

MEDICAL HISTORY OF THE SOUTH AFRICAN WAR.

BY LIEUTENANT-COLONEL R. J. S. SIMPSON, C.M.G.

Royal Army Medical Corps.

(Continued from p. 505, vol. xiv.)

(vi.) We are now in a position to consider *the development as a whole from October, 1899, to July 27th, 1900, of the continued fevers and bowel complaints as they occurred on the western line and in Bloemfontein*, in conjunction with the conditions observed in Natal.

(a) The bowel complaints may be dismissed in a few words. While the troops were in occupation of the line, or in touch with it, that is till about March 9th, the distribution curve (fig. 7) shows the very great sensitiveness to an addition to strength. The sudden rise in the week ending November 29th coincides with Lord Methuen's concentration; the rise from the week ending January 26th coincides with the concentration for the advance into the Free State. After this, the condition, as has been pointed out, is one of comparatively small oscillations of a period of approximately two weeks about a mean level; there is no attempt at the production of a definite maximum, and the whole character of the distribution is in marked contrast to that of the continued fevers, with which the only point of similarity lies in the descent from June 8th. This is exactly the condition seen in the Natal Field Army. Further remarks on the relation between the early bowel complaints and fevers will be found at the end of this section.

It may be noted here that throughout the war the admissions for dysentery varied less from month to month than did those for enteric fever. The annual range was less, and the seasonal influence less distinct (see fig. 11).

(b) Instead of considering the development of the continued fevers on the Western line and in Bloemfontein alone, it is more convenient to take them along with those already described in the garrison of Ladysmith and the Natal Field Army, in the endeavour to ascertain what common features they have, and what is to be learned from them in relation to prevention.

There are two possible views as to the manner in which these and similar epidemics arise. One may be termed the hypothesis of *infection from without*, mass infection, the second that of *infection from within*, or, shortly, auto-infection. Infection from without, or infection in the mass, is taken to mean the infection

of a body of men by a general source outside of and previously unconnected with that body; it has, therefore, a definite date of commencement, and if investigations can be pursued far enough, this date can be correlated with exposure to some known source of infection. One may take as an example an exclusively water-borne epidemic such as that at Worthing. Internal, auto-infection is taken to mean the gradual and, at last, general infection of a body of men of whom a *comparatively small number* are already infective (carriers), or have become infected by some external source. The characters of mass infection are well known: the sudden occurrence of a large number of cases after an interval of about the normal incubation period from the date of infection, followed by a more gradual decline. Auto-infection takes a different form: the first few cases form fresh foci, and with the normal incubation period determining the intervals, the progress and multiplication of cases should be of the type of a geometrical progression, which, however, in practice is always and fortunately limited in the number of its terms, presumably by the inequality in susceptibility in the persons exposed and by the exhaustion of the susceptible population. Otherwise, it is difficult to see why such an outbreak should ever stop.

Now it is of considerable practical importance to ascertain how far one or other type will account for epidemics. Protection against infection in the mass is probably not impossible; sanitary measures which are comparatively simple and practicable can be carried out without difficulty. Auto-infection is much more difficult to deal with; it means the elimination of apparently healthy but infective individuals, of all the minor types of infection—diarrhoea, ephemeral fever, &c.; the isolation of the sick and convalescents (the latter probably permanently so far as the campaign is concerned), and, more difficult still on service, of contacts, besides the full and careful maintenance of all the sanitary measures which are organized for the protection of the force from infection from the outside. The distinction between these two types is not in practice absolute; a water epidemic, for example, begins as an external infection, but usually shows in the manner of its decline evidence of some degree of auto-infection; but the difference between the two types in the mode of development and the possibility of prevention is absolute.

For these reasons it appears to be useful to spend some time in considering the prevalence in the four groups which have been described. The materials allow only of the crudest method of

treatment, but some results appear attainable which, if not absolutely accurate, are at least suggestive.

The epidemics in Ladysmith (the first part), South Natal and on the Western line, show, when plotted, curves of the same type (figs. 2, 4, and 7). They show a maximum, termed for convenience "the apex," a portion which would not be inadequately represented by a straight line, separated from an earlier, more irregular, portion by a sudden change of curvature. Each one of these irregular polygons as plotted can be fairly represented by a continuous curve drawn from the same template, and in each the earlier irregular portion shows an incidence less than that shown by the continuous curve.

