outside the home. The repeated findings of *B. dysenteriae* Sonne suggested that this infection was being spread. The "dropping" cases during the three weeks were what might be expected in an outbreak spread by contact infection; and even though the separation of the healthy from the sick was tightened up, the activity of these children, unbelievably quick in touching, smelling, and putting things into their mouths, made the transfer of infection probable.

The treatment aimed at the bacillus causing the disease: it sought by the action of the bacteriophage to modify the bacillus, and thus render it less capable of giving rise to dysenteric infection. Some modification did apparently occur, as towards the end of the epidemic there were more "atypical" bacilli and steadily fewer typical dysentery bacilli isolated. There was no change in the technique used, so it appears that the modification was truly in and of the bacilli. (It is open to argument whether "atypical" dysentery bacilli can be produced from *pure strains* of known dysentery organisms, but there is some evidence in the authorities which appears to support the proposition.) No medicinal treatment other than bacteriophage was administered. No case was removed from the home. Inquiries at the home at the end of April, 1938, elicited that no further case had occurred.

The bacteriophage was prepared at the Usher Institute of Public Health, Edinburgh. In its preparation races of bacteriophage active against strains of dysentery occurring in this country are largely used, and these include *B. dysenteriae* Sonne from a variety of sources.

I should like to express my thanks to Dr. Eric Pritchard for consulting me about this outbreak, for allowing me to use the bacteriophage treatment, and for his never-failing help and consideration in this and other matters; to Lieutenant-Colonel J. Morison, to whom I am indebted for the supply of bacteriophage, and much kindly help, advice, and friendly criticism; to Dr. W. E. Wallis, medical officer at the home, for his courteous assistance, for the efficient supervision of the outbreak, and for placing his records at my disposal; to the National Institute for the Blind for allowing the publication of this paper and for so readily supplying plans, documents, etc., relevant to this work; and, finally, to Mr. H. Clouston, my senior technician, for invaluable help in the isolation of the dysentery bacilli, and to the other members of my staff for their technical assistance.

BIBLIOGRAPHY

- Arkwright, J. A. (1921). *J. Path. Bact.*, **24**, 36.
 Björlén, K. (1930). *C. r. Soc. Biol.*, **103**, 613.
 MacGill, J. S., and Downie, A. W. (1932). *Lancet*, **2**, 29.
 Morison, J. (1932). *Bacteriophage in the Treatment and Prevention of Cholera*, Lewis, London.
 Nelson, R. L. (1930). *J. Bact.*, **20**, 183.
 Nisbet, B. R. (1938). *Med. Off.*, **59**, 87.
 Pickles, W. N. (1932). *Lancet*, **2**, 31.
 Topley, W. W. C., and Wilson, G. S. (1936). *Principles of Bacteriology and Immunity*, Arnold, London.
 Waaler, E. (1935). *Studies on the Dissociation of the Dysentery Bacilli*, Dybwad, Oslo.
 Whitehead, H., and Scott, W. M. (1934). *Lancet*, **2**, 248.

"Problems of the Nations" will be discussed in a series of talks to be held in the Halls of City Livery Companies in aid of King Edward's Hospital Fund for London. The subjects will be "China" on October 6 in the Hall of the Vintners' Company; "Russia" on October 26 in the Hall of the Goldsmiths' Company; "Eire" on November 10 in the Hall of the Clothworkers' Company; and "Czechoslovakia" on November 24 in the Hall of the Drapers' Company. Ticket holders will be given an opportunity of seeing the premises and historical relics before the talks, which begin at 5.30 p.m. Further information and tickets (price 3s. 6d.) can be obtained from the Secretary, King Edward's Hospital Fund for London, 10, Old Jewry, E.C.2.

