case required 3-4 weeks, another 5-6, and a third 12 weeks' continuous treatment before the sputum could be rendered mucoid and *H. influenzae*-negative. One case failed to respond.

A total of 204 relapses were observed during 306 patient-months of intermittent antibacterial treatment. The majority were associated with reappearance of *H. influenzae*.

In our view, the conclusion is inescapable that non-capsulated *H. influenzae* is responsible for keeping the chronic inflammatory process smouldering in bronchiectatic individuals.

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SERUM PROTEINS IN PULMONARY TUBERCULOSIS

BY

I. C. GILLILAND, M.D., M.R.C.P.

Physician and Lecturer, Hammersmith Hospital; Physician, Prince of Wales and St. Anne's Hospitals

R. N. JOHNSTON, M.D., M.R.C.P.

Assistant Chest Physician

PETER STRADLING, M.D., M.R.C.P.

Chest Physician and Lecturer in Tuberculosis

AND

E. M. ABDEL-WAHAB,* M.B., Ch.B., D.M.Sc.

From the Departments of Medicine and Clinical Pathology, Postgraduate Medical School of London, and the Hammersmith Chest Clinic, W.12

Assessment of disease activity in pulmonary tuberculosis can be very difficult and no test available is an adequate single guide. Many varied clinical factors have to be considered in order to gain a reasonably accurate assessment.

It has been known for some time, and is here confirmed, that there are alterations of serum proteins in the course of tuberculous infection. Such changes are not in themselves diagnostic of, or specific to, any particular disease, but probably reflect the clinical state of the patient.

The present study was undertaken to determine the nature of these serum protein changes in patients with pulmonary tuberculosis, with particular reference to the

possibility of a direct relationship to the extent, duration, and severity of the lesion, and the effect of the remedial chemotherapy now available. In each case a complete quantitative analysis of all protein fractions has been made.

Clinical Method

A total of 327 adult patients with pulmonary tuberculosis were examined. They were selected without reference to their clinical condition, the first six attending each routine chest clinic session being invited to co-operate. To provide control values, 28 of the patients' adult "contacts," who were radiologically free from disease but living in a like domestic environment, were also examined. A clinical assessment was made of each patient at the time that the blood was withdrawn, and the erythrocyte sedimentation rate (Westergren) was also estimated. The assessment was made in relation to five main factors, recorded separately and uniformly for each patient, so that correlation with the biochemical findings was facilitated. These factors were:

1. *Extent of Disease.*—The assessment was entirely radiological, based upon the zone system (Ministry of Health, 1947). Presence of cavitation was also noted.

2. *Duration of Disease.*—This cannot be accurately assessed in the majority of cases, and so, for simplicity, three broad groups were chosen: (i) recent infection (under six months); (ii) intermediate (six months to three years); and (iii) disease present for over three years.

3. *Activity of Disease.*—In all cases bacteriological, radiological, and constitutional evidence of activity was recorded independently to provide additional categories for subsequent analysis. A separate note was made of the presence of severe constitutional disturbance as indicated by pyrexia. Tubercle bacilli demonstrated in sputum or laryngeal swabbing, changing radiological shadows, or the presence of an obvious cavity were necessary, either alone or in combination, before a patient was classed as "active." Separate categories were also provided for "quiescent" and "arrested" cases (Ministry of Health, 1947). A final category—"intermediate"—was used. In this group were placed those patients who could not yet be classified as "quiescent" but in whom there were no signs of activity.

4. *Treatment.*—Special reference was made here to chemotherapy (always the daily administration of two of the three commonly used drugs—streptomycin, isoniazid, and P.A.S.). Four separate categories were used for patients who (i) had not yet received chemotherapy; (ii) were on drugs at the time; (iii) had completed a course within the previous six months; or (iv) had received such treatment more than six months previously. In addition, patients were categorized according to whether they had received minor collapse therapy, resection, or thoracoplasty.

5. *Special Points.*—The majority of patients could be adequately assessed by appropriate placing in the categories outlined above, but a few presented special points of interest, which were noted. In particular, special categories were created for coexisting amyloidosis, pregnancy, or diabetes mellitus.

Biochemical Method

Venous blood specimens were obtained with a minimum of stasis and allowed to clot. The serum was withdrawn on the same day, samples showing any trace of haemolysis being rejected. Most of the samples were analysed on the same day. A few were frozen at -4°C . to be analysed on the next day.