Now the dates at which the exposure of the respective bodies of men began are known, the dates of the maxima are available (except on the Western line), and the date on which the straight line portion began may be determined by inspection of the diagram with comparative accuracy. Tabulating these results we find a close agreement:—

Group	Beginning of straight line	Apex
Ladysmith	In 8th week	11th to 12th week.
S. Natal	"	12th week.
W. Line	About 8th week	(?)

The weeks are counted from the date of exposure.

It appears to be justifiable to take as a working hypothesis that the period of invasion of the epidemic is about eight weeks, or more than twice any possible individual incubation period, and that it takes about four weeks longer to attain its maximum.

We can now attempt to apply this hypothesis to the case of the epidemic in Bloemfontein. The first maximum there—that of April 13th—conforms to the conditions seen above, the beginning of the straight line portion is in the eighth week from January 26th, and the apex is twelve weeks from the same date. That date is practically the beginning of the concentration period on the Western line. The next two apices are less easy to deal with. Their relation to possible external causes has already been spoken of, and it has been seen that it is difficult to trace any connection between them and any definite and known source of infection, widespread but of limited duration—a condition which is required to explain the short period of development of these maxima.

Now if we take the figures for the prevalence in South Natal, and eliminating the irregularities by taking the means of any two successive weeks instead of the actual numbers for these weeks, if we add the same series of numbers *twice* to the original set, at intervals corresponding to the intervals between the maxima in

Bloemfontein, and then plot the resulting series of figures, we obtain a curve of the same general character as that in Bloemfontein, with three maxima separated by deep gaps. There are, however, certain important differences which are due to the character of the Natal curve, which shows only a very short period of decline. This is of course a very crude method, but it suffices to show that three similar but independent epidemics superposed will produce a curve of the characters shown, without any necessity for the assumption of specific instances of widespread infection at definite times, and it points to the gradual development of each epidemic in the same way as is seen in the Natal groups described above. The differences seem to show that in all probability the growth of the second and third epidemics, superposed on that beginning on the Western line, was rather more rapid than in the cases shown above. This is *a priori* probable, as the chances of infection increased with the number of troops brought into the area, and the opportunities for infection were multiplying rapidly during March and probably April, so that one might expect to find the number of cases increasing more rapidly than in the earlier epidemics, because of the greater number of foci introduced into the group.

We can now consider the probabilities regarding the two later maxima. In both the origin of straight line portion of the hypothetical curve is obscured, but in the examples already given the apex has been found to have a fairly constant relation to the origin. Hence, in relation to the maximum of May 18th, the earliest possible date for the origin is February 23rd, towards the end of the investment at Paardeberg. This agrees well with the known conditions, but the suggestion of a shortened development may place the origin actually in the early days of the occupation of Bloemfontein. As regards the maximum of June 8th, the earliest possible date for the origin is March 16th, so that this outbreak certainly originated in Bloemfontein. Summing up the possibilities under the two heads, external infection and auto-infection, and indicating the epidemics by the dates of their maxima, we find:—

April 13	..	External infection	..	Not earlier than February 23, at Paardeberg.
.. 13	..	Auto-infection	..	Continuous development from the Western line.
May 18	..	External infection	..	Not earlier than mid-April.
.. 18	..	Auto-infection	..	Possibly Paardeberg; probably Bloemfontein in the early days.
June 8	..	External infection	..	About middle of May.
.. 8	..	Auto-infection	..	Soon after occupation of Bloemfontein.

Either hypothesis will conform with the actual conditions, except that, as pointed out above, there are difficulties in pointing out *special* intensities of infection which seem necessary for the explanation of the sudden sharp rises of the two later maxima. Auto-infection places the origin, *i.e.*, the first cases and the limited early infection, considerably earlier than external infection—the infection of considerable numbers. The actual dates of infection are of no moment; what is important is to ascertain, if possible, whether mass infection (which can with great care be prevented) is the effective agent, or whether the slower, less definite and much more intractable, gradual infection of the whole mass from the infectivity and infection of small numbers is in practice not only possible but probable. The summary shows that if a full incubation period of about three weeks is allowed, the infection which determined the epidemic April 13th may have taken place at Paardeberg. But there seems little doubt that this particular epidemic was the result of continuous development from the Western line. Similarly, if we allow a three weeks' incubation for the epidemics culminating on May 18th and June 8th, the infection may be dated back to somewhere about the middle of April and of May respectively. The sudden rise in these two epidemics may represent the maturation of specific infection of large numbers, but from the very sharpness of the rise, if instances of specific infection were the cause, these infections must have been widespread, and of *limited duration*. They are of the type of a sudden general infection. Opportunities for infection were undoubtedly frequent; what is not known is the existence of a sudden increase in the intensity of the infection lasting but a short time.

