X & XI), and whose cases have been described. These received vaccines, as indicated by the letter "V" on the charts, when the pyrexia had become of the chronic type. There is apparent a gradual fall

but/

but no immediate effects. The disease may be said to have died hard in both cases.

Vaccine treatment was given in a number of other cases, but owing to the long distances of the farms at which the patients lived, the injections were few and far between, and there were no opportunities of making continuous observations such as would lead to definite conclusions.

The observations recorded above by the writer tend to lead to conclusions which are not inconsistent with those arrived at by Basset Smith, and quoted by the writer on page 43 .

An abstract from "The Hospital", October 20th, 1906, giving an account of the treatment with cyllin of eight cases of Malta Fever by Fleet Surgeon D. J. McNab was sent to the writer by the makers of cyllin. It appeared that the average duration of the disease was shorter in the cases treated with cyllin than in those treated without it, and that the pyrexia lost its undulatory character under the cyllin treatment.

In the three cases of Andrew, Alice, and Annie Lindsay (Charts VI., VII., & VIII.) the writer used the cyllin treatment throughout, the dosage being that used by McNabb, viz.:- 2 three-minim capsules of cyllin by the mouth thrice daily. The patients being children aged 11, 10 and 9 years, only one capsule thrice daily was given for the first few days until it was found that the cyllin was well tolerated. It can be seen from the Charts that although the duration of the illness in all three cases was short, the periods being

42, 45, and 26 days, the fever was high, and the undulations were the best marked which the writer has to show. It must not be forgotten that the disease tends to run a short course in children.

Constable M. (Case(VI.) of vaccine treatment) was treated with cyllin concurrently with the vaccine treatment. Several other cases were treated with cyllin by the writer, but there were no proper opportunities for observing the effects. In no case in which the treatment was carried out consistently did the illness last longer than four months, but such rapid effects as those described by McNabb were never observed by the writer. Cyllin is prepared by the Jeyes' Fluid Sanitary Compounds Company. It is said to be an almost non-toxic powerful antiseptic, the whole of which is recoverable from the faeces after swallowing. Its action, if it has any, on a disease like Undulant Fever, which is a true septicaemia, must therefore be an indirect one.

Probably the proper care and nourishment of the patient, and the treatment of symptoms are still of more importance than any form of specific treatment that has hitherto been tried. The writer has little to add to the recommendations of others, but a few points may be emphasised:-

(1) In all acute cases the patient should be kept in bed during the first month of the illness, or longer if the illness persists in an acute form.

(2) To guard against the neuralgiae warm clothing should be worn, whether the patient be in or out of bed, due regard being had to the temperature of the air.

(3)/

(3) The diet need never be so severely restricted as it usually is in the treatment of Typhoid Fever. During the early acute stage soups, milk, custard, jellies, and farinaceous milk puddings may be given. Later the patient may be allowed to return to his normal diet of meat, vegetables, bread, etc., perhaps long before the fever has come to an end.

(4) The best treatment for high pyrexia in this disease, as in most others, is cold sponging or the bath.

(5) The patient should be allowed and even encouraged to get out of bed in the forenoon, after the acute stage of the pyrexia is over, and should return to bed in the afternoon when the temperature is about to rise. A tepid or cold bath at two o'clock in the afternoon, just before the patient retires to bed, is often well borne, and is an excellent means of keeping the evening temperature lower.

(6) Constipation must be combated for obvious reasons already given. Tonics such as Nux Vomica, Strychnine and Digitalis may be given at intervals for a few weeks at a time. The writer has found the following mixture useful in many cases:-

Tr. nuc. vom. ℥ii – ℥iv

Extr. cascarae Sagradae Lig. ℥ii – ℥i

Spt. ammon aromat ℥ss

Aq. ad ℥vi

℥ii t. i. d. p. c. ex. aq.

The following notes on two cases illustrate the remarkable effect of securing regular evacuations of the bowels:-

Case (1)/

Case (1):- Mrs. C. was taken to Philippolis by cart from a farm 42 miles north-west of the town. Her temperature at 5 p.m. was 103.6 F.- tongue large and flabby, and covered with a thick yellowish white coating - abdomen distended with flatus - muscular tremors - no delirium. The bowels had not been opened for five days, and the fever was said to have begun ten days previously. The patient had been drinking goats' milk for some months and her husband's brother had contracted Undulant Fever at the same farm. Her serum was found to agglutinate the M. Melitensis completely in dilution of 10 and 100. Treatment:- milk and soup diet, 4 grs. of calomel with 2 grs. of extract of hyoscyamus in pills, and the mixture of nux vomica and cascara. The constipation was relieved, and the cascara mixture was found to be sufficient to cause a daily motion. In three days the tongue was clean, and the temperature became normal, and in ten days the patient travelled to Johannesburg apparently quite convalescent. It was reported by her relatives that she remained well.

Case (2):- Mrs. B., aged 23, came to Philippolis from a farm 24 miles North North-west of the town in September, 1909. She complained of weakness and wasting. She believed she was suffering from Undulant Fever because several of her brothers and sisters on the same farm had been infected during the past year, and one brother was still on crutches. Her temperature at 7 p.m. was 102.3 - tongue moist and almost clean with light silvery fur - constipation absolute for ten days. Her serum completely agglutinated the M. Melitensis in dilutions of 10 and 100. The clumping came on rapidly. Birt found complete clumping of three different strains of M. Melitensis/

Melitensis in a dilution of 2000. After she had taken a mixture the same as that prescribed for Mrs. C. her temperature became normal in five days, and she returned to the farm. She was reported to have suffered from ill-health for some weeks longer, but she did not require to call a medical attendant again.

In the above two cases it appears that the constipation was the main evil, and that when freed from auto-intoxication the patients were able to use their defensive mechanism effectually against the M. Melitensis.

SERUM DIAGNOSIS and CULTURAL EXPERIMENTS.

Many obscure cases of Undulant Fever can be diagnosed with certainty and rapidity only by means of the agglutination test or by culture.

On 1st June, 1904, Dr. Edington of the Government Laboratory, Grahamstown, intimated to the writer that he had received a supply of M. Melitensis. Between that date and August, 1905, the writer sent to Dr. Edington and to Dr. G. W. Robertson, Government Bacteriologist, at Capetown, blood samples from twenty-five patients, which were found to agglutinate the M. Melitensis in dilutions of 1-10 to 1-50. Normal controls were negative. Higher dilutions were not tried. These results were published in the British Medical Journal of 15th July, 1905.

In August, 1905, Lt.-Colonel Birt, then stationed at Pretoria, communicated with the writer expressing his interest in the subject, and his desire to test the serum of/

of persons suffering from Undulant Fever, or persons who had recovered from the disease. Since August, 1905, the writer has been in constant correspondence with Lt.-Colonel Birt, and has sent him blood samples from every case of Undulant Fever which he has met with in his practice, as well as numerous samples from cases occurring in the practice of others in other parts of South Africa. The writer has to express his great gratitude and sense of indebtedness to Lt.Colonel Birt, who, during the past six years has examined and reported upon all the material sent him by the writer, viz.:- 329 samples, consisting of human blood, milk, pus and serous fluid, and goats' and cows' blood and milk. Since August, 1905, Lt.Colonel Birt has kept the writer supplied with killed cultures of M. Melitensis, with which the writer has been enabled to carry out the treatment himself, and to prepare vaccines for treatment. At first the M. Melitensis sent by Lt.-Colonel Birt was derived from Mediterranean sources, but in March, 1906, at Q. Alexandra's Hospital, London, he began to plate out the blood samples sent by the writer, and to obtain cultures of M. Melitensis from some of them. The results of work done by Lt.-Colonel Birt now about to be recorded are the most valuable which the writer is able to produce in support of his thesis. Other bacteriologists to whom the writer wishes to express his thanks and whose work will be recorded, are the following:- Major J. M. Buist, Major Statham and Major J. G. McNaught. By means of the serum test the writer was enabled to select the material which was sent to the above named gentlemen.

In the vast majority of cases of Undulant Fever in human subjects a positive reaction is obtained in a dilution of the serum of 10 or upwards provided the test be

applied/

applied not earlier than five days after the onset of pyrexia. In a small minority, in which pyrexia is low or absent, the reaction may be negative. The writer has met with only two such, and in one of these a positive reaction was found later. A third, in which the writer found an incomplete positive reaction in a ten-fold dilution, gave a negative reaction in the hands of Birt three weeks later, but furnished a culture of M. Melitensis. On the other hand the writer has never known a case in which a complete positive reaction was found in a ten-fold dilution, which did not prove to be Undulant Fever clinically or by culture. (24) According to Birt and Lamb complete clumping in a dilution of 1-10 is diagnostic of Mediterranean Fever past or present. They found the serum negative in 150 individuals, of whom 50 were in normal health, and 100 were suffering from various diseases other than Undulant Fever. (25) Basset Smith using a dilution of 1-30 found the serum negative in 146 out of 150 cases representing 41 different diseases other than Undulant Fever. In the remaining 4, in which positive reactions were got, there were histories pointing to Undulant Fever in the past.

In a paper on Mediterranean Fever in South Africa read in the section of tropical diseases at the annual meeting of the British Medical Association, held at Exeter, July-August, 1907, Birt made thefollowing statement regarding the value of the agglutination test in Malta Fever:- (26) "It is essential to make use of a recently isolated culture or one grown on a medium which does not induce auto-agglutinability or sensibility to the agglutinins of normal blood. I have found that emulsions of growths on glucose nutrose agar of + 25 reaction (Eyre's scale),/

scale), though isolated more than a year, are still satisfactory. When emulsions of old laboratory cultures on ordinary agar are made with physiological salt solution no clumping may be apparent, yet a minute trace of human serum from any source may agglutinate the micrococci completely. Hence it is incumbent on the bacteriologist to control his emulsion by testing with normal human blood. A reliable culture is usually unaffected by, and is never completely clumped by, a ten-fold dilution of blood serum derived from healthy people or from those suffering from any disease except Malta Fever". The writer has quoted the work and opinions of these bacteriologists at some length because doubts have been cast upon the value of the agglutination test in Undulant Fever.

(27) In a joint paper by Lt.-Colonel Birt and the writer published in the Journal of the Royal Army Medical Corps (Aug. 1909, pp. 159-165) Birt has given an account of his method of testing serum for agglutination, and of cultivating the M. Melitensis from small blood samples such as the writer was in the habit of sending him. When making the glass capsules for the blood the writer always sealed both ends of the capsule in the flame. At the moment of using the ends were broken with a sterile instrument. The lobe of the patient's ear was washed with alcohol (90 per cent), and dried with sterile absorbent wool The blood was drawn off through a puncture made in the lobe of the ear with the broken capillary end of the capsule. It was found that this method was less painful to the patient than the making of a hole with a needle, and the puncture couldbe made to bleed much more freely than that made with a needle, a clean hole being punched out by rotating the hollow capillary limb. Out of/

of 185 samples taken in this way, and plated by Birt, 127, or 68.6 per cent, were found to be uncontaminated. Two capsules, each half full of blood, were taken from each patient, one of which the writer kept for the serum test, while the other was sent to Lt.-Colonel Birt unbroken. By weighing ten capsules empty and then half full of water the writer found that the average capacity of half a capsule was 84 c.mm., or less than $\frac{1}{10}$ c.c.