The total protein concentration was measured by the specific-gravity method (Phillips *et al.*, 1944). Electrophoresis was carried out on Whatman No. 1 filter paper at pH 8.6 in an M/10 barbitone buffer. By means of a glass slide 0.01 ml. of serum was applied to the paper strip. A potential of 105 volts was applied to the paper for 15-16 hours. The strips were then dried in an oven at 120°C . for 30 minutes, and stained for 10 minutes in 0.2% lissamine

*Participated in the work during the tenure of a scholarship from the Egyptian Government.

green S.F. 150 (I.C.I.) in 15% acetic acid (Abdel-Wahab and Laurence, 1955). Washing was continued with 2% acetic acid in tap-water until the background of the strip was white. Three successive washes were usually required, each for two minutes. The lissamine green stain was preferred because of the ease with which the background can be cleared, the inexpensive nature of the washing fluid, and the ease of elution of the dye. The strips were scanned in an automatically recording densitometer (Laurence, 1954), using an Ilford No. 205 filter. The areas of the resulting recordings were measured by planimetry and the relative concentrations calculated.

Results

The results were obtained by arranging the biochemical findings according to the various clinical categories into which the subjects had been placed.

Those from the 28 healthy controls are shown in Fig. 1. This was done to establish the normal values by this method and to provide a means of assessing the differences due to pulmonary tuberculosis.

FIG. 1.—Serum proteins in 28 normal controls. Electrophoresis on paper

TABLE I.—Serum Proteins in Tuberculosis. X-ray Extent of Disease in Active Cases (mean and standard error of the mean)

Zones Affected (No. of Cases)	Total Protein	A/G Ratio	Albumin	α1	α2	β	γ	Alb./α2 Ratio
<1 (11)	7.50 ±0.16	0.99 ±0.16	3.68 ±0.13	0.36 ±0.02	0.74 ±0.04	0.96 ±0.06	1.75 ±0.13	5.11 ±0.35
<2 (13)	7.69 ±0.12	0.93 ±0.12	3.65 ±0.13	0.36 ±0.02	0.81 ±0.12	1.04 ±0.09	1.80 ±0.10	4.71 ±0.29
<3 (10)	7.59 ±0.18	0.83 ±0.06	3.41 ±0.17	0.44 ±0.02	0.82 ±0.08	1.06 ±0.13	1.87 ±0.10	4.23 ±0.28
<4 (9)	7.69 ±0.25	0.76 ±0.04	3.36 ±0.11	0.47 ±0.03	0.94 ±0.12	1.05 ±0.16	1.85 ±0.12	3.62 ±0.13
<5 (3)	7.91 ±0.07	0.64 ±0.02	3.09 ±0.08	0.36 ±0.04	0.90 ±0.03	1.00 ±0.05	2.54 ±0.23	3.45 ±0.21

1. *Extent of Disease.*—Table I gives the results of serum analysis in active groups only, classified according to the degree of lung involvement. There is a progressive fall in albumin concentration and a progressive rise in the α2 globulin concentration as the extent of the lesion increases. This is illustrated in Fig. 2. On this semiquantitative diagram, the mean serum protein values in subjects with relatively small lesions (less than two zones) is contrasted

FIG. 2.—Serum proteins in pulmonary tuberculosis.

with the mean values in those with lesions of less than four zones. Both of these are set against a dark background figure which shows the normal distribution with one standard deviation from the mean. The depression in the

FIG. 3.—Serum proteins in tuberculosis: extent of lesion.

broken down into the five who had radiological cavitation and the eight who showed no radiological evidence of cavitation. There is no significant difference between these two subgroups.