OBSERVATIONS ON THE POTENCY AND STABILITY OF DICK TEST TOXINS

BY

H. MASON LEETE, M.D.

City Hospital, Cottingham, Hull

J. McGARRITY, M.D. and F. L. KER, M.B.

City Hospital, Little Bromwich, Birmingham

AND

J. REID, M.D.

Lanark County Hospital, Motherwell

The Dick test is less reliable than the Schick test, and is therefore employed much less in clinical work. From time to time questions are asked about the possibility of improving the Dick toxin used clinically in many hospitals in this country. Is it of optimum potency at the time of preparation, and does the diluent ensure that undesirable deterioration does not occur before use?

We have recently been able to compare the potency of two toxins, one of which, Toxin A, was diluted in boric acid borate buffer solution (B.B.S.), and the other, Toxin B, in 0.4 per cent. phenol saline and in B.B.S. The former toxin is the preparation now used clinically by many workers in this country. We have taken the opportunity to inquire into the stability of the various reagents and also to endeavour to assess the error of the skin method of comparing two toxins in human subjects.

Reagents and Technical Details

The following toxin dilutions were available for injection:

1. Toxin A, diluted in B.B.S. 2 to 3 days previously
2. " " " " " 1 month
3. " B, " " " phenol saline 2 to 3 days previously
4. " " " " " 1 month
5. " " " " " B.B.S. 2 to 3 days previously
6. " " " " " 1 month

Dilutions 1, 3, and 5 were posted on the day of preparation, and dilutions 2, 4, and 6 had been kept at 4° C. for four weeks and were sent by post at the same time as dilutions 1, 3, and 5. The tests were made on the anterior surfaces of the forearms of Dick-positive individuals, separate syringes being used for each dilution. The sites of injection varied in different patients; thus a dilution might be injected on the forearm near the elbow in one patient and near the wrist in another. Readings were made after sixteen to twenty-four hours, the key to the order of injections being unknown to the persons making the readings. Throughout the investigation the greatest care was taken to exclude conscious and unconscious bias. The dimensions of the reactions were recorded in millimetres and notes made of their intensity.

Results

An analysis of the comparisons made at the different hospitals is shown in the table.

The following conclusions may be drawn:

1. Toxin A is considerably stronger than Toxin B.
2. Toxin A deteriorates slightly after four weeks in cold storage followed by two to three days at room temperature.
3. Toxin A which has been kept for one month is still considerably stronger than Toxin B freshly prepared.
4. Toxin B deteriorates slightly after four weeks in cold storage followed by two to three days at room temperature.

5. B.B.S. is a more suitable diluent than phenol saline for Toxin B. It ensures less deterioration after (a) two to three days at room temperature, and also after (b) four weeks at 4° C. followed by two to three days at room temperature.

Comparison of two Dick toxins, A and B, diluted in B.B.S. or 0.4 per cent. phenol saline (a) two to three days before injection, and (b) one month before injection

			Observers		
			M.L.	McG. and K.	R.
A (B.B.S.) 2-3 days	>	B (phenol) 2-3 days	11	18	16
" " " "	>	" " " "	0	0	0
" " " "	>	" " " "	2	0	0
A (B.B.S.) 2-3 days	>	A (B.B.S.) 1 month	2	12	4
" " " "	>	" " " "	4	2	2
" " " "	>	" " " "	7	4	10
A (B.B.S.) 1 month	>	B (phenol) 2-3 days	11	18	16
" " " "	>	" " " "	0	0	0
" " " "	>	" " " "	2	0	0
B (phenol) 2-3 days	>	B (phenol) 1 month	6	7	1
" " " "	>	" " " "	2	3	3
" " " "	>	" " " "	5	2	12
B (phenol) 2-3 days	>	B (B.B.S.) 2-3 days	4	1	0
" " " "	>	" " " "	4	9	10
" " " "	>	" " " "	5	0	6
B (phenol) 1 month	>	B (B.B.S.) 1 month	1	2	1
" " " "	>	" " " "	5	6	8
" " " "	>	" " " "	7	0	7

The toxins were supplied to the various hospitals in sealed glass phials and in rubber-stoppered bottles. There did not appear to be any significant difference between the results obtained with toxins from the two types of container, which were disregarded when the above table was compiled.

