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concentrated *Salm. typhi* H suspension for use in urine; and Major-General A. J. Beveridge, O.B.E., M.C., Q.H.P., D.M.S. M.E.L.F., and the Medical Director-General of the Navy for permission to publish this work.

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## OBITUARY NOTE

It was with profound regret that we heard of the tragic death of Surgeon Commander W. Sloan Miller very shortly after the completion of this paper, at the hands of the Cairo mob.

Sloan Miller was a laboratory worker of high achievement and even greater promise, who had already most worthily upheld the reputation of his Service in international circles. He had a boldly original and keenly analytical mind, and his help and advice were ever available to colleagues, not only of his own Service, but also of the other Medical Services of the Crown, to whom he was in addition a kind and generous host when they visited Cairo.

His passing is a sad loss not only to his friends and to the Medical Service of the Royal Navy, but to the Armed Forces and to the Medical profession.—Ed.

## EXPLOSIVE OUTBREAK OF $\beta$ -HÆMOLYTIC STREPTOCOCCAL SORE THROAT

BY

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THIS is an account of an outbreak of  $\beta$ -Hæmolytic streptococcal sore throat, occurring in a group of approximately 130 men, acting as an independent unit in the field. Altogether 61 men were affected and admitted to hospital, that is to say almost half the strength of a battery. It was considered worth while describing the outbreak at some length both because of its unusual mode of onset and because several points arise which serve to emphasize the ever-constant need of vigilance in the matter of hygiene during exercises in the field.

## MODE OF ONSET OF THE OUTBREAK

The whole of a Field Regiment went on manœuvres for a period of seven days ending at 1500 hrs., 20/7/51. Throughout this period the individual batteries acted as entirely separate units. The only battery affected by the out-

break consisted of approximately 130 men, of whom 7 were officers, 10 sergeants, and 6 members of the A.C.C. All the rest were bombardiers, lance-bombardiers, and gunners.

On the morning of 21/7/51, the day following the end of the exercise, 17 members of this battery, all below the rank of sergeant, reported sick with sore throat, headache and malaise (Cases 1-17). Seven of these had vomited, one of them (Case 2) repeatedly. In view of the severity of many of these cases, and the presence of membrane in most of the throats, the R.M.O. arranged for all 17 cases to be admitted to the British Military Hospital. Furthermore, he arranged to inspect the throats of all the remaining members of the battery on the afternoon of 21/7/51. During this inspection he picked out 23 more cases, 21 of whom had symptoms but had not reported sick (Cases 18-40). Once again all these cases were below the rank of sergeant, but one was a member of the A.C.C. (Case 37). Thus it was clear that an explosive outbreak of sore throat had occurred which so far had been confined to members of the battery below the rank of sergeant.

#### MEASURES TO DEAL WITH THE OUTBREAK

All clinical cases were admitted to the British Military Hospital. The remaining members of the battery (including attached A.C.C. personnel) were, as far as possible, segregated from the rest of the regiment. They were confined to the precincts of a separate block, and advised to spend as much of the daytime as possible in the open air, and not to mix with members of other batteries. The problem of feeding was especially difficult as there was only one kitchen and dining room for the whole of the regiment. However, this situation was overcome by arranging that the battery fed after all other batteries in one end of the dining room set aside for them. The windows of the dining room were kept open all day. Dishes and cutlery were washed and sterilized twice after each meal. Throats of all remaining members of the battery were examined each day, and fresh cases sent to hospital immediately.

Liaison was established between the A.D.A.H., the Officer i/c Laboratory at Wuppertal, and the R.M.O. of the unit concerned, particularly with a view to discovering the cause of the outbreak.