TABLE II.—Serum Proteins in Tuberculosis. Breakdown of 13 Cases with Less than Two Zones Affected (mean and standard error of mean)

No. of Cases	Total Protein	A/G Ratio	Albumin	α1	α2	β	γ	Alb./α2 Ratio
5 with radiological cavitation	7.66 ±0.13	1.04 ±0.09	3.83 ±0.17	0.33 ±0.02	0.86 ±0.06	1.02 ±0.08	1.54 ±0.09	4.59 ±0.50
8 with no radiological cavitation	7.70 ±0.19	0.87 ±0.19	3.54 ±0.18	0.37 ±0.02	0.78 ±0.04	1.05 ±0.04	1.96 ±0.13	4.78 ±0.37

TABLE III.—Serum Proteins in Tuberculosis. Duration of Disease in Active Cases (mean and standard error of mean)

Duration No. of Cases	Total Protein	A/G Ratio	Albumin	Globulins				Alb./α2 Ratio
				α1	α2	β	γ	
Under 6 months (12)	7.45 ±0.16	0.92 ±0.11	3.49 ±0.17	0.41 ±0.02	0.78 ±0.03	0.99 ±0.04	1.81 ±0.12	4.70 ±0.35
6 months to 3 years (24)	7.52 ±0.13	0.90 ±0.09	3.54 ±0.09	0.41 ±0.02	0.80 ±0.03	1.01 ±0.06	1.75 ±0.06	4.54 ±0.21
Over 3 years (36)	7.66 ±0.09	0.90 ±0.04	3.59 ±0.07	0.37 ±0.01	0.82 ±0.03	1.03 ±0.06	1.84 ±0.06	4.53 ±0.18

TABLE IV.—*Serum Proteins in Tuberculosis. Activity of Disease (mean and standard error of mean)*

Evidence of Activity (No. of Cases)	Total Protein	A/G Ratio	Albumin	α_1	α_2	β	γ	Alb./ α_2 Ratio
Bacteriological and/or radiological only (41)	7.52 ±0.04	0.92 ±0.03	3.56 ±0.07	0.39 ±0.02	0.77 ±0.03	0.98 ±0.03	1.80 ±0.08	4.84 ±0.24
Clinical symptoms in addition to bacteriological and/or radiological (25)	7.41 ±0.13	0.89 ±0.05	3.42 ±0.09	0.40 ±0.02	0.82 ±0.03	0.97 ±0.08	1.79 ±0.09	4.38 ±0.22
Pyrexia in addition (3)	6.93 ±0.42	0.78 ±0.06	3.02 ±0.14	0.51 ±0.04	0.86 ±0.10	0.93 ±0.09	1.60 ±0.19	3.57 ±0.27

2. *Duration of Disease.*—Table III again presents active cases only, but analysed according to duration of disease. A slight rise in α globulin occurs both in recent and in long-standing cases, and the changes in albumin and α_2 globulin are already present in those whose tuberculosis is of less than six months' duration. There is no significant difference in albumin/ α_2 ratio between the groups. An investigation

FIG. 4.—Serum proteins in tuberculosis: recovery from active disease.

of patients whose infection is of even shorter duration will be needed to establish how soon these serum protein changes occur.

3. *Activity of Disease.*—Table IV gives the results from the active group arranged according to the following evidence for activity: (i) finding of tubercle bacilli and/or changing radiological shadows and/or cavitation; (ii) symptoms in addition to the above; and (iii) additional severe constitutional disturbance indicated by pyrexia. The albumin/ α_2 ratio becomes progressively lower with increasing evidence of activity. Severe constitutional disturbance is clearly reflected in the protein changes. A progressive return of this ratio towards normality occurs with progressive clinical improvement. This is demonstrated in Fig. 4 and Table V, which give the results in "active," "intermediate," "quiescent," and "arrested" categories. Thus protein changes, conveniently and numerically given as albumin/ α_2 ratios, reflect the course of the disease, whether for better or for worse.

TABLE V.—*Serum Proteins in Tuberculosis. Recovery from Active Disease (mean and standard error of the mean)*

Category (No. of Cases)	Total Protein	A/G Ratio	Albumin	α_1	α_2	β	γ	Alb./ α_2 Ratio
Active >6 months (60)	7.60 ±0.07	0.90 ±0.04	3.57 ±0.06	0.39 ±0.02	0.81 ±0.02	1.02 ±0.03	1.80 ±0.04	4.53 ±0.13
Intermediate (36)	7.65 ±0.09	1.01 ±0.04	3.75 ±0.08	0.38 ±0.02	0.76 ±0.02	0.97 ±0.04	1.66 ±0.05	5.09 ±0.23
Quiescent (76)	7.71 ±0.05	1.07 ±0.03	3.98 ±0.05	0.34 ±0.02	0.71 ±0.01	0.93 ±0.02	1.73 ±0.01	5.69 ±0.12
Arrested (36)	7.82 ±0.10	1.12 ±0.06	4.17 ±0.08	0.36 ±0.01	0.69 ±0.02	0.93 ±0.04	1.62 ±0.06	6.14 ±0.20