Neither of the methods of development ever works alone; it is really a question of degree. But there is certainly sufficient evidence to show that the prevalence of specific febrile disease in the field is not determined alone, or even chiefly, by a mode of infection which may be prevented by what are ordinarily included under the term "sanitary precautions"—that is, by the provision of a pure water supply, which of itself will never stop its development, nor by the successful execution of the more difficult task of preventing the spread of infection from latrines and urinals, or their equivalents; that effective preventive measures involve the treatment of the specific fever, enteric fever, as if it were, as in fact it is, as easily spread, and by the same modes as any other member of the group. These effective preventive measures must include isolation and disinfection of the patients (both in the acute and

convalescent stages), of the attendants and of all contacts; and those who have practical experience of war conditions, especially with a large native establishment in close relation to the troops, will easily recognize the difficulty of carrying out these measures, absolutely essential if disease of this type is to be eliminated.

The other side of the question is the development of the bodily resistance. This is successful in a considerable degree under the milder conditions of peace, but even if the result under war conditions is as good as this, there will remain a material incidence of enteric fever which will have to be dealt with in some such way as is suggested—by the elimination of the element of personal infection, whether direct or indirect.

(c) Another important point is the relation of the group of bowel complaints to the outbreaks of continued fevers. This comparison is facilitated by first of all tabulating the features of the occurrence of bowel complaints under certain heads:—

CHARACTERISTICS OF THE GROUP "BOWEL COMPLAINTS."

Ladysmith.

Duration of observations, twenty-one weeks, October 13th, 1899, to March 2nd, 1900.

Early appearance and rapid development.

Considerable similarity to febrile disease curve.

Curve characteristic: definite maxima in twelfth and twenty-first week.

Predominant type dysentery till seventeenth week (4 to 1).

Increase of diarrhoea towards end of period; first maximum dysentery, second diarrhoea.

Natal Field Army.

Duration of observations, fifteen weeks, November 24th, 1899, to March 2nd, 1900.

Early appearance and rapid development.

No similarity to febrile disease curve.

Sudden rise to an irregular mean incidence.

Oscillations considerable.

Predominant type dysentery (2 to 1).

Steady increase of diarrhoea during the first nine weeks, in addition to dysentery.

De Aar.

Unimportant.

Orange River.

Duration of observations, eighteen weeks, October 20th, 1899, to February 16th, 1900.

Early appearance, irregular development.

No similarity to febrile disease curve.

Characters very irregular.

Predominant type dysentery first nine weeks, declining and replaced by diarrhoea second nine weeks.

Modder River.

Duration of observation, twelve weeks, November 24th, 1899, to February 16th, 1900.

Early appearance and rapid development.

No similarity to febrile disease curve.

Distinct early maximum and well-marked fall.

Predominant type diarrhoea.

Both dysentery and diarrhoea increasing at end of period.

Bloemfontein.

Duration of observation, twenty weeks, March 9th, 1900, to July 27th, 1900.

Oscillation about a high mean level, carried on from the Western line.

No similarity to febrile disease curve.

Predominant type—first half, diarrhoea; second half, dysentery.

Inspection shows that there are three features common to all of these groups, with an exception in the case of Ladysmith. These are:—

(1) The early appearance.

(2) The rapid development (exceptionally in Ladysmith, to a definite maximum).

(3) The absence of any resemblance to the febrile disease curve (except in Ladysmith).

In the Natal Field Army, and the force under Lord Roberts from the end of January, the features are almost identical—in both the rapid development is followed by a comparatively steady mean incidence—that is, there is no tendency for these diseases to attain more than a certain degree of prevalence, nor to a definite epidemic with a distinct decline and fall.