The transit of the capsules to London occupied about three weeks. Birt found that the agglutinins did not undergo much diminution after several weeks. A serum six weeks old clumped the M. Melitensis when diluted 1-12000, eight weeks later it was reduced to "500" and two years later it was "640". The last figure indicates an apparent increase, which was perhaps due to the use of a more sensitive emulsion.

(28) "In thirteen samples the highest agglutination 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 agglutination power of the blood. Thus a serum, the value of which Strachan determined as $\frac{1}{360}$, reacted in London $\frac{1}{180}$, though contaminated."

The above quotation is from Birt's contribution to the Royal Army Medical Corps Journal of August, 1909. The /

The fractions really indicate the proportion of serum used; the agglutination value would be better expressed by their reciprocals. The number of bacteria suspended in a given volume of the emulsion, in other words the thickness of the emulsion, is a factor which has to be taken into account in estimating the agglutinative power of the serum, thinner emulsions becoming clumped in higher dilutions of the serum. The emulsions used by Birt contained fifty thousand million cocci per c.c., and those supplied by him to the writer contained one hundred thousand million, which were diluted down to fifty thousand million before being used. When a dilution of serum with emulsion has been prepared there are two methods of examining it, viz.:- microscopic and macroscopic. It may be examined immediately in a hanging drop under the microscope, when clumping will be seen, in some cases immediately, in others within half-an-hour. A time limit of half-an-hour is usually given. The writer has frequently seen clumping appear immediately in a 100 fold dilution of a specific serum, while a 10 fold dilution of his own serum or of another non-specific serum showed not a trace of clumping after twenty-four hours. A $\frac{2}{3}$ and a $\frac{1}{6}$ objective with a No. 4 eye piece are sufficient for the purpose. The lower power is strong enough to show a complete reaction, which may be visible to the naked eye, but when the reaction is feeble, small clumps may be seen with the higher power, while only a roughening or coarse grained appearance of the field is seen with the lower. A complete reaction is indicated by discrete clumps and the absence of free moving cocci.

The /

The macroscopic method consists in preserving the serum diluted with emulsion in a capillary tube, which is kept vertical for 12-24 hours. A complete reaction is indicated by complete clarification of the previously turbid fluid, and the appearance of one or more dense white masses of clumped cocci which have fallen towards the bottom of the column of fluid; a partial reaction, by similar masses with incomplete clarification. The writer has made use of both methods, the microscopic method being used when an immediate diagnosis was required, or when only a small number of samples had to be tested.

All the agglutination tests carried out by Birt and the writer were efficiently controlled, non-specific serum from healthy individuals or from persons suffering from diseases other than Undulant Fever being tested against the emulsions used in 10 fold dilutions. Dead cultures only were used except on certain occasions when Birt tested the serum against the living germ obtained from the same serum. Living cultures appear to be more readily clumped, but Birt considers them to be less reliable, besides being dangerous to work with. The following quotation is from Birt's paper published in the Royal Army Medical Corps Journal of August, 1909, p. 161:- (29) "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."

Most/

Most of the blood samples sent by the writer to Lt.-Colonel Birt were tested to their agglutination limits. In his reports he has given for each sample a series of numbers indicating the dilutions in which complete clumping took place, and other series in which the reaction was incomplete characterised by the terms, nearly complete, well marked, marked, a trace, a faint trace, nil.

The following tables exhibit the highest dilutions in which a complete reaction, and the highest in which an incomplete reaction was found in each of 206 cases occurring in the writer's practice, 171 being white, and 35 negro or coloured patients. The latter have been put in a separate table. The letters "M. M". indicate that a culture of M. Melitensis was grown from the blood. Where the same numbers occur in the columns headed complete and incomplete no higher dilution was tried:-

WHITES.

Complete.	Incomplete.	Culture.
20	40	
40	160	
20	40	
200	2400	
400	400	
20	30	
20	90	
30	90	
200	1000	
20	90	
20	90	
90	90	
10	30	
60	200	
120	120	
30	90	
10	30	
10	10	
10	30	
90	300	
100	150	
100	1000	
0	10	
20	1000	
30	40	
100	150	

W H I T E S (Continued).

Complete.	Incomplete.	Culture.
50	100	
10	50	
10	40	M.M.
50	100	
10	30	
200	800	
40	100	
400	800	
480	480	
200	200	
0	10	
50	50	
40	80	
10	20	
640	1280	
40	80	M.M.
20	80	
1000	4000	
80	160	
20	80	
10	80	
620	1200	
40	80	
40	80	
80	320	
20	40	
10	80	
10	20	
10	20	
0	10	
40	160	
10	40	
40	80	
10	160	
20	160	
1280	1280	
80	320	
50	200	
80	640	
80	400	
640	640	M.M.
640	1000	
160	1280	
160	320	M.M.
80	320	M.M.
160	320	M.M.
640	1000	M.M.
1000	4000	
80	160	
10	80	M.M.
20	80	
80	320	
40	80	M.M.
40	80	
160	320	
40	160	M.M.
10	20	
80	160	
20	80	
160	640	
40	160	
20	40	
160	320	
10	20	
640	1000	

W H I T E S (Continued).

Complete.	Incomplete.	Culture.
320	640	
40	80	M.M.
320	640	
80	160	
40	80	
80	640	M.M.
160	320	M.M.
160	1280	
640	1000	
40	160	
20	40	
500	1000	
80	640	M.M.
40	80	
40	160	
40	160	
20	80	
320	640	
20	160	
10	20	
100	100	
0	0	M.M.
80	160	M.M.
320	320	M.M.
80	160	
40	80	
0	10	M.M.
10	20	
10	40	M.M.
40	160	
80	160	M.M.
640	2000	
80	160	
1000	2000	M.M.
20	160	
?	640	
20	160	
10	80	
80	80	
320	800	
20	40	
400	2000	M.M.
200	1600	
30	30	
10	40	
20	160	M.M.
40	160	
40	320	M.M.
160	160	
640	2000	M.M.
2000	2000	
160	320	M.M.
40	80	
40	80	
1280	4000	
320	320	
40	160	
20	20	
160	640	
80	100	M.M.
40	640	M.M.
640	1280	M.M.
320	640	
80	160	
320	320	

W H I T E S (Continued).

Complete.	Incomplete.	Culture.
160	160	
40	80	
640	640	
20	80	
40	80	M.M.
640	1280	
40	40	
320	1280	M.M.
0	10	
80	320	
20	80	
20	40	
0	0	M.M.
1280	1280	
40	160	
640	640	
80	640	
10	40	

NEGROES & COLOURED.

Complete.	Incomplete.	Culture.
50	100	M.M.
200	400	
0	20	
10	80	
80	160	
20	80	M.M.
20	160	
80	300	
0	10	
10	20	M.M.
160	320	
80	320	
200	400	
10	40	
10	40	
20	40	M.M.
10	20	M.M.
20	80	M.M.
640	2000	M.M.
0	10	
160	320	
40	80	
80	320	
20	80	
10	40	
320	400	M.M.
96	216	
40	160	
20	40	
160	320	
20	80	
80	160	
20	160	
20	40	
20	80	

The average dilution for a complete reaction in the series of whites is 173, and for an incomplete, 430. The number of cultures is 32 or 18.7 per cent of the cases. The average numbers in the negro series are 78 complete and 204 incomplete, and the number of cultures is 8, or 22.8 per cent of the cases. Thus, the average agglutination value among the negros is less than half that among the whites, while the percentage of cultures from negros is a little higher than from whites.

The writer has found that the febrile reaction to M. Melitensis infection, as well as the agglutination reaction, is lower in negros than in whites. The difference in the percentage of cultures obtained is probably of less significance.

The cultures were obtained from volumes of blood varying from $\frac{1}{50}$ to $\frac{1}{10}$ c.c.. The blood clot was planted on a glucose nutrose agar slope, and incubated at 37 C. Colonies of M. Melitensis, when a growth occurred, appeared usually within a week, but their appearance was delayed in some cases as long as 14, 20, 34, and 41 days. It will be seen from the tables that cultures of M. M. were obtained from two samples which gave no agglutination reaction, while three having a titre as high as 2000, and one with a titre of 4000, gave cultures. In the last the growth was limited to one Colony, and did not appear until 41 days had elapsed. The M. Melitensis is therefore capable of living for many weeks immersed in a serum containing powerful specific agglutinins.

(30) "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/

in milk, by their readiness to form 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". "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 following are minimal volumes of blood from which M. Melitensis was isolated by members of the Mediterranean Fever Commission:-

.01 c.c. (31) (Staff Surgeon R. T. Gilmour, Pt. I. of Reports p. 76)

.005 c.c. (32) (by Do. T. Zammit on two occasions, from a man and from a monkey, both acute cases, temperatures 104 F and 105 F, respectively. - Pt. I, p. 91)

$\frac{1}{256}$ c.c. (by Staff Surgeon E. A. Shaw (Pt. I. p. 103) and (Pt. III. p. 19).

The most certain method of obtaining cultures of M. Melitensis from the blood is to inject several c.c. into a flask of broth and incubate.

In March, 1907, Major Statham at Pretoria grew a culture of M. Melitensis from 5 c.c. of blood, which the writer drew from the median basilic vein of a negro woman. The blood was immediately injected into a flask of sterile broth, which was sent to Pretoria to be incubated. Birt at London obtained a culture from a small sample of blood from the ear of the same patient.

MODE/

MODE of TRANSMISSION of the DISEASE.

In many instances several individuals in one family became infected about the same time. The mode of infection was probably from a common source, not by direct contagion. (33) The Mediterranean Commission collected abundant experimental evidence tending to prove that contagion must be a rare mode. Monkeys could not be made to infect one another by contagion so long as they were prevented from soiling one another with their urine, in which it has been proved that the M. Melitensis is excreted.

In June, 1905, (34) the momentous discovery was made by the Mediterranean Commission at Malta that the goat is the chief factor in the spread of the disease there. The writer's attention was therefore turned to the question of the presence of goat carriers in South Africa. It was found that Undulant Fever was most prevalent in that portion of the District of Philippolis, in which large numbers of goats are kept, namely, a strip of mountainous country 10 to 20 miles wide running from south-east to north-west along the Orange River. The north-eastern portion of the District was, and is, almost free from the disease. Undulant Fever had also been most prevalent during the first two years after the war, and among the poorer farmers. At that time cows were scarce and goats' milk was more largely used than at a later date. The majority of the patients stated that they had been in the habit of drinking goats' milk unboiled, chiefly in their morning coffee.

In October, 1905, the writer took blood samples from fourteen female goats of the hairy type called "Boerbok" (plural Boer-bokken) at a farm 29 miles north-west of Philippolis, where several cases of Undulant Fever had occurred/

occurred. The samples were sent to Pretoria to Lt.-Colonel Birt, but as he was on the point of leaving for England, he did not test them until he arrived in England. Only one gave a positive reaction, which was complete in a 20 fold dilution.

In February, 1906, blood samples were taken from 20 goats at a farm seven miles west of Philippolis, where a man lay ill with the fever. The writer tested these himself in dilutions of 1-20. Only one gave a positive reaction. Blood and milk specimens were taken from the same goat next day, and sent to Lt.-Colonel Birt, London, and to Captain Buist, Pretoria. Their reports were as follows:-

Buist:-

Serum positive 1-100

milk sterile.