#### MEASURES TAKEN TO DISCOVER THE CAUSE OF THE OUTBREAK

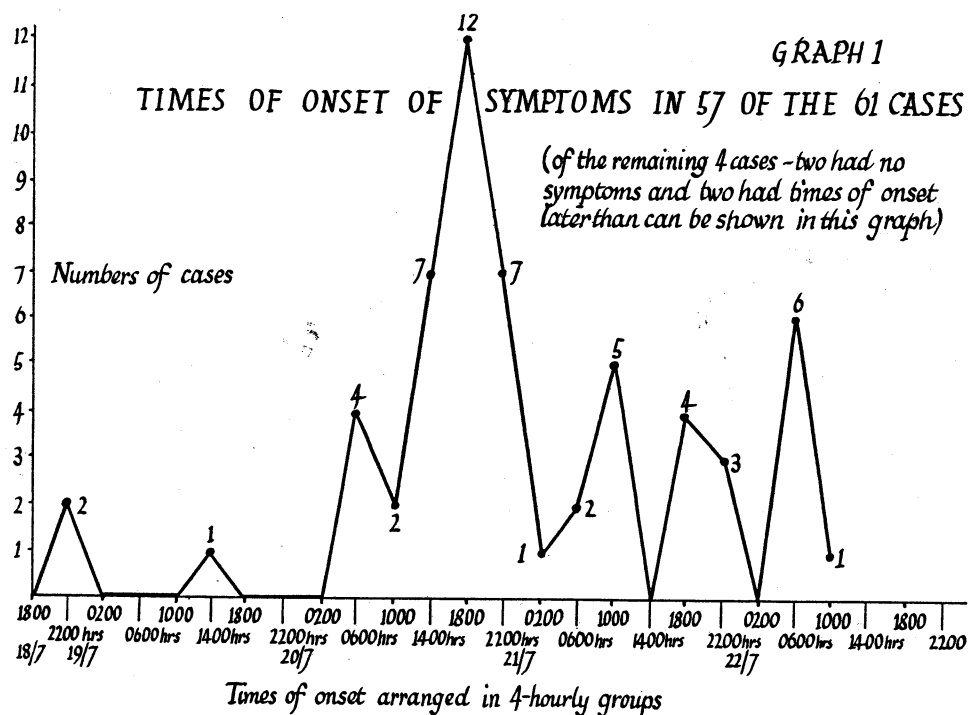
On arrival at the British Military Hospital patients were questioned closely as to the time of onset of symptoms. The results of this inquiry are expressed in the graph. It was noted that in 33 cases the onset of symptoms was between 0400 hrs. 20/7/51 and 0400 hrs. 21/7/51, and that in a further 3 cases (Cases 6, 17, and 24) sore throat was present between twenty-four and forty-eight hours prior to the main outbreak.

Cases 6, 17, and 24 were very closely questioned as to their handling of food, water or milk during the exercise. No significant facts emerged.

All throats were swabbed on arrival at hospital, and all except two swabs (Cases 30 and 58) grew  $\beta$ -Hæmolytic streptococcus.

Members of the A.C.C. were interviewed separately. Throat swabs were taken, and hands were examined for septic lesions. A menu for all meals served during the exercise was obtained, and the methods of preparing and serving each individual meal were laboriously ascertained. Finally, a list of all sources of water used by battery was requested.

Several significant facts emerged from these inquiries and examinations and are listed as follows :



#### From Examination of Members of the A.C.C.

The throat swab from one of the cooks who was not clinically affected (Case 43) grew *β-Hæmolytic streptococcus*. The growth was not profuse and owing to delays (because of lack of media) it was not possible to send a subculture of this organism to Millbank for Lancefield Grouping. However, subsequent throat swabs gave scanty growths of *β-Hæmolytic streptococcus*, although the patient never once complained of sore throat. The R.A.M. College, Millbank, reported two subcultures of streptococci from these later swabs as Lancefield Group A.

Although, at the time of inspection of the cooks (22/7/51), no septic lesions were observed on any of their hands or faces, on 24/7/51 Case 43 (*vide supra*) was admitted to the British Military Hospital with an almost symptomless paronychia

of one finger. Pus from this lesion grew a streptococcus which was subsequently reported by the R.A.M. College, Millbank, as Lancefield Group A.

It later transpired that this same Case 43 had been admitted previously to B.M.H. Wuppertal (28/4/51) with a boil on his face. He remained in hospital ten days on that occasion, but there is no record of a swab having been taken. The patient denied any previous sepsis apart from this.

*Result of Inquiry into Food served and Methods of Serving, etc.*

As stated above, it had been noted that in 33 cases the time of onset of symptoms was between 0400 hrs. 20/7/51 and 0400 hrs. 21/7/51, and therefore the inquiry was directed particularly at discovering contamination of food, milk or water at a suitable incubation period before the mean time of onset of symptoms of these cases.

It came to light that the meal prepared for the evening of 18/7/51 had been prolonged over a period of almost six hours after its preparation. This was because, just when the meal was about to be consumed, the battery was ordered to move. The meal in question consisted of:

Thick soup and potatoes; boiled pudding with a sauce prepared by adding milk powder to cold, unboiled water; tea and bread.

Case 43 thinks that he helped to mix the milk sauce and may have handled the soup. (N.B.—He is not a good witness.) Unfortunately, none of the food served at this or any other meal was preserved for bacteriological examination.

For tea on the 18/7/51 lettuce and cucumber were served which had been washed in unboiled water.

No other significant facts emerged from this particular inquiry.

*Result of Inquiry into Sources of Water Supply*

It is understood that this was followed up by the Hygiene Wing, who discovered that the water-cart was filled up without precautions on no less than three occasions with water of unknown purity, and that this was done without the supervision or knowledge of any responsible person.