Ladysmith, for reasons which have already been stated in some detail, is in no way comparable with the other two main groups. The permanent occupation of a limited area, the excessive privation and the effects of the siege diet have no parallels elsewhere. These conditions possibly explain the divergent features in the

outbreak there, the tendency to epidemic development, producing a maximum, and similarity to the febrile-disease curve. The garrison of Ladysmith also contained a larger proportion of men who had previously been exposed to dysenteric infection (in India) than either of the other groups, and hence the admissions in the two last probably include a greater proportion of fresh infections than in the former case.

The difference in the predominant disease cannot be taken as of very great importance; so much depends on the matter of diagnosis that the figures are probably subject to considerable errors (see Section D, iii.).

Now these bowel complaints may be taken to include:—

(A) *Non-specific diarrhœas*—i.e., those of which the cause has not been definitely ascertained. These may then be infective or not.

(B) *Specific diarrhœas*: (1) dysenteric, (2) typhoid group.

The recorded admissions for bowel complaints will then include all non-specific diarrhœas, all dysenteric diarrhœas and their consequences—that is, cases diagnosed by their true name, dysentery—and probably all, or nearly all, the typhoid diarrhœas. But they do not include the consequences of infection from a typhoid diarrhœa which do not remain of the same simple type of reaction. Hence, some portion of the diseases under this head passes from observation in the group “Bowel Complaints,” and reappears in the group “Continued Fevers,” so that the growth of the bowel complaints is possibly slightly more of an epidemic character than the bare figures show. But apart from this, which can be but a small element, the aggregate of the non-specific diarrhœa, dysenteric diarrhœa, and dysentery showed a limitation in its development as compared with febrile disease, and tended more to a regular prevalence. The fact that the admissions to hospital represent only a proportion of the bowel complaints actually occurring does not affect this conclusion, as there is no reason to assume that this proportion varies greatly from time to time.

Within the group of bowel complaints dysentery always appeared earlier than diarrhœa—that is, dysentery appeared in the very first week of exposure—and (except at Modder River, where the conditions were unusual) its development became considerable before diarrhœa attained any prominence.

The spread of infective bowel complaints—dysentery—is conditioned by the same circumstances which spread enteric fever. The modes of propagation are, so far as we know, identical;

the source is the same—infective excreta. Now a simultaneous infection of two groups of men, one with dysentery, the other with enteric fever, will, from the difference in the incubation periods, produce obvious cases of dysentery almost at once, while the obvious cases of febrile disease only appear at a later interval, and the development of the contact epidemic from each of these sources will show even greater time differences. So that the early appearance and rapid development of diseases of a dysenteric type are in this way absolutely unconnected with any development of the febrile group. The limited development of bowel complaints, and especially the comparatively early decline of dysentery (if this is, in fact, the case), is not so easy to explain; it may, however, be due to the (usually) shorter acute infective stage, and to the distinct difference in the bacterial content of the excreta, which in dysentery appear to return to the normal condition more rapidly than in enteric fever, where carriers are perhaps rarer, and where dissemination by the urine does not occur. Hence contact infection, both direct and indirect, is more limited in time than in enteric fever.

As to the question of a specific relation between the appearance of diarrhoea and that of enteric fever, only in one case, of the Natal Field Army, do we find any similarity (and that very slight) in the time, relations, and mode of development of diarrhoea and the continued fevers (only twelve cases of *enteric fever* were recorded from this group during the period of observation). But, as has already been pointed out, the distinction between diarrhoea and dysentery cannot be accepted as a basis for close examination of relationships. It is far safer to contrast the whole group "Bowel Complaints" against the "Continued Fevers," and, having done so, we find that, as stated above, excepting in Ladysmith, no similarity existed.

(d) As to the sequence of events in the development of disease in the field, it has been stated that the series is: diarrhoea, non-specific continued fevers, enteric fever—pointing to a development and intensification of the infecting agent on the spot. With our present knowledge of the carriage of pathogenic bacteria by apparently healthy persons, and of the long periods after recovery from enteric fever, during which the bacillus may be carried about and excreted, it seems needless to invoke the doubtful transformation of a non-specific into a specific type to explain the appearance of this disease under conditions which apparently forbid direct infection. In passing, it may be said that, as has been pointed out

in some detail already, the conditions in South Africa were by no means of this nature.