Birt:-

Serum positive 1-40

milk sterile.

Captain Buist used living cultures.

At a farm ten miles west of Philippolis seven individuals had become infected between December, 1905, and February, 1906. They were distributed as follows:- Family P. 5 cases; Family B. Sr. None; Family B. Jr. 1; negro servant 1. Family B. Sr. had formerly lived at a farm 20 miles north-west of Philippolis, and the mother and daughter were found by the writer to be suffering from Undulant Fever in November, 1903. All the goats ~~were~~ being milked by family P, ~~numbering~~ in number seventeen, were tested for serum reaction to M. Melitensis in a dilution of 1-20. None gave a positive reaction. Then ten of B.Sr.s goats were examined, and one was found to give a positive reaction, complete in a dilution of 1-40. The milk from this/

this goat was scanty and serous. Birt and Buist confirmed the serum reactions, but Birt found the milk too much contaminated with other micro-organisms to render isolation of the M. Melitensis possible, had it been present. Milk samples from twenty more of B. Sr.s goats were collected, and tested against M. Melitensis in hanging drops, equal parts of milk and emulsions being used, with a time limit of twelve hours. The writer was surprised to find positive reactions, more or less well marked, in nine out of the twenty. As the emulsion contained 0.5 per cent of phenol, it was not considered necessary to add an antiseptic to the milk. (35) Dr. T. Zammit, Major W, H. Horrocks, and Captain J. C. Kennedy applied the milk test as above described and concluded that it was just as reliable as the blood test.

The disparity between the results of using the blood test and the milk test in the above instance was so great that the writer decided not to use the milk test again. Unfortunately the goats from which the milk was taken were not ticketed and numbered so that their serum might be afterwards tested to enable a comparison to be made between the behaviour of the serum and that of the milk from the same animals.

During the Summer 1907-1908, there was a severe epidemic of Undulant Fever in the town of Philippolis. Hitherto nearly all the cases had occurred at farms. In October, 1907, at a small holding on the town commonage one mile north of the town two members of a family, S., were found to be suffering from Undulant Fever. Subsequently two other members became infected. S. had a large herd of goats. His family drank the milk, and he sold it in the town. In the town cases of Undulant Fever continued to occur from October, 1907, to March, 1908. Most of the patients had been drinking goats' milk supplied by

S./

S. Some had been obtaining goats' milk from other sources, and some denied that they had ever taken goats' milk. The writer put up notices in conspicuous places warning the public against the use of goats' milk. For a time these notices were ridiculed and subjected to somewhat hostile criticism. It was contended that the disease, which apparently had been less prevalent in Philippolis before the war, and had not been known under the name, "Malta Fever", had been introduced to South Africa by the British troops. After the year 1908, patients were loth to admit that they had been drinking goats' milk. In one family, B., living in town, three individuals, in fact the whole family, were infected. Mr. B. said that they had never drunk goats' milk. On being questioned as to where he kept his cows, he replied that his two milch cows were kept by S. on the commonage. These cows were kept by S. in a Kraal adjoining the goats' kraal. The sera of five boerbokken and five Angora goats were tested in a dilution of 1-10. One of the boerbokken and two of the Angoras gave positive reactions. These were the first Angoras tested by the writer. The serum of one of the cows gave a positive reaction, almost complete, in 1-10. Major McNaught, using a living culture, found it complete in 10 and marked in 20.

A girl, L. v. S., a member of a large family living in town, became infected, and Birt got a culture of M. Melitensis from her blood. The family owned no goats, and did not drink goats' milk. They kept one cow. The serum of the cow gave a negative reaction. Probably L.v.S. became infected in some other house; for no other member of the family took the disease.

In the Natives' location all the members, three, of a family J. became infected. They kept only one goat, the serum of which reacted in high dilutions. The writer found

a/

a well marked reaction in a dilution of 40, but Major McNaught and Major Statham, using living cultures, found it positive up to 200. The goat was purchased by the writer, and sent alive to Pretoria to Major Statham. Owing to some disorganisation of the laboratory at Pretoria, Statham was unable to take the goat until three months after it was first examined. He fed a baboon on the milk for three weeks, but it did not become infected. He failed to get cultures of M. Melitensis from the blood or milk, but on slaughtering the animal he got one from the spleen.

S., J's brother, had two goats, kept in the same enclosure as J's. The writer found the serum of S's goats negative; Major McNaught found one positive in low dilutions. S's wife became infected in November, 1907.

Another negro and his son were found to be suffering from Undulant Fever in December, 1907. They kept and milked ten goats belonging to a white man. The writer found the serum of four of these positive in dilutions of from 10 to 40.

Major McNaught and Dr. G. W. Robertson, both using living cultures, found among the same samples, six positive, three doubtful, and only one absolutely negative. Goat No. 8, which gave the strongest reaction, was purchased by the writer, and sent alive to Dr. Robertson at Cape Town. Beyond a telegram stating that the goat had arrived safely, the writer never received any report on this goat, nor is he aware of the existence of any published report. Fresh blood samples from the four goats, which the writer found positive, were sent to London to Lt.-Colonel Birt. The agglutination reactions

were/

were confirmed by him, and the sample from goat No. 8, which reacted most strongly, gave a culture of M. Melitensis. It is remarkable that the other three were uncontaminated, although the hairy ears of the goats were not washed with an antiseptic.

In January, 1909, the writer examined ten goats belonging to an infected family, K., living near Philippolis. Two of them gave positive reactions, complete in 10 and marked in 20. These were confirmed by Birt. On culture they were found to be contaminated.

During the period October, 1909, to January, 1910, at a place near Philippolis, nearly all the members of a family, B., became infected, a breast-fed infant alone escaping. Birt got a culture from the blood of the mother. Two boer-bokken only had been milked by this family, and one of these gave a positive reaction, complete in 80, and well marked in 160, while the other was negative. The samples of blood and milk sent to Birt from this goat gave positive reactions. On culture they were found to be contaminated.

At the South African Medical Congress of October, 1910, two papers by Dr. A. Garrow of Steytlerville were read, one on the epidemiology, and one on the clinical manifestations of Malta Fever. Before presenting these papers to the Congress Dr. Garrow was kind enough to submit them to the writer's perusal. It appeared that the disease was almost as severely endemic in the District of Steytlerville, Cape Colony, as it had formerly been in Philippolis. Steytlerville is situated at an elevation of about two thousand feet above sea level, eighty miles north-west of Port Elizabeth, and about two hundred and fifty miles almost due south of Philippolis. The

farming/

farming industry there consists chiefly in the breeding of Angora goats and ostriches. The number of goats in the district is estimated at about 266,000, of which only about 40,000 are boer-bokken.

A district in South Africa is of about the same area as an average British County.

As the writer found it impossible to examine goats on a large scale in the district of Philippolis, owing to the exigencies of private practice, he suggested to Dr. Garrow that he should pay a visit to Steytlerville in order to spend some time there examining animals. Steytlerville being awkwardly situated as regards railway facilities, nearly a week had to be spent in travelling. During the last week of February, 1911, the writer was hospitably entertained by Dr. Garrow, who placed every facility for visiting farms in his way. It was decided to examine fifty goats at each of three farms, where cases of Undulant Fever had recently occurred, and fourteen at the native location, the property of a negro who was convalescent from Undulant Fever. At two of the farms the writer found that cows were kept in the goat-kraals. Blood was taken from all these, two cows at one farm, and three at another. Lt.-Colonel Birt having been engaged during the Summer of 1909 at Malta in the study of stand fly, phlebotomus or papatassii, fever the appointment which he had occupied at Q. Alexandra's Hospital was filled by another when he returned to England, and for several months he had not a laboratory of his own to work in. The supply of South African M. Melitensis having run short, Birt sent the writer an emulsion prepared from a Mediterranean Strain. With this and a thin emulsion, also of Mediterranean/

Mediterranean origin, supplied by Major J. G. McNaught, the tests at Steytlerville were carried out.

In the following tabular statement of the results the numbers on the left hand side of the brackets indicate the distinguishing numbers of the blood samples, while the numbers to the right indicate the dilution used, and the signs +, ±, ∓, and —, and indicate respectively "complete," "marked", "a trace", and "nil". The letter "A" indicates "Angora", "B", "Boerbok". On a parallel column are placed the results afterwards found by Major McNaught, to whom all the positive samples and all the cows' samples collected at the first two farms were sent as well as all the samples collected at the third farm.

Farmer Bester's Animals:- 25 Boerbokken, 25 Angoras, and two cows, of which the following were positive:-

Tested by Strachan.		Tested by McNaught.	
To M.M. Birt. Microscopic.		Microscopic.	
B_{11}, B_{25}	10 +	B_5, B_{11}	20 + 50 +
B_1, B_5, B_9	10 ±	B_1	20 ∓ 50 ±
To M.M. McNaught microscopic.			
B_{11}	10 + 40 ±	B_9	20 ± 50 —
		B_{25} broken in transit.	
B_{25}	10 + 40 ±		
B_5	10 ∓ 40 —		
To M.M. Birt Microscopic.			
A_9, A_{13}	10 ±	A_6	20 + 50 +
A_6	10 ∓	A_{13}	20 + 50 ±
To M.M. McNaught microscopic.			
A_9	10 ± 40 ±		

Tested by Strachan.	Tested by McNaught.
To M.M. Birt macro- and microscopic.	
White Cow, Black Cow } 10 ±	White Cow } 20 +, 50 +
	Black Cow } 20 +, 50 —

Farmer Joseph's Animals:- 10 Boerbokken, 40 Angoras, and 3 Cows.

Tested by Strachan.	Tested by McNaught.
To M.M. Birt macroscopic.	Microscopic.
B_7 } 10 ±	B_7 } 20 +, 50 +
A_5, A_6, A_{10} } 10 ∓	A_6 } 20 —, 50 — A_{10} } 20 ∓, 50 —
To M.M. Birt macro- and microscopic.	A_5 broken in transit.
Cow_1 } 10 +	Cow_1 } 20 +, 50 +
Cow_2	Cow_2 } 20 —, 50 —
To M.M. Birt } 10 —	
To M.M. McNaught } 10 ∓	
Cow_3	Cow_3 } 20 —, 50 —
To M.M. Birt } 10 —	
M.M. McNaught } 10 —	

Farmer Fitz Henry's Animals:- 17 Boerbokken and 17 Angoras.

As the writer found all of these negative except three which gave a mere trace of clumping, he sent them all to Major McNaught, who reported as follows on all which he received unbroken.

	20	50
A_{12}	-	-
A_5	-	-
A_{10}	-	-

Farmer Fitz Henry's Animals (Continued):-

	20	50
A_4	+	-
A_{17}	-	-
A_{11}	-	-
A_3	-	-
A_7	-	-
B_{10}	+	-
B_9	±	-
B_{3}	±	-
A_{6}	-	-
A_{15}	±	-
B_4	-	-
B_5	+	±
B_2	+	-
B_{11}	-	-
A_{14}	-	-
B_8	±	-
B_{17}	-	-
A_9	-	-
B_{13}	-	-
B_6	-	-
B_1	-	-
B_{10}	+	±
B_{15}	-	-
B_{12}	-	-
A_{16}	-	-

Thus, while the writer, using emulsion of dead germs found only three positive reactions in this herd, and these feeble and of doubtful significance in dilutions of 10, Major McNaught with living cultures found five complete, two marked, and two which gave a trace in dilutions of 20.

