medical adviser's department, gave invaluable assistance on the section dealing with cases developing symptomatically. My contribution was part of the work as Proffit Scholar of the Royal College of Physicians, and the Proffit Committee of the College made additional clerical help available for the analysis of record cards.

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TECHNIQUE OF JELLY (TUBERCULIN) SKIN-TESTING

COMPARISON BETWEEN VARIOUS TECHNIQUES AND THE MANTOUX TEST

BY

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It is apparent that many physicians reject the jelly test and that others are dissatisfied with results from this method. To a recent questionnaire sent to 246 chest clinics and children's and orthopaedic hospitals in England, 190 replies were received from different individuals (77%).

Of the 190, 80 (42%) do not use jelly tests, some having abandoned them. Of the 110 using the test, the number who abrade the skin with fine sandpaper was 64 (58%); in each group about one-third (35%, 36%) were dissatisfied with results. It is of interest to note that, of those who were dissatisfied, only 2.9% read their results at 72 hours or more.

The series of tests described was undertaken in order to find the most efficient method of jelly skin-testing, to produce a simple, standard, and reliable technique, and, if possible, to determine its equivalent in terms of the Mantoux test. The investigation was carried out independently of the work published by Pointon Dick (1950), and the draft article was written before his publication; some amendments in the text were made after the publication of his findings.

Non-specific Reactions to the Mantoux Test

W.H.O. (1948) has lowered the final test dose of O.T. from 100 (1 mg.) to 10 tuberculin units (T.U.) on the grounds that there are non-specific reactions from the higher dose. It has been shown in America by Furcolow *et al.* (1941), Furcolow (personal communication), and Long and Seibert (1937) that such reactions occur with P.P.D. The former used increasing doses of P.P.D. and found that even infants under 6 months of age who had had no known contact would give a high proportion of positive reactions if the dosage was sufficient. They also stress the instability of the reaction, used by its opponents as a condemnation. Long and Seibert, using a timothy-grass (T.G.) product, found that 86% of those negative to first-strength P.P.D. and to the T.G. product in corresponding dosage, and who were positive to second-strength P.P.D., were also positive to the T.G. product in corresponding dosage.

The great advantage of the intradermal Mantoux test is claimed to be that an accurate known dosage is given. Furcolow and Robinson (1941) reported an interesting series in this connexion, injecting the same individual with the same material (P.P.D.) from the same syringe at the same time. With a dose of 1/10,000 mg. of P.P.D. they found that 3.3% were positive in one arm and negative in the other, and state that with higher dosage "much greater variation takes place"—a finding previously reported by Paretzky (1938). Heimbeck (1950) regards the Mantoux as not so good a test as the von Pirquet, mainly on the grounds of non-specificity.

Standard for Comparison.—The Mantoux test was regarded, for the purpose of this investigation, as the standard by which the various transdermal tests were measured, because it is still accepted in this country as the standard test, even at 100 T.U. dosage. It was felt that, if a test which was consistently equal to or better than 10 T.U. could be found, this would meet the objections to the use of the highest dose—objections considered by some to be exaggerated. The standard used for checking against false positive jelly reactions is therefore the 100 T.U. Mantoux test in those cases in which the 10 T.U. test gave a negative result and in which, therefore, a positive jelly test might be regarded as a false result; but from the work quoted above it appears to be more important to have a high correlation with the 10 T.U. test.

The Techniques

Deane (1946) showed that abrasion of the skin by fine (grade O) cabinet-maker's sandpaper gave 100% positive results, using O.T. jelly, in a series of children known to be positive to the 1/1000 O.T. Mantoux test, whereas without the use of sandpaper only 87.5% were positive. The series was small and no details of age grouping were given.

P.P.D. Jelly.—Technique A (P.P.D.): The skin is given a firm rub with a plug of cotton-wool soaked in acetone; the interscapular area to be tested is then stroked lightly with flourpaper six times, so as not to produce an erythema; the jelly (60% w/v) is applied and covered with leucoplast. The plaster is removed at 48 hours, and the result is read 48 to 96 hours after application. The technique is that described by Pointon Dick (1950). *Technique B (P.P.D.):* Precisely as A (P.P.D.), except that, instead of a "firm rub" with acetone-wool, a deliberate attempt is made to produce an erythema with the wool, before flourpapering. *Technique C (P.P.D.):* This is a commonly used method in clinic practice. It is precisely as B (P.P.D.), except that the flourpapering is omitted.

O.T. Jelly.—Technique D (O.T.): Identical to A (P.P.D.), except that O.T. jelly replaces the P.P.D. jelly.

Standards.—In all tests in both parts of the investigation results were accepted as positive when the jelly gave six papules or more in the shape of the original application; and for intradermal tests an area of induration not less than 5 mm. in diameter. All O.T. was kept in a refrigerator when not in use and was discarded after 21 days from the date of dilution. All tests were performed and read by me.