The early development of bowel complaints was apparently not related to the enteric fever outbreaks, and it is by no means necessary that such a preliminary epidemic should occur. It has been said that this preliminary epidemic occurred in some outbreaks at home, but where it has been possible to compare the distribution of the cases of diarrhoea with the dates of *occurrence* of the cases of enteric fever, not the dates of *notification*, it is found that the diarrhoea, in fact, coincided with the enteric fever and did not precede it. Further, there appears to be no reason to assume that the earlier reactions following typhoid infection are always of the type "diarrhoea"; the severity of the reaction is determined by the subject as well as the agent. This hypothetical mild reaction at the beginning would then depend either on a lessened activity of the agent or a greater resistance of the subject. There does not appear to be any evidence that the former condition is by any means invariable, and, although we know the importance of fatigue, exposure, and privation in increasing the susceptibility of the subject, it is hardly probable that this would have any marked effect in the short period which intervenes between the onset of the bowel complaints and the appearance of enteric fever.

There is little evidence of the existence of mild non-specific fevers in the forerunners of enteric fever. No doubt mild fevers do occur—usually returned as simple continued fever—before any prevalence of enteric fever is recorded. Some small proportion of these are probably in fact non-specific, and their existence at this period is accidental, but the most important constituents of this group are almost certainly true cases of enteric fever which have not been diagnosed. This hesitation in the diagnosis of enteric fever at the outset of a campaign, or, in more general terms, at times or in places where enteric fever is not normally prevalent, is a familiar feature. Where and when enteric fever is expected to occur, there and then the simple continued fevers diminish in importance—that is, when enteric fever is prevalent, mild cases are recognized without hesitation which would be passed over at other times. This, and not the essential mildness of the cases, is the reason why the specific diagnosis is not made. Another factor is this: if two cases are infected simultaneously, that which is admitted to hospital the later is the more likely to conform to the usual type of disease. A case admitted on the tenth day is less likely to be passed over than one admitted on the third, and this difference of a week is somewhat

important in the spacing of the epidemic. One is apt to forget that even in Europe the mild, larval, or abortive forms have been recognised for many years (Murchison), and their frequency has also been brought to notice—as by Letulle—who, in 1886, fixed the proportion as 17·4 per cent. of all cases.

(e) One may then conclude that the early bowel complaints are not related to the development of enteric fever, that these diseases are limited in development as compared with the fevers, and that the development of epidemics of enteric fever is of the normal type, from one or more sources of specific infection, and is continuous.

(f) *Some Details regarding the Epidemic in Bloemfontein.*—

(i) Incidence rates cannot be given. The main army arrived in Bloemfontein some 30,000 strong. The force which advanced to Kroonstadt and Pretoria from Bloemfontein and its vicinity amounted to about 42,000 of all ranks. These are the only numerical statements of strength which can be made. The first figures probably represent the greater part of the whole strength in the Free State till about the middle of April, and hence the epidemic of April 13th may be taken to be limited to this group. The last takes no account of the large aggregate of the troops at other points on the line, or scattered over the country. Now the sick in Bloemfontein were drawn directly from the troops in Bloemfontein and the immediate neighbourhood; they were also drawn indirectly from many, if not from all, of the bodies of troops outside the Bloemfontein area, as, for example, at Glen and Vet River on the north, Edenburg and other places on the south, Sanna's Post and Thabanchu on the east, and so on. Some of the cases were sent in without coming on record at any hospital, or were, in the absence of any information, so treated—that is to say, they appear in our records as cases originating in Bloemfontein, although the strength to which they belonged was elsewhere. Where cases had come on record at some hospital outside Bloemfontein, and had been transferred there, the number who died are recorded as deaths in Bloemfontein, involving a double error, an increased proportional mortality to cases admitted, and an increased mortality to strength, so that it would not be possible, even if strengths were available, to ascertain with any degree of accuracy the true incidence and mortality during the epidemic. We can, however, obtain a maximum case mortality, as will be shown later. Some idea, however, can be given of the incidence during the first part of the epidemic—up to April 13th—by taking the cases in the main army from the advance into the

Free State—that is, from the week ending February 16th onwards to the maximum. This will give results fairly comparable with those obtained in South Natal and the first fifteen weeks of Ladysmith, although the two latter include portions of the decline in their respective curves. These results are as follows:—

Approximate incidence per 1,000 per annum.