Major/

Major McNaught found the samples from the goats and cows of Farmers Bester and Joseph to give stronger positive reactions than those found by the writer.

The fourteen goats in the location were found by the writer to give negative reactions. Their blood samples were not sent to Major McNaught.

(36) The percentage of goats infected in Malta has been estimated by various authorities at 30 to 50. Of all the goats examined by the writer in South Africa, viz:- 227, from selected herds, excluding those to which the milk test only was applied, only 22, or less than 10 per cent, were found to give definite positive reactions in dilutions of 10 or over. The work done by Birt and the writer on South African goats is not strictly comparable to that done at Malta by the Commission; for Major McNaught was a member of that Commission; and it is to be presumed that his use of living cultures was that which was sanctioned by the Commission. There can be little doubt that one of Joseph's cows and the cows of Bester were infected.

(37) The serum of naturally infected goats is not usually so strong in agglutinins as that of human subjects, although in artificially infected goats the agglutinins may be greatly reinforced.

(38) It has been proved that the M. Melitensis is excreted in the urine of human subjects and animals suffering from Mediterranean Fever; (39) that the M. Melitensis can live for long periods in soil, dust, and water, if not exposed to the direct rays of the sun: (40) that monkeys can be infected by being made to swallow and inhale artificially infected dust. The infection of monkeys in this way was found to be/

be difficult except when the dust was grossly infected. The practical extinction of the disease among the troops at Malta since the consumption of goats' milk has been forbidden, renders it highly probable that among the troops the milk was the main source of infection. On the other hand it is not unlikely that the South African farmers and their families sometimes become infected by the dust in and about the goat kraals, which are built quite close to the dwelling houses. Doubtless the goats themselves become infected in this way as well as by direct inoculation of broken skin surfaces with infected urine. They are huddled together in their kraals for from eight to twelve hours every night according to the season of the year. Sheep and goats have to be kraaled at night because the country is infested with jackalls and negro-sheepstealers. (41) Eyre has shown that inoculation of abrasions on the udder of a goat with infected milk may cause infection, and he has suggested that the milkers may transmit the disease from goat to goat in this way. In South Africa only a small proportion of a large herd of goats are ever milked.

It might be supposed that Undulant Fever was introduced to South Africa in recent times through the importation of infected goats from the neighbourhood of the Mediterranean. The writer made some fruitless efforts to obtain information from the Agricultural Department of Cape Colony regarding the importation of goats to South Africa. No information could be given. It was said that no importations had taken place in recent times. Probably the Boerbok has been present in the country from prehistoric times. Major McNaught states that it is quite different from the Maltese goat. The Angora goat is probably a recent importation. The writer has found signs of M. Melitensis infection in both. The disease which was

for/

for many years before the late war, known at Kimberley as "Camp Fever", was Undulant Fever. Dr. A. W. Reid, Medical Officer of Health at Kimberley, informed the writer that when Camp Fever was prevalent in the early days of the diamond industry, goats' milk waslargely used in Kimberley. The disease is less common there now, and it is identified with Undulant Fever by means of the agglutination test. When the writer was in Cape Town, on his way home, in the beginning of June, 1911, he called at the Government Laboratory, and was shown by Dr. Severn a hanging drop preparation of a blood sample from Kimberley, in which clumping of the M. Melitensis was taking place. (42) In a list of names of countries and places where Mediterranean Fever is found, compiled by Dr. Ralph W. Johnstone as lately as April, 1905, for the Mediterranean Fever Commission (P II. p. 12 ofReports), South Africa is not mentioned, but "Kimberley" occurs with the mark "?" after it. Thus, the presence of the disease in South Africa was unknown or considered doubtful by some of the highest authorities on Mediterranean Fever at a time when the most important part of the present writer's work consisted in attending cases of the disease there.

(43) Last year the members of the "Sleeping Sickness Commission" found Malta Fever to be present in Uganda. Although Undulant Fever was first differentiated as a specific disease in Malta, there is no reason why Malta should always be regarded as the fons et origo mali. The question of origin is wrapt in the mists of antiquity. (44) According to Eyre both naturalists and palaeontologists agree that the early ancestor of all varieties of domestic goats /

To face p. 78

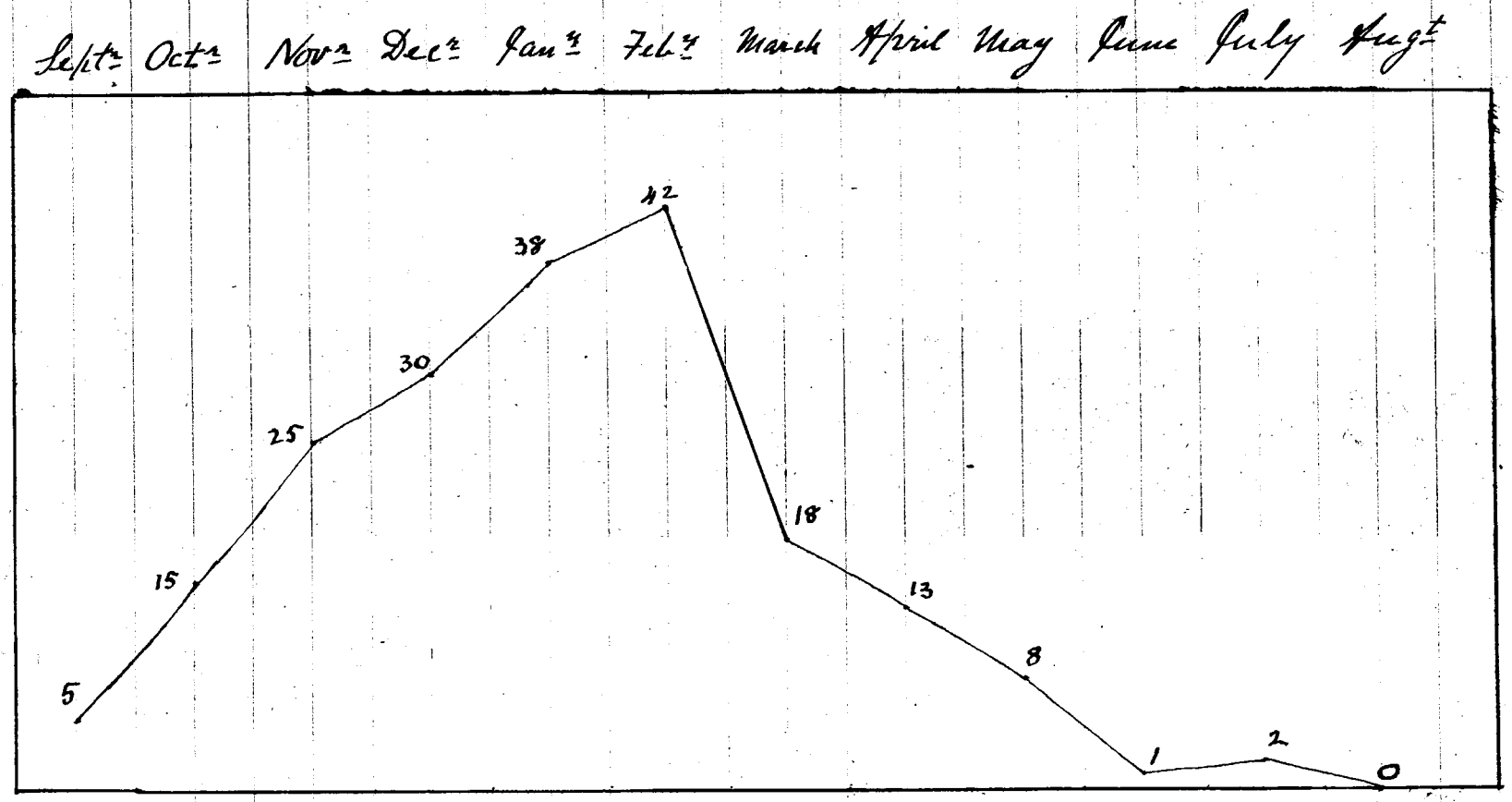


Chart showing seasonal distribution of Undulant Fever in Philippolis, South Africa, during 1905-1911.

goats is the Persian wild goat. Eyre is inclined to the opinion that M. Melitensis Septicaemia is primarily a disease of this goat, and has accompanied it in its world-wide wanderings, wherever it has been taken by prehistoric man, eastwards, westwards, and southwards along the east coast of Africa. He explains the confinement of Undulant Fever to tropical and sub-tropical countries by the hypothesis that the M. Melitensis finds a suitable habitat only in the caprine mammary glands which have become enlarged by selective in breeding in countries where the pasturage is unsuitable for cows. While Eyre's general theory of the origin of the disease commends itself to the writer, this last explanation of its geographical limitation does not seem adequate. Whatever may have been the case in the past, the Dutch farmer of to-day does not breed goats for their milk. The milk is a pure bye-product, so to speak. The boer-bok is bred for its flesh and its hide, while the Angora is bred for its woolly hair. On the other hand Undulant Fever is not endemic in Switzerland, where the goat is bred for its milk,

SEASONAL DISTRIBUTION.

The appended chart has been constructed by taking the number of fresh cases encountered during each month from September, 1905, to June, 1911. The form of the curve is almost exactly the same as that exhibited by (45) Eyre after Johnstone, as well as those shown by Major McCulloch, Major Weir, and Staff Surgeon Clayton for the years 1903, 1904, and 1905 (fronting p. 163 Pt. VII. of Reports of Mediterranean Fever Commission). The season is/

is reversed, as might be expected, in the Southern Hemisphere. Instead of in July and August, we find the largest number of cases in December, January, and February, the hottest months of the year. The rainfall is low, and very irregular in the South of the Free State. In a normal year January and February are the wettest months, and there is no rainfall in winter, May to end of August. In Maltz the hottest season is the dry season. The writer is of the opinion that no direct relationship exists between the State of the weather and the prevalence of Undulant Fever. During a dry Summer cows' milk is scarce, and goats' milk is likely to be drunk in greater quantity: the possibility of dust transmission is also greater.

The kids begin to be born at the end of July, by September the female goats are all in full milk. In December they begin to dry up, but those milked by hand can be kept in milk for several months longer. In the early winter the goats are pregnant and dry. It will be observed that the month of August is the only one in which no fresh cases were ever found.

PROPHYLAXIS.

Doubtless the prevalence of the disease would be enormously dimished if goats' milk were never drunk, or if it were always sterlised by heat before use. No South African Government would incur the great expenditure necessary for the individual examination of all the goats in the country, and the segregation of those found to be infected.

The following precautions suggest themselves:-

(1) Cows should not be kept in the neighbourhood of goat kraals.

(2)/

(2) Goat kraals should not be built near dwelling houses, nor in such a position that dust from them may be carried to dwelling houses by the prevailing wind.

(3) Kraals, and especially roofed sheds, where goats are kept should be frequently cleaned and disinfected either by spraying with some cheap disinfectant, or by burning some of the dried dung in Situ.