Results

First Series. Technique A Compared with Technique C.—Volunteers were 1,452 boys and 1,795 girls from schools in Portsmouth. The jelly tests were applied

to the interscapular area at the same time and were read between 48 and 96 hours later. The results are given in Table I. Thus 175 persons were positive and

TABLE I

		Results by Technique C		
		Positive	Negative	Total
Results by technique A	Positive	175	243	418
	Negative	1	2,828	2,829
Total		176	3,071	3,247

2,828 were negative to both tests; it is seen that technique A gave 243 positive results which were negative by technique C and missed only one which was positive to C. Of the 419 positive to one or other test, 418 (99.8%) were positive to A, but only 176 (42%) to C.

Second Series. Technique B Compared with Technique C.—Volunteers were 702 males and 498 females from schools and industrial concerns in Portsmouth. The results are given in Table II. Of those positive to

TABLE II

		Results by Technique C		
		Positive	Negative	Total
Results by technique B	Positive	88	207	295
	Negative	0	905	905
Total		88	1,112	1,200

one or other test 100% were positive to B but only 29.8% to C, 207 out of 295 positives being missed by technique C.

The results above suggest that technique B is an improvement over technique A, and a third series was undertaken to compare the two directly.

Third Series. Technique B Compared with Technique A.—Volunteers were 452 males and 502 females from a grammar school and two industrial firms in Portsmouth. The results are given in Table III. Of the 285

TABLE III

		Results by Technique A		
		Positive	Negative	Total
Results by technique B	Positive	225	60	285
	Negative	0	669	669
Total		225	729	954

positive reactions 100% were positive to B and only 225 (78.9%) to A. Of the 60 individuals showing a difference between the results, 57 were retested by Mantoux (100 T.U.) and each was positive.

Sex and Age Groups.—There is no significant difference in the results as between the sexes, and when divided into age groups the same trend is seen for all groups.

Comment on First, Second, and Third Series.—Table III shows that there is an advantage in the erythema factor, which is also used in technique C, but when technique C is compared with A (Table I), the advantage of flourpapering is seen to outweigh that of erythema. When techniques C and B are compared (here the only difference is the flourpapering) the advantages of flourpapering are even more clearly shown (Table II). It is possible that had results been read on the fifth or even the sixth day, instead of the third or fourth, more positive results would have been obtained

with technique C, as entry of the tuberculin into the skin* is presumably slower when abrasion is not used. The results show that of the P.P.D.-jelly techniques used B is the most sensitive, followed by A, with C the least sensitive.

Fourth Series. Technique B Compared with Technique D.—Volunteers were 417 infants and boys. The results are given in Table IV. Of the 20 differences

TABLE IV

		Results by Technique D		
		Positive	Negative	Total
Results by technique B	Positive	134	0	134
	Negative	20	263	283
Total		154	263	417

(D+, B-), 12 were positive by Mantoux 10 T.U., 7 by 100 T.U., and one was lost sight of. Results suggest that technique D gives results midway between 10 and 100 T.U. and is superior to the most sensitive P.P.D. technique.

A Further Investigation

This investigation was undertaken in order to compare the efficiency of the O.T. jelly and the P.P.D. jelly, using the same—flourpaper—method, and to find their equivalent in terms of the Mantoux test in standard dilutions of O.T.

Fifth Series.—The jelly tests were applied to the interscapular area at the same time, and, as a result of experience gained in previous series, were read either on the fourth day or, more often, at the beginning of the fifth day. The Mantoux test was performed at the same time (approximately 20%) or on the day the jelly test was read; the Mantoux was read at 48 to 54 hours, with a small proportion, in the case of absentees (approximately 0.5%), at 70 to 74 hours. Volunteers were 867 males and 1,047 females, aged 4 to 20 inclusive, from schools and industrial concerns in Portsmouth. The results are given in Table V. This shows that the

TABLE V.—Results by Technique D and Technique A

		Result by D		Result by A		Total
		Positive	Negative	Positive	Negative	
Results by 10 T.U. of O.T.	Positive	712	1	632	81	713
	Negative	27	1,174	20	1,181	1,201
Total		739	1,175	652	1,262	1,914

O.T. jelly failed to find only one case which was positive to 10 T.U., but the P.P.D. jelly (used by the same method) missed 81 such cases. The results of 10 T.U. Mantoux and technique D differed in 28 cases: in 27 the jelly was positive and the Mantoux negative—that is, the jelly was more sensitive—and in one the jelly was negative and the Mantoux positive. The results of 10 T.U. and technique A differed in 101 cases. In 20 the jelly was positive and the Mantoux negative, and in the remaining 81 the jelly was negative and the Mantoux positive. Compared with the Mantoux, the P.P.D. jelly test was somewhat unpredictable and in general less sensitive.

Retest by Mantoux 100 T.U.—The 1,201 individuals negative to 10 T.U. were retested by 100 T.U. Of the 27 positive to D, 24 were positive to 100 T.U. Similarly, of the 20 positive to A, 18 were positive to 100 T.U.