	Enteric	Simple continued fever	All fevers	Dysentery	All bowel complaints
Ladysmith ..	227	133	360	371	401
S. Natal ..	24	149	173	264	312
Main Army ..	167	377	544	72	216

It must again be noted that such annual rates are affected by very large errors; they are, however, necessary for comparative purposes, and are useful if the comparison is not pushed too far into detail.

Two things are evident—that the main army up to this period suffered less from bowel complaints and certainly from dysentery, than the other groups. Further, in the main army, the proportion of mild continued fevers was greater than in the others. Reasons have been given for believing that some part of this incidence may have been due to mild fevers not of the typhoid group, and this must be remembered in comparing these rough incidence rates. But in any case the incidence in the main army up to this time was exceptionally high.

Attention may again be called to the downward tendency of the curve from April 13th (fig. 7), notwithstanding the sudden increase on the two occasions mentioned. This suggests an exhaustion of the susceptible population in spite of the reinforcements which arrived in Bloemfontein during the period, many of them direct from England. One may conclude from experience elsewhere—in India and South Africa—that the more susceptible of these were infected at once and went to swell the numbers; the less susceptible escaped for the time, and formed the material for the epidemic at Kroonstadt, after its occupation, and elsewhere.

(ii.) The total number of cases of all kinds admitted to hospital in Bloemfontein during the twenty weeks March 16th to July 27th was 17,141, of which 8,568 were cases of continued fever, 2,121 cases of bowel complaints—that is 50 per cent. and 12 per cent. respectively, of the total number. The average weekly number remaining in hospital was 2,629, of whom 1,054 were cases of continued fever.

The effect of the variations in the number of troops in or near Bloemfontein on the continued fever curve may be gauged by

plotting out the numbers admitted to hospital for other causes than the two groups specially considered, continued fevers and bowel complaints. This shows very little correspondence with the fever curve; the only definite resemblance is in the rise immediately after our arrival. Maxima occur on April 6th and 20th, May 4th and June 8th. There is a considerable fall from May 4th, rising again slightly to the maximum of June 8th, from which date there is a sharp fall to the 15th, a slight rise to the 29th, and then a steady fall. Thus, on the whole, the numbers admitted were steadily increasing up to May 4th, from which date they fell in two stages. Probably, then, the increase of troops in and around Bloemfontein partially determined the fever maximum of May 18th, but not the other two maxima.

(iii.) *The Case Mortality for Enteric and all Continued Fevers.*—These may be regarded in two ways, first as absolute figures, and secondly, as a means of comparison of the severity (of which the case mortality is a useful index) among the four groups that are available for this purpose.

The absolute case mortality shows 961 deaths among 4,959 cases of enteric fever *admitted* to hospital—*i.e.*, 19·38 per cent.—and 964 deaths among 8,568 cases of all continued fevers *admitted* to hospital—*i.e.*, 11·25 per cent. But these relations of deaths to cases do not convey an accurate impression of the actual facts; cases were *transferred* to the Bloemfontein hospitals without being included among the admissions, and, on the other hand, some (not many) deaths occurred among the cases transferred from Bloemfontein to other stations. These two sources of error do not balance one another. There is no question that the deaths among the cases transferred to Bloemfontein were greater in number than among the cases sent out of Bloemfontein, first because of the larger number sent into the town in the acute stage, and secondly, because of their greater severity. Cases were sent in from the surrounding district as a matter of necessity; cases sent out were at least fit to be moved. Hence this case mortality of 19·38 per cent. is a maximum rate, and is by no means high compared with those found elsewhere.

The second use of the case mortalities is not open to the same doubt as to accuracy; each of the groups compared was under the same average conditions. We have two main groups, Colonial troops, and those for brevity called Regulars, which included some Volunteers and Imperial Yeomanry. Each of these two groups is divided into the sub-groups, officers and men. The following table

shows the case mortalities in each of these groups, with the probable errors and differences, for enteric fever and for all continued fevers. The general case mortality in the corresponding groups for the whole period of the campaign is also shown in dark type for comparison.