Discussion

From the combined research it is obvious that one has to use large numbers of persons in comparing the dilutions which were supplied of Dick toxins A and B. Discrepancies are apparent in an analysis of the data from different hospitals, and indicate the need for care in the interpretation of comparisons based on small groups. At the same time undue emphasis must not be placed on the discrepancies reported by different workers. Many of these were explained by a difference in measurement of a very few millimetres, as was evident from the original protocols (unpublished).

The influence of the diluents is also of interest. Boric acid borate buffer solution, which is now used in Great Britain, is a better stabilizing agent than phenol saline. A similar conclusion was reached by O'Brien, Okell, and Parish (1928), although in their early work a slightly higher concentration of phenol was used and a more rapid deterioration of toxin was observed. It is now well known that phenol is an unsuitable antiseptic for various other toxins—for example, diphtheria and tetanus—and for such immunizing agents as diphtheria prophylactic, A.P.T., which may lose its antigenicity rapidly in the presence of phenol.

A comparison of various Dick toxins has also been made by Ker (1937), who commented on the stability of the material used in his tests. His work emphasizes, too, the necessity for tests on a large group of persons in any investigation of this type.

With regard to the strength of Dick toxin used normally in our clinical work, the dramatic reduction of scarlet fever among nursing staffs after the introduction of the Dick test and active immunization indicates clearly that a

Dick-negative staff of nurses has a high degree of protection against infection; but we have seen a small number of relapses to Dick-positive and a few cases of scarlet fever among nurses who had formerly, or recently, been Dick-negative. On reviewing all the evidence, however, the results of immunization indicate that the Dick toxin used is of satisfactory potency.

Summary

1. In comparing two different samples of Dick toxin, tests on small groups of persons may be misleading. We would emphasize the need for making a considerable number of tests if an accurate result is required.

2. Boric acid borate buffer solution is a preferable diluent to 0.4 per cent. phenol saline, since it ensures greater stability.

3. The Dick toxin A, used normally in our clinical work, is of satisfactory potency and stability. Negative reactions with this toxin indicate a high degree of protection, although we have observed a few cases of scarlet fever in Dick-negative nurses.

We are indebted to Dr. R. A. O'Brien and Dr. H. J. Parish of the Wellcome Physiological Research Laboratories for the Dick toxins and diluents used for the tests.

REFERENCES

- Ker, F. L. (1937). *British Medical Journal*, 1, 852.
O'Brien, R. A., Okell, C. C., and Parish, H. J. (1928). *Publ. Hlth.*, 41, 181.

A NOTE ON DIPHTHERIA IMMUNIZATION IN LONDON

BY

MAX SORSBY, L.M.S.S.A.

The increasing attention that is being paid by public health authorities to the immunization of children against diphtheria and the satisfactory results that have been obtained by various authorities in the reduction of the incidence of the disease by this procedure have led to the present study of the extent of diphtheria immunization in the child population of London. Diphtheria is a problem of no mean order in the metropolis. For the decennial period 1926-35 the following yearly averages for the County of London show the extent of morbidity and mortality.

Approximate population (0-15 years)	1,000,190
Diphtheria cases	9,047 (Attack rate of 9.04 per 1,000)
Deaths	367 (Death rate of 3.65 per 10,000)
Case mortality, per cent.	4.05

Immunization is carried out in the County of London mainly by the authorities of the different metropolitan boroughs. Holborn has provided facilities since 1922, and it was some years before other authorities followed: even now Bethnal Green has no local facilities, but makes arrangements for applicants to be immunized elsewhere. By reason of this lack of uniformity a much larger number of children are immunized in some parts of London than in others. Taking all the London boroughs together, by the end of 1935 there were 29,616 children potentially protected against diphtheria, either because of a natural immunity or as a result of immunity acquired by inoculation. The proportion of naturally immune children is not insignificant, for of nearly 30,000 no fewer than 4,698 were found Schick-negative at the primary test. On this basis something like 20