There has been a steady decline in the prevalence of Undulant Fever in Philippolis District since 1908. In that year 38 cases occurred. In 1910 there were only 14 and in the early part of 1911, January to May, the writer found only three cases in the district of Philippolis, and one from the district of Colesberg, Cape Colony, The knowledge that goats are held responsible for the spread of this disease is now widely distributed, and the belief that they are infective is gaining ground among the people

GEOGRAPHICAL DISTRIBUTION IN SOUTH AFRICA.

During the Autumn and Winter of 1906 the writer sent circular letters to medical practitioners in the high veld of Cape Colony, the Orange River Colony, Basutoland, Natal, and the Transvaal. In those circulars a brief clinical description of the disease was given, and information as to its presence or absence in each district was requested. An offer to test blood samples from cases was made. The dates of sending these circulars, number sent to each Colony, and numbers of replies received were as follows:-

Date/

Date.	Colony	Number Sent	Number of Replies
13th March, 1906	Cape Colony	47	25
12th June, 1906	Orange River Col.	62	22
" " "	Basutoland	2	3
10th July, 1906	Natal	30	8
16th July, 1906	Transvaal	42	14

The result of this investigation was published in the South African Medical Record of 10th December, 1906. The accompanying spot map of South Africa is a copy of the one published on that occasion, with certain additions rendered possible through information obtained since then. The places are numbered and their names are given in a key to the map.

The following notation is used:-

0 - Disease never observed.

\- " diagnosed clinically.

⊛ - Blood samples sent gave positive reactions. in dilutions of 30 or over.

? - Presence of disease doubtful.

The map speaks for itself, and only a few comments are required. Undulant Fever appears to be endemic all along the valley of the Orange River from Bethulie to Uppington; In the south-east, west, and north-west of Cape Colony; in the Orange Free State; in Basutoland; In the north of the Transvaal; and in Bechuanaland.

By the medical Officers at Leribe, Maseru, and Mohaleshock, all in Basutoland, Undulant Fever was believed to be endemic in Basutoland. Negative reactions, however, were found in one blood sample sent from Leribe, and in another sent from Mohaleshock. The writer has frequently seen negro servants, who had served their time, trekking back/

back with herds of goats from Philippolis to Basutoland. Thus, if the disease were not already endemic in Basutoland, it would hardly fail to be introduced there.

CONCLUSIONS:-

(1) That Undulant or Malta Fever is endemic, and widely distributed, in South Africa.

(2) That its clinical manifestations do not differ materially from those exhibited by the disease in Malta.

(3) That the infecting organism is the same, namely, the Micrococcus Melitensis.

(4) That the mode of transmission is the same as in Malta.

(5) That it is not necessary to assume that the disease has been introduced into South Africa in recent times.

P. D. Strachan.

12th August. 1911.

KEY to MAP.

Cape Colony.

1. Laingsburg
2. Prince Albert
3. Clanwilliam
4. Sutherland
5. Beaufort West
6. Pearston
7. Williston
8. Murraysburg
9. Carnarvon
10. Richmond.
11. Hanover
12. De Aar
13. Petrusville
14. Fraserburg
15. Hopetown
16. Prieska
17. Kenhardt
18. Uppington
19. Griquatown
20. Kimberley
21. Barkly West
22. Taungs
23. Mafeking
24. Douglas
25. Steytlerville
26. Somerset East
27. Bedford

Orange River Colony.

1. Bethulie
2. Rouxville
3. Springfontein
4. Philippolis
5. Luckhoff
6. Koffyfontein
7. Fauresmith
8. Jagersfontein
9. Reddersburg
10. Wepener
11. Bloemfontein
12. Winburg
13. Senekal
14. Ficksburg
15. Ventersburg
16. Vredefort
17. Frankfort
18. Vrede
19. Heilbron
20. Boshof

Basutoland.

1. Mahaleshoek
2. Maseru
3. Leribe

Transvaal.

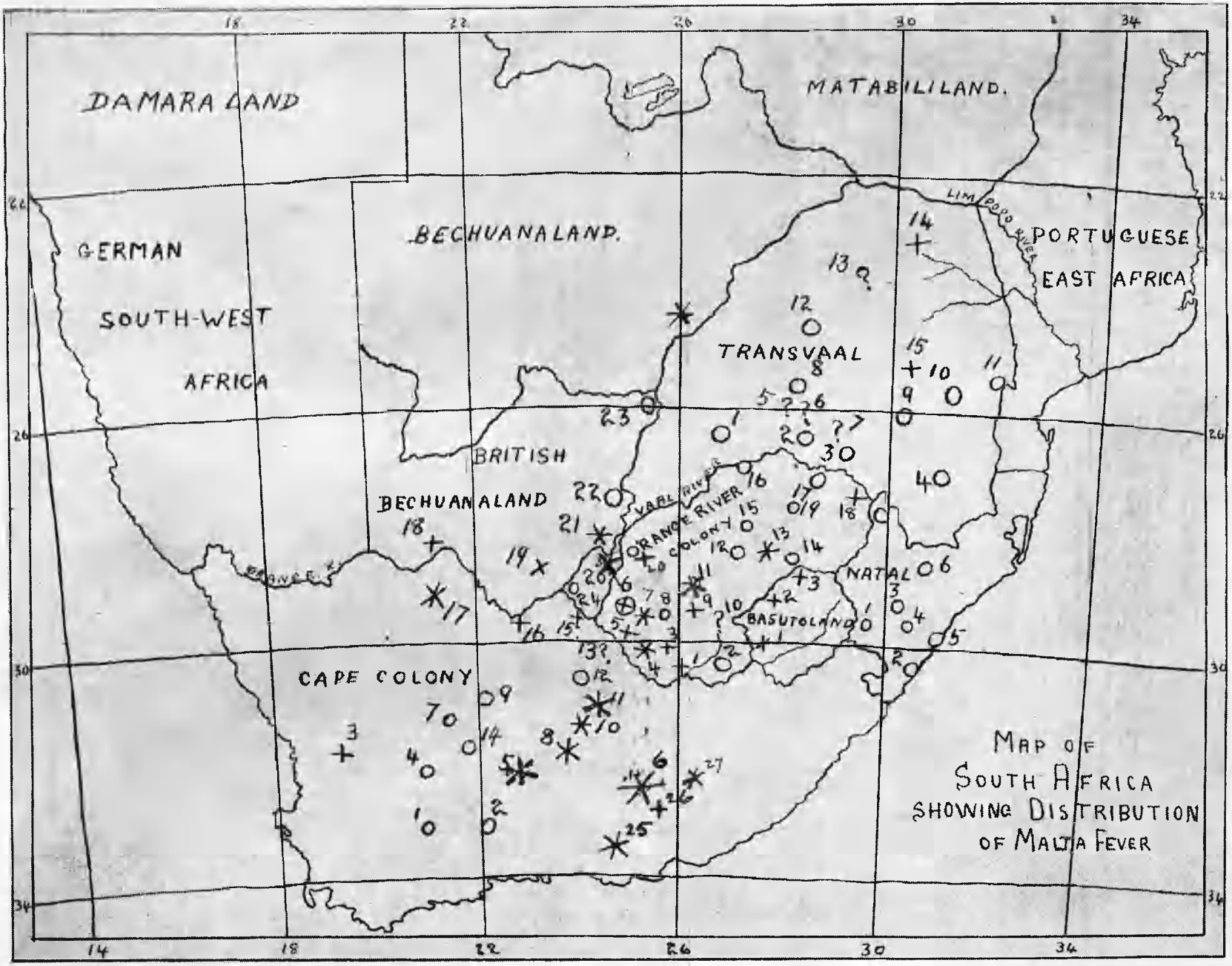
1. Ventersdorp
2. Heidelberg
3. Waterval
4. Post Retief
5. Johannesburg
6. Boksburg
7. Nigel
8. Pretoria
10. Barberton
12. Nylstroom
13. Pietersburg
14. Zoutpan
15. Belfast

Natal.

1. Impendhle
2. Umzinto
3. Howick Falls
4. Pietermaritzburg
5. Durban
6. Krantzkop

Bechuanaland.

1. Gaberones.


DAMARA LAND
MATABILILAND.
GERMAN
SOUTH-WEST
AFRICA
BECHUANALAND.
TRANSVAAL
PORTUGUESE
EAST AFRICA
LIMPOPO RIVER
BRITISH
BECHUANALAND
VAAL RIVER
ORANGE RIVER
COLONY
NATAL
BASUTOLAND
CAPE COLONY
MAP OF
SOUTH AFRICA
SHOWING DISTRIBUTION
OF MALTA FEVER