One of these three sources had been used by another battery without ill effect. A sample from the second of these sources was tested by McGrady method and found to contain 50 *B. coli* per 100 c.c. The third source was not to my knowledge investigated.

THE FURTHER COURSE OF THE OUTBREAK

As already stated, 40 cases were admitted to B.M.H. on 21/7/51. On 22/7/51 a further 18 cases were admitted (Cases 48–65) and thereafter only 3 more cases occurred. Two of these 21 further cases were sergeants. No officers were affected. The measures taken were entirely effective in confining the outbreak to one battery.

The over-all attack rate (excluding officers) was approximately 50 per cent. (i.e. 61 cases out of 123 men at risk).

THE TREATMENT, COMPLICATIONS AND DISCHARGE FROM  
HOSPITAL

Approximately one-third of the cases were given procaine penicillin (300,000 units I.M. once daily). The remaining two-thirds were treated with sulphonamides in usual doses. Clinically cured cases were discharged when they had achieved one clear swab.

Three cases relapsed two days after discharge (Cases 8, 21, and 39). However, in only one case did the organism persist in the throat after 7/8/51 (Case 57). Complications were limited to peritonsillar abscesses in cases 5, 6, and 16, all of which had the complication on admission. No complications occurred during hospitalization.

## BACTERIOLOGY

All throat swabs were examined in the routine manner. No Vincent's organisms were seen in any case, and in no case was K.L.B. isolated. Owing to shortage of staff and materials, later swabs were cultured on  $\frac{1}{8}$  blood plates. This procedure made subsequent readings of plates and subculture difficult.

In 59 out of 61 clinical cases a  *$\beta$ -Haemolytic streptococcus* was isolated. The exceptions were Cases 30 and 58. It was decided that subcultures would be sent to the R.A.M. College, Millbank, for Lancefield Grouping. Unfortunately, the outbreak had already depleted stocks of media, and there was a two-day delay whilst fresh stocks were obtained for the purpose of subculturing the streptococci. This delay, and the practice of using  $\frac{1}{8}$  plates for the later cultures, made successful subculture difficult or impossible in some cases.

Of 41 subcultures actually received at Millbank for Lancefield Grouping—

- 25 were reported as  *$\beta$ -Haemolytic streptococcus*, Lancefield Group A.
- 1 was reported as  *$\beta$ -Haemolytic streptococcus*, untypable with sera A, C and G (Case 17).
- 6 were reported as sterile on arrival at Millbank.
- 5 yielded staphylococci only.
- 3 gave a growth of  *$\alpha$ -Haemolytic streptococcus* (Cases 6, 28 and 29).
- 1 gave a mixed growth of  *$\alpha$ -Haemolytic streptococcus* and *staphylococcus* (Case 34).

It is very reasonable to suppose that the fact that 15 cases were not reported as giving growths of  *$\beta$ -Haemolytic streptococcus* was due to the difficulty and faults of subculture.

It is, however, interesting that none of the three cases whose symptoms dated back prior to the main outbreak was reported as having a Lancefield Group A streptococcus (Cases 6, 17 and 24).

## DISCUSSION AND CONCLUSIONS

It must be almost certain that contamination of food, water, or milk was the cause of this explosive outbreak of  *$\beta$ -Haemolytic streptococcal* sore throat.

Despite the efforts described above to find out, in detail, how the outbreak occurred, it is impossible to come to any definite conclusion.

However, it has come to light that—

- (a) The water-cart was filled from possible unsuitable sources on three occasions without proper precautions.
- (b) There was working in the kitchen a cook carrying  $\beta$ -Hæmolytic streptococcus in his throat, who had previously had a boil on his face, and who subsequently developed a paronychia of one finger, which grew a Lancefield Group A streptococcus.
- (c) Approximately thirty-six hours before the onset of symptoms in the main body of cases, a meal was eaten several hours after it had been prepared, and that the cook, referred to above, almost certainly helped in preparing a powdered milk and water sauce, served with the second course of this meal.

The truth of the matter surely is that lack of good and intelligent hygiene in a unit may only come to light when the unit is plunged into field conditions. In this particular case it seems that if proper precautions had been taken in the sterilization of water and preparation of food, then the outbreak would not have occurred.

One cannot hope to exclude all carriers from kitchens, etc., under present conditions, and therefore one must rely on the sterilization of food by heat very shortly prior to consumption, and the general clean handling of food under all circumstances.

A plea is made for the supervision of food and water during field conditions by adequately trained and responsible persons.

[For lack of space the table of cases has had to be omitted.—Ed.]

#### ACKNOWLEDGMENTS

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