Vollmer and Goldberger (1937), the pioneers in this work, established the superiority of the patch test over that of von Pirquet. In a recent communication—September, 1938—using a method similar to that described above, their results were as follows: Of 169 children with active tuberculosis only one failed to react positively to the patch, though Mantoux-positive—a discrepancy of less than 1 per cent. In 118 routine cases the Mantoux test with 1:1,000 O.T. did not reveal a single case of infection that was not already discovered by the patch test. These last results compare closely with those obtained above.

Advantages of the Patch Test

1. *Simplicity in Technique.*—It cannot be denied that the Mantoux reaction is reliable only if the injection is a true intradermal one, with exact amounts of material. The patch test, on the other hand, demands a minimum of manipulative skill. This, though obvious, is none the less important in routine work, notably in general practice. At the same time it obviates yet another of the "pricks" to which children are subjected in these days of increasing investigation. There seems to be no tendency on the part of the child to interfere with the patch once it is applied.

2. *Durability of Material.*—For solutions of old tuberculin to be reliable they must be renewed at least every two months. The patch test material, if kept in a cold dry place, will remain reliable for a year.

3. *The Absence of Undesirable Complications.*—General and focal reactions never occur, and necrosing local reactions are unknown.

The Disadvantages

1. The patch test is slightly less reliable than the intracutaneous method. Nevertheless from the present series, and those reviewed in the literature, it is clear that at least 95 per cent., and at most 98 per cent., of cases infected by the tubercle bacillus can be exposed by this method. This leaves 2 to 5 per cent. in which further investigation will be required. In such cases the patch test should be supplemented by the Mantoux, using a 1 in 100 dilution. If the discrepancy still remains, the latter, because of its greater range of sensitivity, should be taken as the reliable indicator.

2. Severe local skin reactions have been reported. I have no personal experience of this whatever. In the main, the patch test would appear to produce a less intense reaction than the corresponding Mantoux. Furthermore, there is little or no associated pruritus, and the erythema fades within two to three weeks at most.

Conclusions

The Vollmer patch test approaches in reliability the intracutaneous method of Mantoux.

In a very high proportion of cases it will reveal the presence of tuberculous infection. For the remaining minority a combination of the patch test and the Mantoux, using stronger concentrations of old tuberculin, or its equivalent, will prove satisfactory.

My thanks are due to Dr. Donald Paterson for his help and permission to use his patients. The "patch tests" were very kindly supplied by Chas. F. Thackray of Leeds.

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THE DIAGNOSTIC VALUE OF THE INTRADERMAL TUBERCULIN TEST IN CHILDREN

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The graded intradermal tuberculin test was introduced by Mantoux in 1910, and has for some years been accepted, at least in this country, as the most reliable tuberculin test. Although the information afforded by the result of the test in any given case is usually clear, it is difficult from the figures available to answer the question of how useful the test is as a general diagnostic measure, and it is to provide this information that the following analysis has been made. The figures heretofore published relate to special groups, such as children from tuberculous homes (Schlesinger and Hart, 1930), the clinically tuberculous (Hart, 1932), the clinically non-tuberculous (Hart, 1932), and children attending a special (chest) hospital (Dow and Lloyd, 1931); nor are figures compiled in other areas or relating to normals directly relevant. The fundamental facts underlying the use of the Mantoux test for diagnostic purposes are:

1. The test is positive in almost 100 per cent. of proved cases of tuberculosis (moribund cases excluded) (Hart, 1932).

2. A positive reaction is proof of past or present tuberculous infection, but it can never be direct evidence that active tuberculosis is present or that any given lesion or symptom is tuberculous in origin.

3. It follows from (1) and (2) that the value of the Mantoux test lies mainly in the exclusion of tuberculous infection which is implied by a negative reaction. Its limit of usefulness is therefore determined by the percentage of positive reactors among the general population. Where this is low, as in infants and young children, the test has found its chief application; where high, as in the adult population, the test can seldom yield useful information.

In its diagnostic application the test is used in patients presenting symptoms or signs that are probably or possibly tuberculous in origin. In the patently tuberculous and non-tuberculous the test is not required for diagnosis. The value of the Mantoux test therefore depends upon the proportion of negative reactors in the group of "probably or possibly tuberculous." This proportion is limited by the factors set forth above, but will vary from one community to another and even within the same community according to age groups, social standing, etc. In addition the increasing use of safe milk, segregation of open cases, and improvement in social conditions should lead to a progressive drop in the number of those who have become tuberculin-sensitive. The test should therefore be more useful with the passage of time. In the light of what has been said there can be no absolute or final assessment of the value of the Mantoux test for diagnosis, and the view is widely held that it is only worth while performing the test in the younger children.