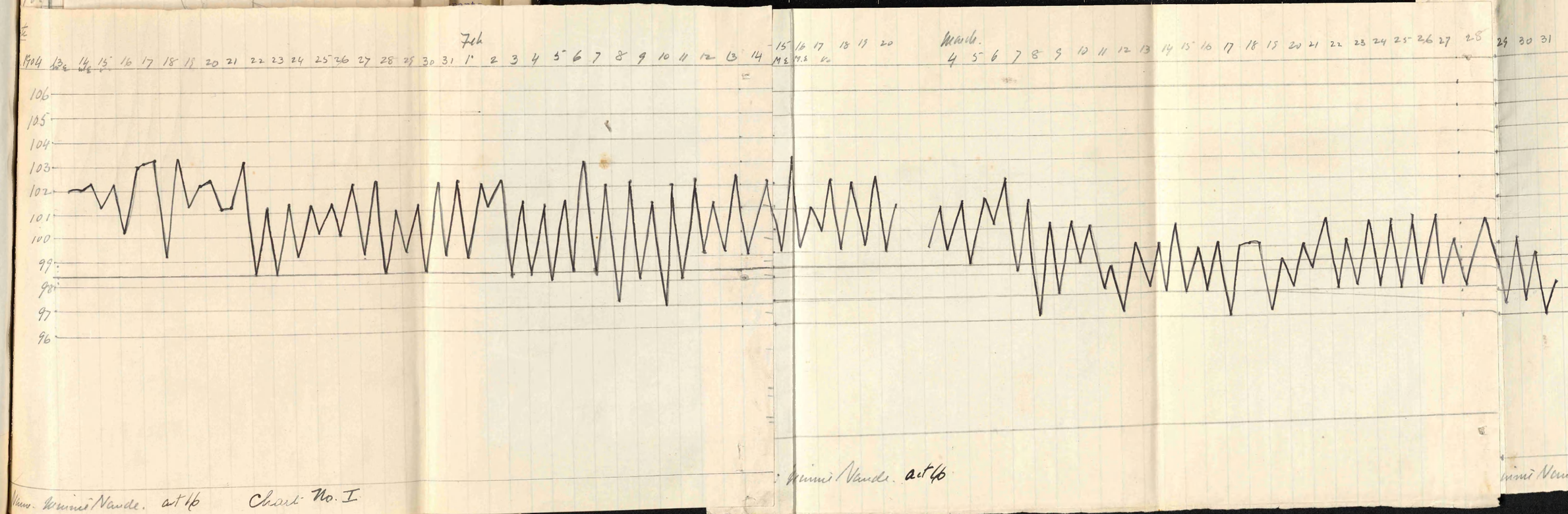
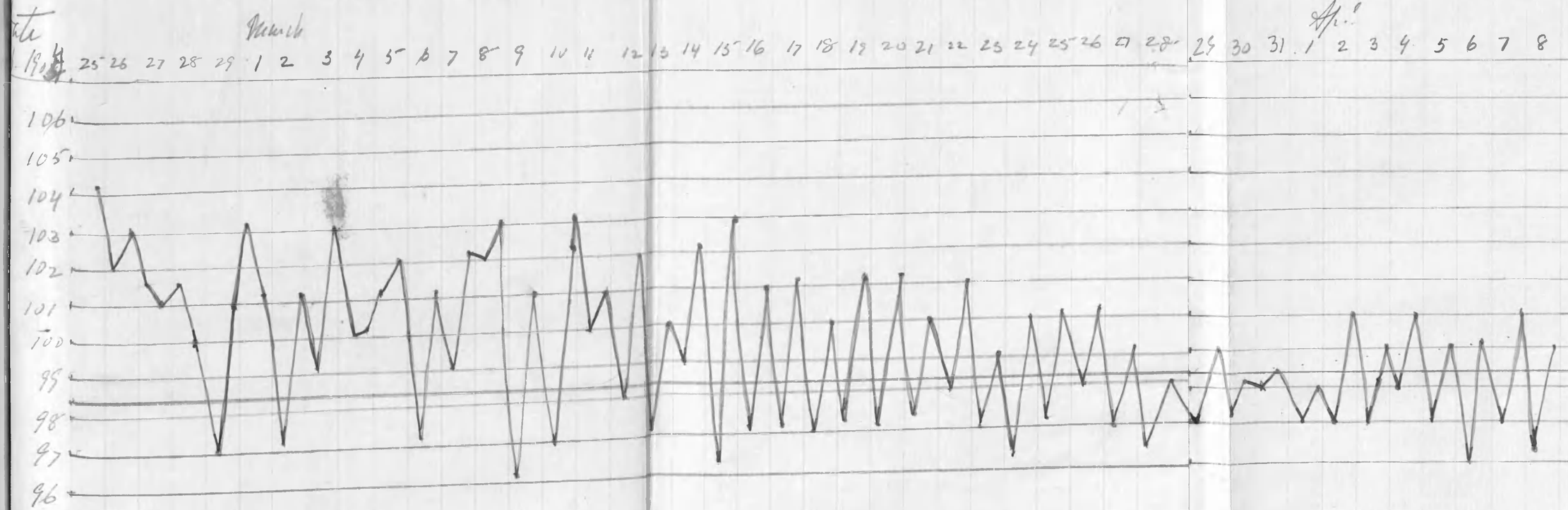
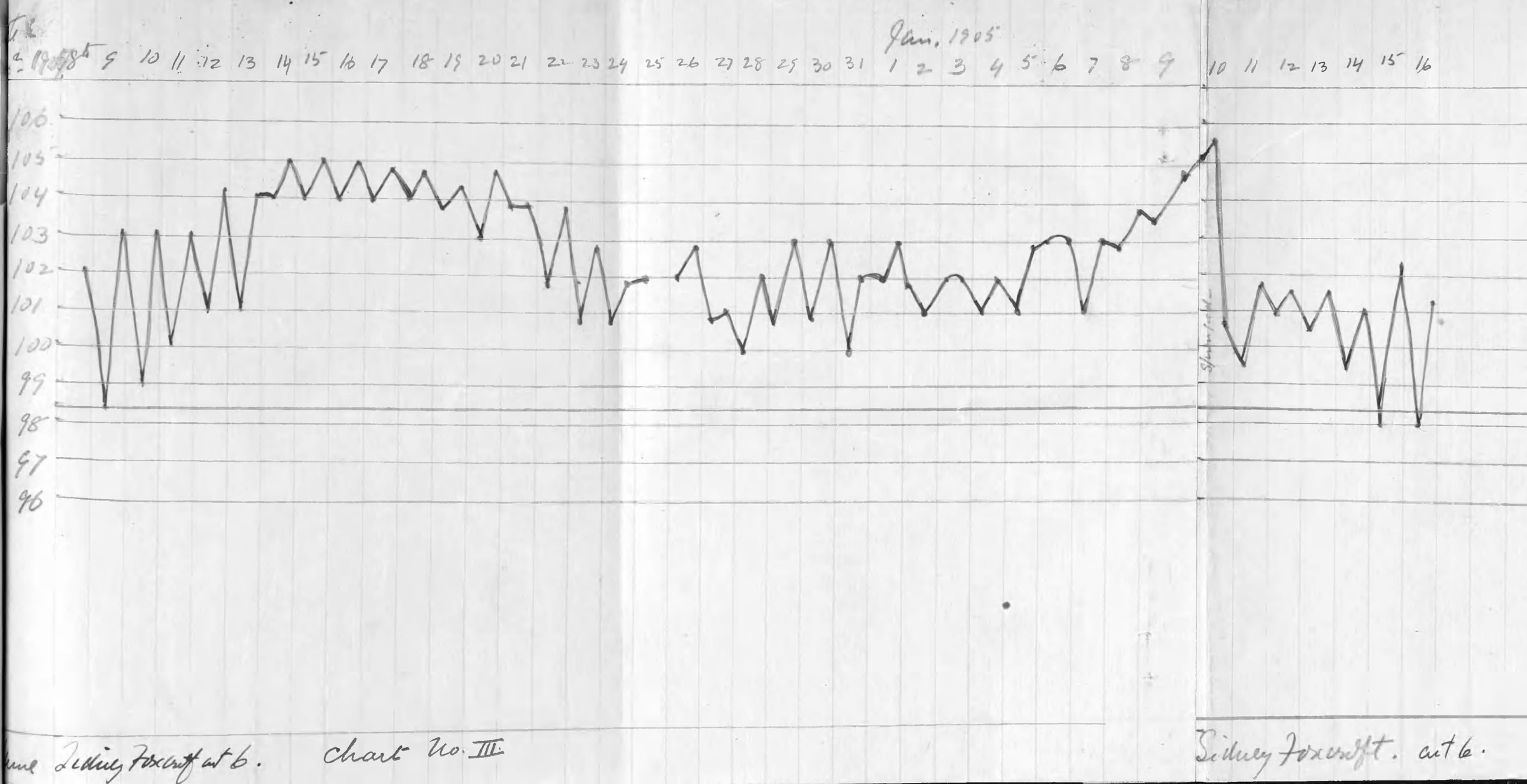


Chart No. I



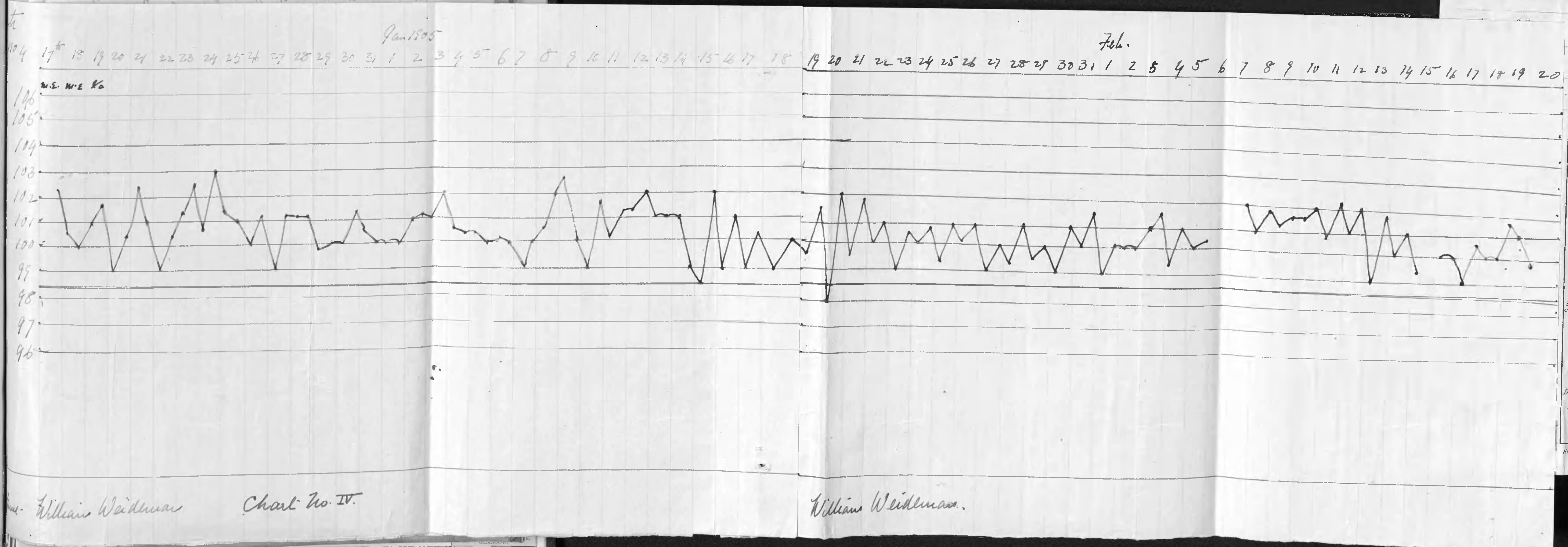
Name. Wm Vaude . at 51 Chart No. II.