COMPARATIVE CASE MORTALITIES IN BLOEMFONTEIN.

	ENTERIC FEVER			ALL CONTINUED FEVERS		
	Regulars	Colonials	Totals	Regulars	Colonials	Totals
Officers—						
Bfn. ..	12·58 ± 1·82	10·64 ± 3·03	12·12 ± 1·56	7·98 ± 1·19	8·62 ± 2·49	8·11 ± 1·07
S.A.W. ..	9·73 ± 0·47	11·19 ± 1·30	9·92 ± 0·44	6·09 ± 0·30	7·35 ± 0·87	6·24 ± 0·28
	2·85 1·88	0·55 3·30	2·20 1·62	1·89 1·23	1·27 2·64	1·87 1·10
	—	—	—	—	—	—
Men—						
Bfn. ..	20·37 ± 0·42	13·68 ± 1·05	19·68 ± 0·39	11·76 ± 0·25	7·86 ± 0·62	11·36 ± 0·24
S.A.W. ..	14·28 ± 0·10	11·33 ± 0·25	13·91 ± 0·10	9·07 ± 0·07	7·46 ± 0·17	8·87 ± 0·06
	6·09 0·43	2·35 1·08	5·77 0·40	2·69 0·26	0·40 0·64	2·49 0·25
	+	—	+	+	—	+
COMPARATIVE RATES BETWEEN OFFICERS AND MEN—BLOEMFONTEIN ALONE.						
Officers ..	12·58 ± 1·82	10·64 ± 3·03	12·12 ± 1·56	7·98 ± 1·19	8·62 ± 2·49	8·11 ± 1·07
Men ..	20·37 ± 0·42	13·68 ± 1·05	19·68 ± 0·39	11·76 ± 0·25	7·86 ± 0·62	11·36 ± 0·24
	7·79 1·87	3·04 3·21	7·56 1·61	3·78 1·22	0·76 2·56	3·25 1·09
	+	—	+	+	—	+

The table may be summarised as follows: (1) There is really only one difference—between the Warrant and N.C.O.'s and men of the "Regulars" as here used, and the other sub-groups. The first shows a distinctly higher case mortality than the second, among whose components no significant difference exists. This distinction applies to enteric fever and to the total of all continued fevers, both in the epidemic in Bloemfontein and in the results of the whole campaign. It may be safely accepted as a true distinction. The grouping in the case of Bloemfontein is this:—

Regular forces, excluding officers ..	Enteric fever	All continued fevers	
	20·37 ± 0·42	11·76 ± 0·25	
	and			
Officers, regulars	12·58 ± 1·82	} 3·69	7·98 ± 1·19	} 2·83
„ colonials	10·64 ± 3·03		8·62 ± 2·49	
Men, colonials	13·68 ± 1·05		7·86 ± 0·62	

It may be pointed out, in relation to these comparative case mortalities, that the proportion of the total continued fevers which

were diagnosed enteric fever was substantially the same in Bloemfontein and throughout the whole campaign, about 60 per cent., except in the case of the Colonial officers in Bloemfontein, where it rose to 81 per cent.

(2) Among the officers the case mortality in Bloemfontein did not show any significant variation from that obtaining over the whole campaign. Among the men of the Regulars it was higher in Bloemfontein than during the whole campaign, both for enteric fever and all continued fevers. Among the men of the Colonials, it did not differ from that of the whole campaign.

(3) The case mortality from enteric fever and from all continued fevers was then greater among the men of the Regulars than among any other group, and greater than the average of the same group over the whole campaign.

Messrs. Holt and Schooling in pointing out that the death-rate from other causes than wounds was invariably higher among the men than among the officers, say that "it is probable that as a body, they (the officers) were men of better stamina than the rank and file, and perhaps were better cared for when ill" ("The Mortality Experience of the Imperial Forces in South Africa," p. 20. It should be noted that this conclusion is drawn from the bare ratios without consideration of probable errors or differences). Here we have two propositions, which are perhaps generally accepted; the latter, indeed, has been put more bluntly. But the fact that the case mortality among the men of the Colonials shows no significant variation from that in the two groups of officers shows that the cause must be sought elsewhere than in the treatment, as at no time was there any differentiation in treatment between the Colonial and Regular rank and file. The Colonial troops in Bloemfontein, and indeed during the whole area of operations during the early part of the war, were men of good physique; later on the same adjective could not be applied to the whole group.