The Present Investigation

At the Hospital for Sick Children the test is extensively employed, and we have for some time had the impression that it is of greater value than is usually accepted. The present analysis has amply borne out that impression. The figures under review relate to Mantoux tests carried out in the out-patient department between 1934 and mid-1938. Except where otherwise stated the tests were done

with 1:1,000 tuberculin. Tuberculin T or P.T. (Burroughs Wellcome) was used indifferently, the dose employed being between 0.1 c.cm. and 0.15 c.cm., injected intradermally. All tests were performed and read either by Dr. A. G. Signy or by me, the technique of testing and the criteria for reading being identical. The tests were usually examined on one occasion only, not earlier than the third or later than the seventh day. An area of erythema 5 mm. in diameter, with or without induration, was the minimum criterion of positivity. Doubtful reactions were very few. Those were retested with 1:100 tuberculin, and are not included in the present figures. Since the patients were in the course of investigation the diagnoses were in most cases provisional. With the exception noted below the whole field of "suspects" was covered (for example, wasting, "contacts," adenitis, arthritis, etc.). It was not felt justifiable to include cases bearing a diagnosis of erythema nodosum, phlyctenular conjunctivitis, or epituberculosis, since these were not primarily tested to 1:1,000 tuberculin because of the danger of severe reactions. The number of cases thus excluded is in any event too small to alter significantly the figures for the series.

The total number of cases in the series is 3,010, of which 748 were positive, giving an over-all percentage of 24.8 positive reactors. The figures for the individual years are shown in Table I. The table suggests that an appreciable

TABLE I

Year	Number of Tests	Number of Positives
1934.. .. .	370	114
1935.. .. .	578	159
1936.. .. .	580	140
1937.. .. .	870	211
1938 (Half-year) .. .	612	124

fall in the percentage of positive reactions has occurred since 1934. Although a fall is to be expected on *a priori* grounds, it could hardly have been so rapid, and a certain caution is necessary before that conclusion is drawn from the present figures, because the number of tests performed has increased at a more rapid rate than has the number of new out-patient attendances. This may well be the expression of a tendency to test cases in which the diagnosis of tuberculosis is progressively less likely. The percentages for the various years are therefore not strictly comparable. By eliminating from the gross figures 183 cases in which the age was not recorded and arranging the remainder according to age groups Table II is obtained. Consideration of this table

TABLE II

Age	Number of Tests	Number Positive	% Positive
0-6/12	19	1	—
6/12-1	30	3	—
1-2	145	24	16.5
2-4	552	93	16.8
4-6	837	171	20.4
6-8	706	187	26.4
8-10	335	131	39.1
10-12	203	96	47.2

shows that the Mantoux test enables a diagnosis of tuberculosis to be excluded in three "suspects" out of four up to the age of 8 years; and even in the age group

10 to 12 years, in which the test is commonly thought to be of little help, it will eliminate just over one-half of the suspects.

Two objections may be raised to the validity of the above figures. (1) Owing to the exigencies of out-patients' conditions many of the tests were read as late as the seventh day, when weak positive reactions might have so faded as to be read as negative. (2) The use of higher concentrations of tuberculin would reveal further positive reactors. With regard to the first point, the stronger grades of positive reaction are easily readable at seven days, and, while it is not possible to correlate intensity of reaction with active tuberculous disease, this is in general associated with well-marked tuberculin sensitivity. Positive reactions missed through late reading are therefore likely to be weak reactions produced by those sub-clinical infections which lead to tuberculin sensitivity in the healthy population. The following observation lends weight to this assumption: It is the practice at the hospital to re-test to 1:100 tuberculin those negative reactors in whom the diagnosis of tuberculosis is still held to be possible on clinical grounds. During 1937 and the first half of 1938 fifty-one such cases were tested to 1:100 tuberculin, the tests being usually read on the third or fourth day. In no case was a positive reaction recorded. (Hart also finds a difference of only 1 per cent. between the results of 1:1,000 and 1:100 tuberculin tests in clinical tuberculosis.)

It should also be remembered that tests done with concentrated solutions of tuberculin may give rise to non-specific reactions, as has been emphasized by Long and Seibert (1937), working with a chemically pure tuberculin (P.P.D.—purified protein derivative) and a similar product prepared from a non-pathogenic acid-fast organism (*timothy-grass bacillus*). It is probable, therefore, that the number of true positive reactors missed by relying solely on 1:1,000 tuberculin is very small.

Summary

Three thousand and ten tests to 1:1,000 tuberculin are reported.

An analysis of these tests suggests that the diagnostic value of the test is underrated, especially in older children.

The test enables a diagnosis of tuberculosis to be excluded in three "suspect" cases out of four up to 8 years of age, and in one-half of those aged from 10 to 12 years.

My thanks are due to the members of the honorary staff to whose cases these figures relate; to Dr. Nabarro for much help and encouragement; and to Dr. Signy for the use of records relating to 1934-5. The work has been done under a grant from the Sir Halley Stewart Trust Fund.

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On the occasion of its fifty-second anniversary a special number of *Brazil-Medico* has been issued containing, among others, articles on fixation of the complement in leishmaniasis, Addison's disease of malarial origin, morbid anatomy of typhus, duodenal intubation, seventy cases of Jacobaeus's operation, finger-prints, the normal radiological appearances of the sella turcica, and conservative surgery of calculous cholecystitis.