Wm Vaude at 51

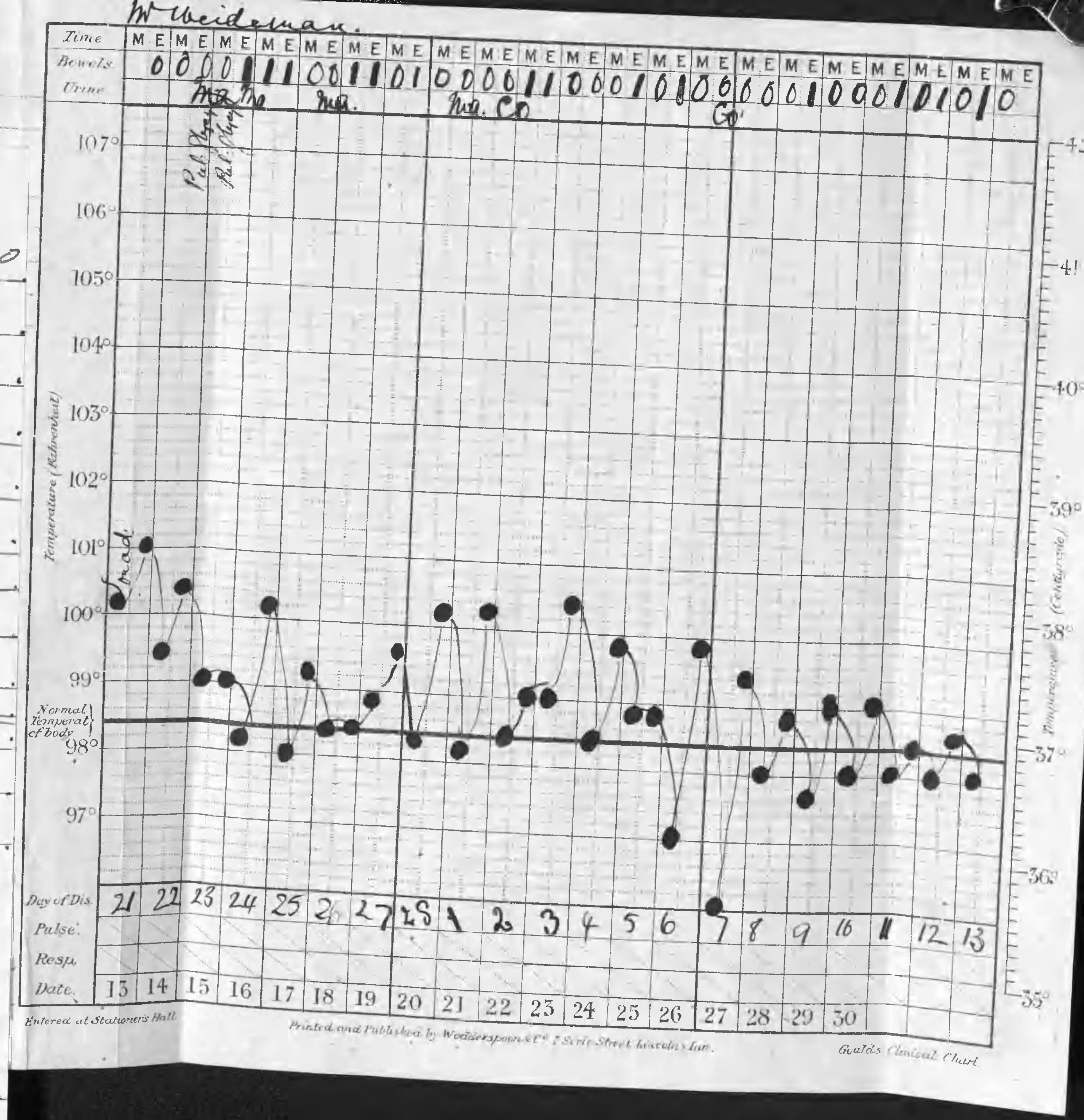


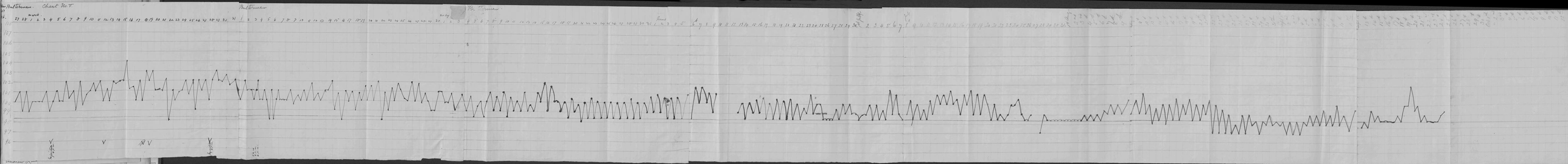
Sidney Foxcroft at 6. Chart No. III

Sidney Foxcroft. at 6.


Jan 1895
Feb.
William Weideman
Chart No. IV
William Weideman.

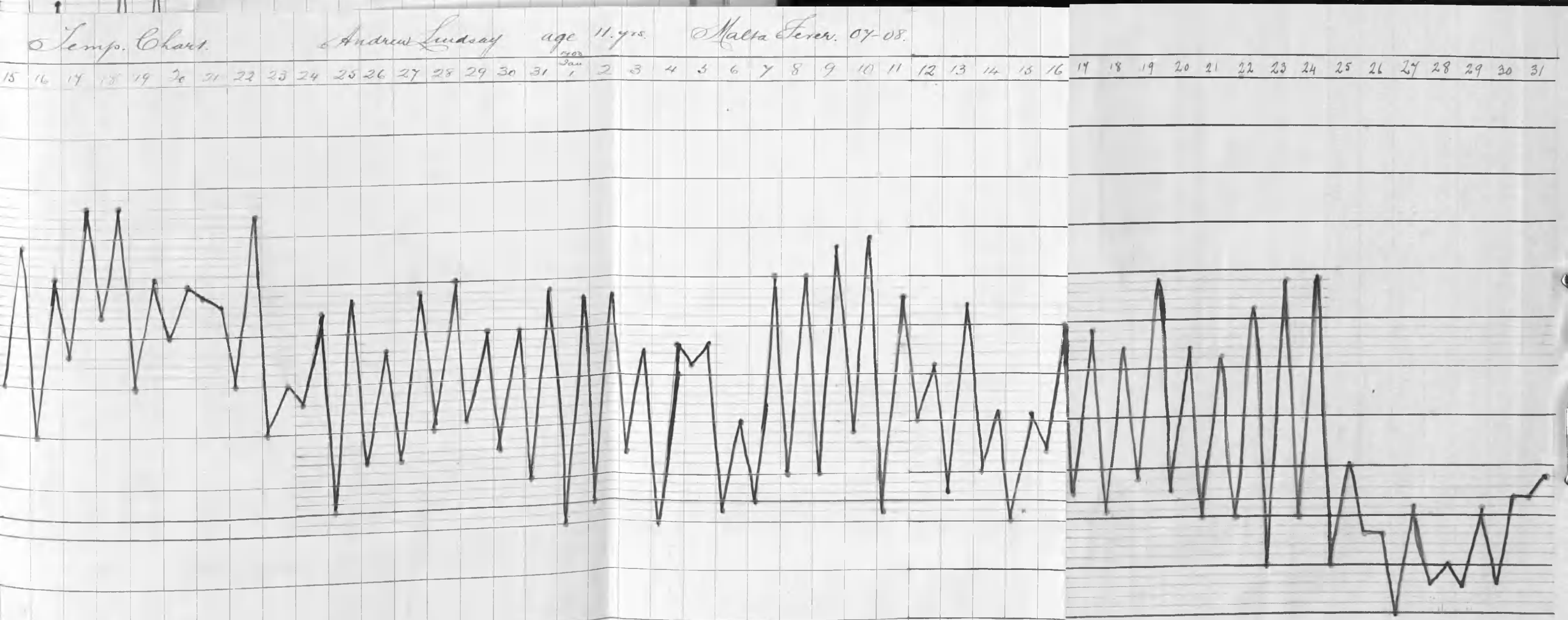
DISEASE.


W. Weideman.
Time
Bowels
Urine
Temperature (Fahrenheit)
Normal Temperat. of Body
Day of Dis.
Pulse
Resp.
Date
Entered at Stationers Hall
Gould's Clinical Chart



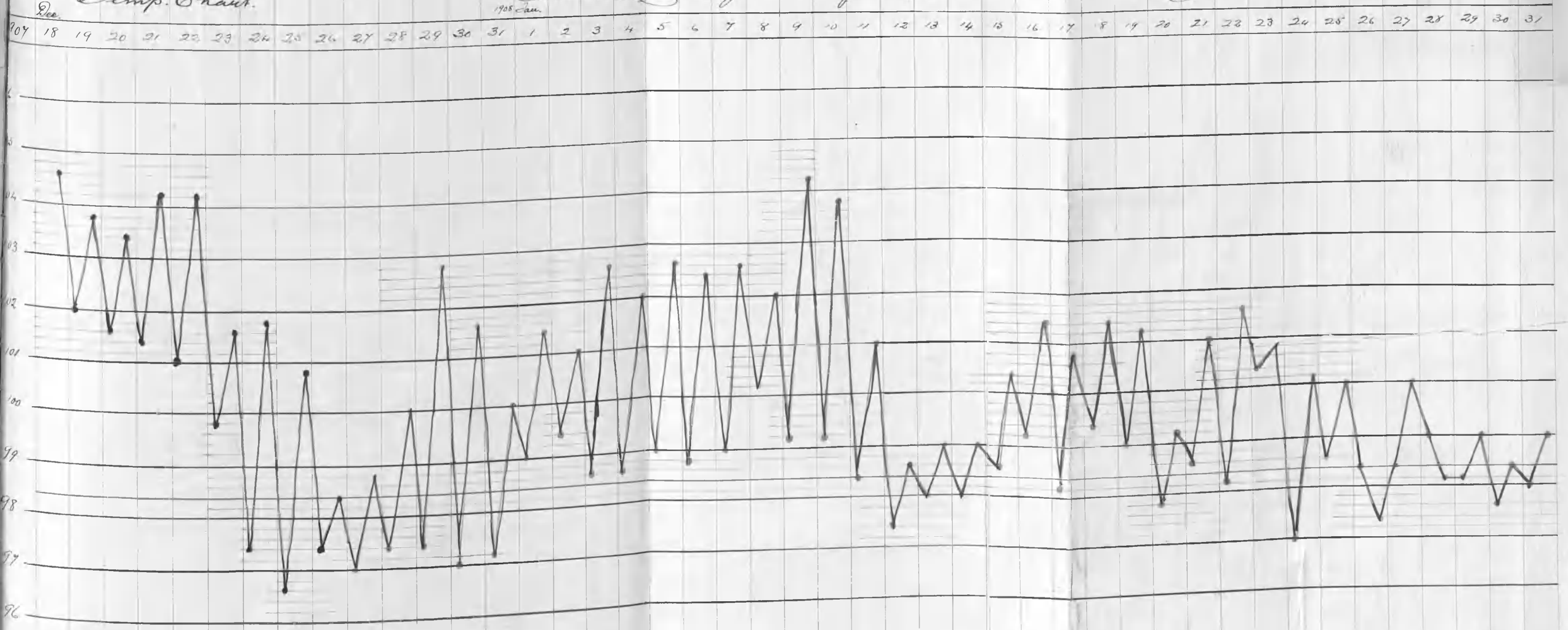
Temp. Chart. Andrew Lindsay age 11. yrs. Malta Fever. 07-08.