Total Comparisons of Technique D and 10 T.U.—Volunteers were of all age groups from 4 to 20 inclusive,

It has already been pointed out that there are objections to the Mantoux test in high strength, of which the greatest is probably the non-specific reaction. If a test which has the accuracy of the Mantoux in lower strength, without its disadvantages of needing special apparatus and dry sterilization facilities, without the need for differing dilutions of short life (even with refrigeration facilities), with resulting unavoidable waste—if this can be found, it would be a test of immense value. The results reported here suggest that, properly used, the O.T. jelly is such a test material. Technique D has further advantages: it costs less than half as much in test material alone; the test material can be stored at room temperature and is easily portable; and, most important of all, this technique avoids the disruption of good relations between physician and child patients which may follow the Mantoux test. Many young adults also object to the test, and some refused to have a second injection, although negative to the first.

Practical Use.—It is considered that the jelly test might be of value as the final test prior to B.C.G. vaccination, in view of the evidence that its sensitivity lies between 10 and 100 T.U. and of the objections to the Mantoux test. A case has at least been made for its consideration and trial for this purpose. There would appear to be no doubt that for use in hospital, clinic, and general practice the test has many advantages over the intradermal test and has a failure of only 0.2% with O.T.; even this degree of failure must be considered in relation to the non-specific element of the intradermal test, referred to above.

Summary

Three techniques using P.P.D. jelly are described and are compared with each other in trials on some 5,400 persons of all ages from 4 to 20.

It is shown that techniques involving the use of flourpaper are essential if the best results are to be obtained. The use of the erythema factor alone gives poor and inconsistent results; its use in combination with flourpaper is not recommended as a deliberate policy.

There are some grounds for thinking that the less satisfactory results from the use of P.P.D. jelly are in part due to insufficient time being allowed before reading the test; the fifth day is suggested as the optimum for reading, but further work on this aspect is proceeding.

The use of O.T. jelly by technique D gives superior results to those of the same technique using P.P.D. jelly, and gave 98.4% agreement with 10 T.U. of O.T. in 3,092 cases aged 4 to 20, as opposed to 94.7% in 1,914 comparisons with P.P.D. jelly. The recommended technique is therefore technique D, which is that described and reported by Pointon Dick (1950).

Technique D (O.T. jelly) is as efficient in the higher age groups as in the lower, which is not the case with P.P.D. jelly.

The advantages of transdermal tests as opposed to the Mantoux test are emphasized; the jelly test has all the advantages of the former with none of the disadvantages of the latter, and when used as recommended is more reliable than 10 T.U. Its sensitivity level is between 10 and 100 T.U.—probably about half-way between the two.

It is to be preferred for hospital, clinic, and general practice to the Mantoux test; it is suggested that a case has been made out for its trial as the final test prior to B.C.G. inoculation, in view of non-specific reactions from 100 T.U.

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POLIOMYELITIS IN ISLINGTON IN 1947, 1949, AND 1950

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In common with the county of London and also England and Wales, three substantial outbreaks of poliomyelitis were experienced in the Metropolitan Borough of Islington in each of the years 1947, 1949, and 1950. In all of these years the number of cases was considerably greater than had ever been previously experienced. However, as has been pointed out elsewhere, geographical distribution in poliomyelitis is very uneven, and each outbreak has its own peculiar and special features, as will be evident from the three outbreaks reported.

Incidence and Mortality

TABLE I.—*Poliomyelitis and Polio-encephalitis Notifications and Deaths*

Year	Population	Confirmed Cases	Rate per 1,000 of Population	Deaths	Case Mortality	Cases Under 5
<i>London</i>						
1947	3,309,700	702	0.212	49	7.0%	27.9%
1949	3,389,850	668	0.208	50	7.4%	55.3%
1950	3,410,720 (Dec. 31, 49)	456	0.133	35	7.7%	
<i>Islington</i>						
1947	236,840	22	0.093	4	18.0%	27.3%
1949	239,580	62	0.259	2	3.2%	61.3%
1950	240,370 (Dec. 31, 49)	30	0.125	2	7.3%	40.0%

NOTE.—The deaths recorded are of cases included as confirmed cases.

Table I shows that in 1947 the Islington case rate per thousand population was considerably below that for London as a whole. The case mortality rate, at 18%, was two and a half times that for London. But the numbers are small and the difference may be due to chance.

The Islington case rates for 1949 and 1950 were comparable to those for the County of London, although mortality was low in 1949. The proportion of cases under the age of 5 varied considerably for each outbreak, the percentages showed reasonable approximations to the county figures for 1947 and 1949; the London figures for 1950 are not to hand.

With regard to the low case rate in Islington in 1947, Benjamin (1949) reported a significant negative correlation coefficient of -0.48 between the poliomyelitis attack rate and the average number of persons per room in each administrative area—that is, where more people were crowded together in the household there was less overt poliomyelitis. The extent of overcrowding did not materially alter in Islington in 1949 and 1950, but, as Breen and Benjamin (1950) mentioned in relation to the 1949 outbreak, immunity factors may well invalidate attempts to relate variations to social factors such as housing or economic environment.

Epidemic Spread and Age Grouping

The attack in 1949 showed a sudden onset in July, without preliminary sporadic cases in Islington, and high peaks in September and October (Table II). 1950 gave earlier peaks in July and August with a gradual