The differences in exposure between officer and man in the advance to Bloemfontein and its early occupation can have been very small, at least for the regimental officer; in Bloemfontein one was as likely to be attacked as the other, and it will be seen later that over the whole campaign, the officers of the Regulars and Volunteers were attacked rather more frequently than the men of the same group.

We have then, among the group of lesser mortality, two conditions: "better stamina"—that is the result of antecedent differences in nurture, better feeding during childhood and adolescence,

the habit of exercise instead of the overwork of the undeveloped youth of the labouring classes, and a habit of cleanliness in person and with regard to food, which in some degree withstood the temptation to revert to primitive savagery.

Among the Colonial troops, we have probably greater average age, the habit of life in some degree analagous to field service, and the lessened susceptibility due to previous exposure and infection. The difference in mortality then is explainable by reference to conditions which long preceded the actual attack of the disease.

(g) *The Later Prevalence of Enteric Fever and Dysentery.*—

(a) From the date of our occupation of Bloemfontein, the conditions in the area of operations became more and more complicated as time went on. There were, in the first place, the lengthening lines of communication, liable to be broken at any point and consequently guarded by small bodies of troops at every station and almost at every culvert. The medical arrangements on these lines have been described in the Report on the Medical Arrangements in South Africa. There were the large garrisons of important points on and off the line: Bloemfontein, Kroonstadt, Johannesburg, Pretoria, Standerton—all permanently important as the centres from which the columns started and to which they returned for refitting. Besides these, smaller garrisons were maintained at other points of less permanent importance, such as Harrismith, Machadodorp, Potchefstroom, and other places, depending on the area in which the mass of the columns was operating. Next came the smaller garrisons of posts off the railway line, not continuously occupied and only occasionally important; next the chains of blockhouses extending along the railway line or from point to point across country, and last of all the columns themselves, working in various parts of the area, remaining out for variable periods, but finally coming to the line somewhere to obtain supplies and refit. It is quite evident that it is absolutely impossible to examine the prevalence of these two diseases in any detail under such complicated conditions; the sick population of a hospital was drawn from a very wide area, an area, too, which differed to some extent from week to week according to the direction from which the columns came.

On the other hand, there is little to be gained from an inquiry into the mode of propagation under these conditions. From about the date of the occupation of Bloemfontein, enteric fever and dysentery occurred in varying degrees of intensity throughout the whole area for the remainder of the campaign. It is safe to say that no known means of dissemination, except drains, oysters, and fried fish,

was wanting. Numerous specific instances of sanitary mistakes or apparent neglect have been published in the medical press and elsewhere, during and after the campaign, which no doubt exemplified the possible modes of dissemination which existed, but they rarely, if ever, correlated the supposed antecedent cause and the consequent case, and never revealed any new method of infection. Hence there appears to be little benefit in discussing them. Further, it is probably not unjust to say that in certain of these examples the scientific interest was not the motive which determined publication: in one instance, indeed, an illustrative map was (one can only suppose inadvertently) lettered and printed upside down, which made a very material difference in the lesson to be drawn from it—the relation of a water intake to a sewage outfall. These examples revealed one thing—the necessity of a much more complete knowledge of details than was possessed by the authors, in order to understand the true meaning of the facts as they appeared.

One has only to read the reports of the Local Government Board to recognise the very great difficulty in tracing the mechanism of infection under the comparatively simple conditions of an almost stable population and environment. How much more difficult the investigation then must be when the population is essentially mobile, the conditions varying from day to day, when also, except at once and on the spot, it is almost impossible to make any satisfactory attempt at the reconstitution of the case.

Among the various accounts of the occurrence of enteric fever and dysentery in South Africa which have been published, that by Dr. H. H. Tooth, C.M.G., of the Portland Hospital, may be specially mentioned as a careful statement of the position. Farther, that portion of the Report of the Commission on Enteric Fever and Dysentery, by Colonel J. Lane Notter and Professor W. J. Simpson, contains much interesting information in this connection. This report, however, is more likely to be of use to those who have practical knowledge of the conditions met with in the field in war time than to others.

(To be continued.)