15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31 1 Nov 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31



Andrew Lindsay Chart No. VII

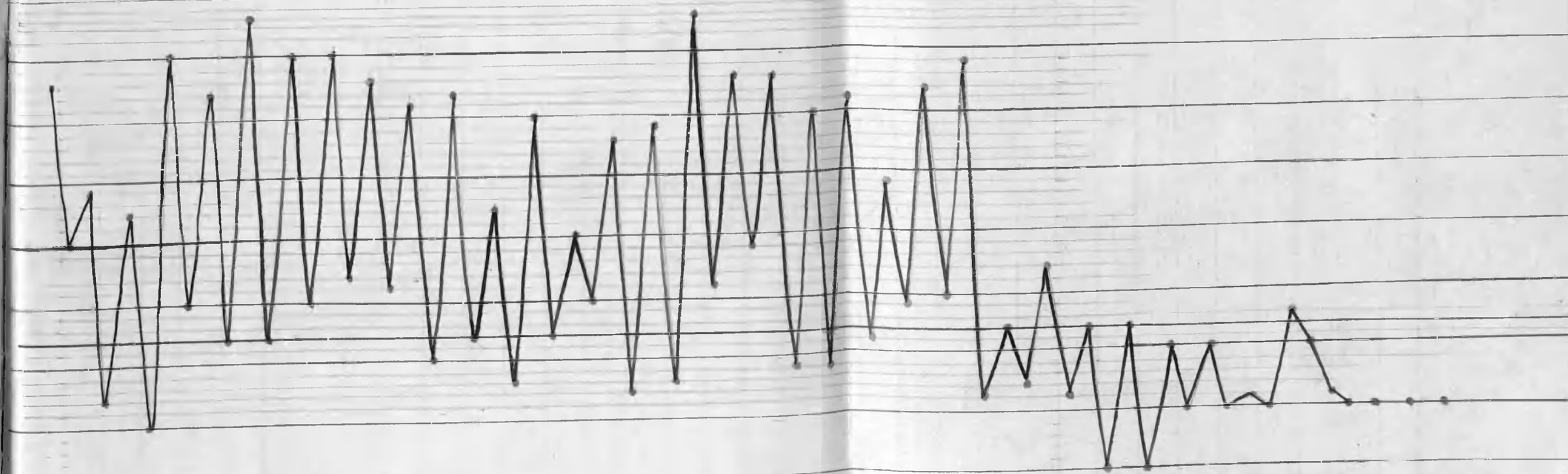
Temp. Chart. Alice Lindsay. Age 10 yrs. Malta Fever 07-08



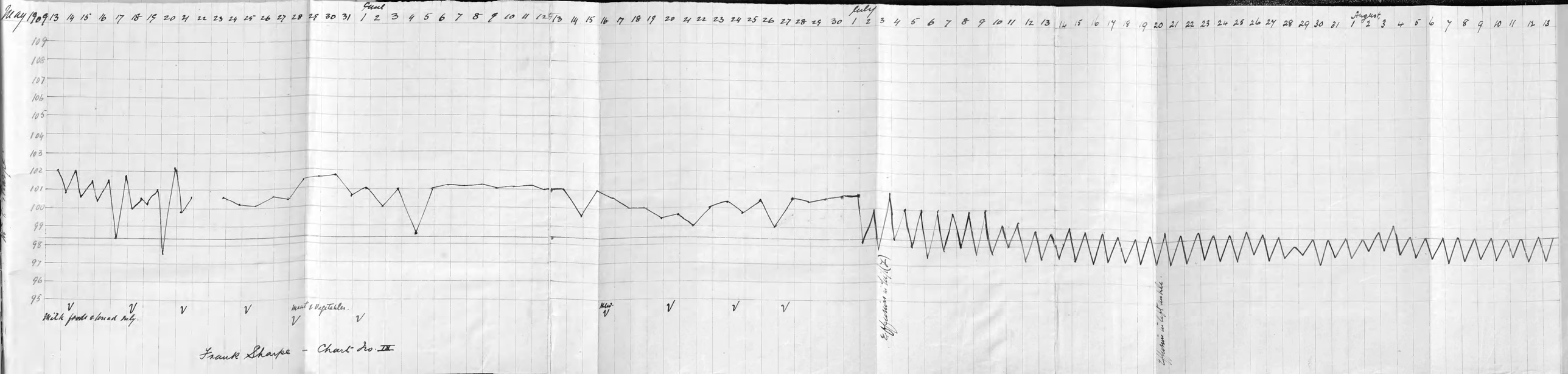
Alice Lindsay - Chart no. VII.

Temp. Chart. Annie Lindsay Age 9. Malta Fever. 1907.08.

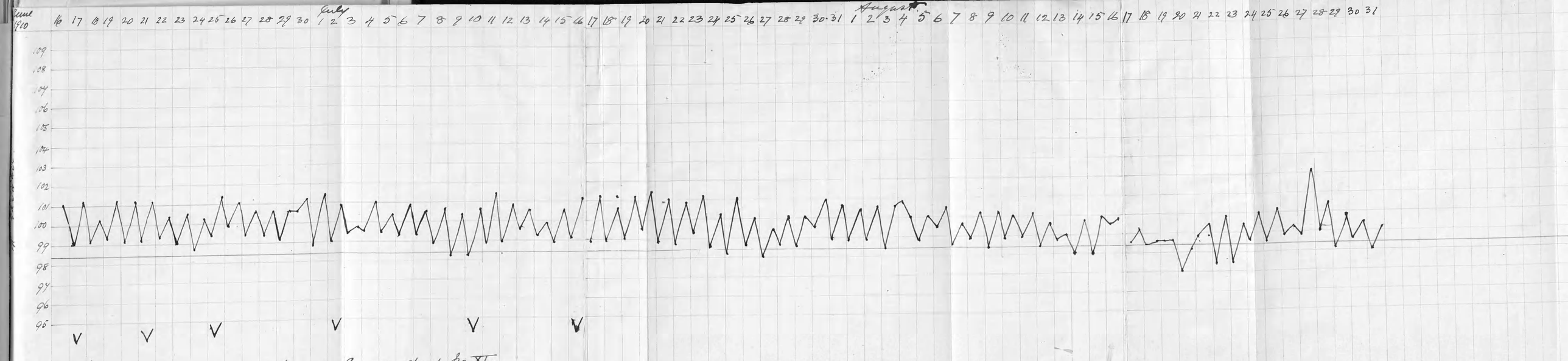
18 19 20 21 22 23 24 25 26 27 28 29 30 31 1908 Jan 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22



Annie Lindsay – Chart No. VIII.


May 1909
13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31
June
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30
July
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31
August
1 2 3 4 5 6 7 8 9 10 11 12 13
109
108
107
106
105
104
103
102
101
100
99
98
97
96
95
Milk foods & mixed diet.
Meat & Vegetables.
Milk
Frank Sharpe - Chart No. IV


Reports
Mrs Philip Venter - Waterkloof
March
April
May
June
Vaccines on Jan. 20, 24th Feb. 2nd, 10th, 16th
Mrs. Philip Venter - Chart No X.



Mrs. De Swart - Chart No XI

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6. " " " " " "

7. " " " " " "

8. " " " " " "

9. " " " " " "

10. " " " " " "

11. " " " " " "

13. " " " " " "

14. " " " " " "

15. " " " " " "

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19. Major W.H. Horrocks & Captain, J.C. Kennedy. Mediterranean Fever Commission's Reports, Pt.IV. p.61.

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27. (28). Birt, Journal of the Royal Army Medical Corps, Aug. 1909 pp.159-165.

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33/

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Shaw, Pt. V. p. 8-10.

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Kennedy " " Pt.111 p. 56
Shaw, " " Pt.IV. pp.3-15.

39. Commission's Reports :- Horrocks Pt. 1. p.13.
Basset Smith Pt. 11 p. 66. Shaw Pt. 111 pp. 47-49.
Horrocks Pt.1V.pp.27-31.

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41. Eyre - Lancet 27th. June, 1908 p. 1828.

42. Dr. Ralph W. Johnstone, Pt. 11, p. 12,

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Philippolis
O.F.S.
S. Africa
3rd June 1912.

To
The Assistant Clerk,
Matriculation Office, University of Glasgow,

Dear Sir,

Enclosed please find "Extracts from a History of S. Africa by George McCall Theal, Litt.D., L.L.D." for attachment to my Thesis on Incidence of Malta Fever in S. Africa.

Yours faithfully,

P. D. Strachan.

SOUTH AFRICAN GOATS.

EXTRACTS FROM A HISTORY AND ETHNOGRAPHY OF SOUTH AFRICA BY GEORGE Mc CALL THEAL, LITT.D., LLD.

1505 to 1700. Vol. I. Page 154

(Domestic animals of the Bantu)

" The other domestic animals were goats, dogs, and barnyard poultry everywhere, and in the north sheep of the large-tailed hair-covered breed. "

Since 1795

Vol. II. Pages 41-42

"In 1835 Captain Robb tried to introduce Angora goats from New South Wales. Some died on the passage, but he succeeded in landing two males and one female, which were purchased by Mr. Frederick Korsten, of Cradock's Place near Port Elizabeth, for £150. In 1830 Mr. Korsten commenced to farm with woolled sheep, and he now resolved to make an experiment with the goats, to ascertain which was most profitable. This was the origin of the production of mohair in South Africa, though many years elapsed before that article attained a noticeable place in the list of exports. In 1836 Captain Robb introduced four more Angora Goats and nearly three hundred fine woolled sheep. In that year the Cape of Good Hope Agricultural Society presented to him a handsome cup as a testimonial of the services he had rendered to flockmasters. There is a plain tablet in his memory on a wall of the old Scotch church in Cape Town, and his name deserves a place among those of the men who have helped to promote the prosperity of South Africa.

At Almost the same time an effort to introduce Angora goats of the purest breed was made by a retired military officer. Lieutenant-Colonel Henderson, a gentleman who was well acquainted with Asiatic Turkey, had come to reside at the Cape, and was impressed with the view that the Country was eminently adapted for the production of mohair, the silk-like fleece of the Angora goat. Accordingly he procured through Agents, though with considerable difficulty and at

great expense, a flock of thirty-nine of the valuable animals, which were sent through Constantinople to Egypt. From Egypt they were taken through Persia to Bombay, and from that Port shipped to the Cape, Twenty-seven of them died on the passage. In 1838 one she-goat, eleven of the original males, and one male born on the way arrived, but to the great disappointment of their owner, the whole of the original males, though apparently perfect, had by some means been made useless for breeding purposes. The she-goat too never bred after arrival. The male born on the passage, however, was purchased by Mr. Hendrik Vos, and by crossing with selected ordinary goats, and then with their offspring, in course of time a flock with fairly good fleeces was obtained.

A beginning having been made, some merchants in Port Elizabeth took the matter in hand, and managed to procure pure-bred goats occasionally, until the industry was thoroughly established and South Africa became, what it is to-day, the first mohair producing country in the world. The Angora goat, being a highly-bred animal, is far from hardy, and requires great care. It is not adapted to all parts of the country, but in some places it thrives well under good management, and brings in fair returns."

Vol. V. Pages 12-13.

"An account of the introduction of Angora goats into the Colony has already been given, but as it was at this time that the production of mohair first became a really important industry, some further reference to the subject seems requisite. Various farmers acquired some of the progeny of the he-goat belonging to Mr. Hendrik Vos and of those belonging to Mr. Korsten, and by several of them much care was bestowed upon the animals. Still the strain of the common goat was so strong that the hair was shorter and coarser than that of the pure breed, though it was sold for eight pence a pound or 1/5¾ a kilogramme, in England, where it attracted considerable attention. Manufacturers there gave assurances of a much higher price for a better article, but for twenty years it was found impossible to procure thoroughbred goats to breed from. When however sea voyages were much reduced in length by the use of steamships, there was a better chance of success, as the loss by death on the way to the Cape would be greatly diminished. Mr. Julius

Mosenthal, a merchant in Port Elizabeth, then resolved to attempt again to introduce some pure stock.

For this purpose Mr. Adolph Mosenthal proceeded to Asia Minor, where with the assistance of Lord Stratford de Redclyffe he succeeded in obtaining a number of the purest and best of the animals required. These were shipped at a port in the Black Sea, and sent by way of the Mediterranean to England, where they were kept some time to recover strength. They were then forwarded to the Colony, where thirty of them arrived in the summer of 1856. The choicest of these animals were sold to different farmers at a price of from £80 to £90 each, and after a few seasons the number so increased that the production of mohair of superior quality became one of the established industries of the Colony. At a later date other merchants followed the example of Mr. Mosenthal, notably Messrs Blaine & Co., of Port Elizabeth, and introduced pure bred animals from Asia Minor, which were shipped at Constantinople, so that the stock was prevented from deteriorating."