4. *Treatment.*—Fig. 5 and Table VI show the effect of antituberculosis chemotherapy on groups of patients at the start, during, and at the end of therapy, and on a group six months or more after therapy ceased. There is again a progressive relationship, the albumin/ α_2 ratio returning towards normal at the conclusion of treatment. The slight

FIG. 5.—Serum proteins in tuberculosis: effect of treatment.

lowering of this ratio in the group who completed their chemotherapy more than six months previously is not significant. However, the group contained seven patients whose albumin/ α_2 ratio was still low, and these were again clinically reviewed. Three were shown to have had recent radiological change, one had a positive sputum, and one was pregnant. No evidence of activity was found in the other two. Table VII shows a further breakdown of the apparently quiescent cases into those which had been submitted to collapse therapy or resection. This would appear to show that serum proteins are more nearly normal at this stage in those patients who have had resection or thoracoplasty than in those who had pneumoperitoneum. No rigid conclusions can be drawn from the findings in this group because of various biasing factors, such as methods of selection for treatment and extent or duration of disease.

TABLE VI.—*Serum Proteins in Tuberculosis. Effects of Treatment. Chemotherapy (mean and standard error of mean)*

Category (No. of Cases)	Total Protein	A/G Ratio	Albumin	α_1	α_2	β	γ	Alb./ α_2 Ratio
Start (7)	7.71 ±0.10	0.78 ±0.05	3.37 ±0.09	0.44 ±0.04	0.94 ±0.05	1.04 ±0.04	1.89 ±0.20	3.66 ±0.28
During (62)	7.49 ±0.07	0.96 ±0.04	3.63 ±0.07	0.39 ±0.01	0.77 ±0.02	0.97 ±0.03	1.72 ±0.05	4.88 ±0.16
End (13)	7.75 ±0.08	1.10 ±0.05	3.99 ±0.10	0.34 ±0.02	0.72 ±0.03	0.92 ±0.07	1.72 ±0.07	5.72 ±0.37
Over 6 months from conclusion (90)	7.76 ±0.04	1.04 ±0.03	3.92 ±0.05	0.32 ±0.01	0.73 ±0.01	0.98 ±0.02	1.76 ±0.04	5.53 ±0.13

TABLE VII.—*Serum Proteins in Tuberculosis. Collapse and Resection Treatment. Quiescent Patients (mean and standard error of mean)*

Category (No. of Cases)	Total Protein	A/G Ratio	Albumin	α_1	α_2	β	γ	Alb./ α_2 Ratio
All quiescent patients (76)	7.71 ±0.05	1.07 ±0.03	3.98 ±0.05	0.34 ±0.02	0.71 ±0.01	0.93 ±0.02	1.73 ±0.01	5.69 ±0.12
Pneumoperitoneum (12)	7.63 ±0.12	0.95 ±0.04	3.71 ±0.07	0.38 ±0.01	0.75 ±0.02	1.06 ±0.04	1.79 ±0.10	5.01 ±0.18
Resection (9)	7.51 ±0.13	1.22 ±0.09	4.09 ±0.07	0.35 ±0.02	0.69 ±0.03	0.90 ±0.07	1.47 ±0.08	5.77 ±0.31
Thoracoplasty (7)	7.56 ±0.22	1.24 ±0.08	4.17 ±0.19	0.34 ±0.02	0.65 ±0.03	0.84 ±0.03	1.95 ±0.10	6.66 ±0.17

TABLE VIII.—Serum Proteins in Tuberculosis. Coexisting Amyloidosis

	Total Protein	A/G Ratio	Albumin	α_1	α_2	β	γ	Alb./ α_2 Ratio
Moderate proteinuria	6.20 6.57 6.37	0.46 0.60 0.52	1.96 2.45 2.24	0.33 0.34 0.38	0.85 1.20 1.17	1.57 1.15 1.08	1.48 1.44 1.70	2.31 2.04 1.91
Heavy proteinuria ..	6.93	0.17	1.12	0.39	2.80	1.59	1.75	0.40

5. *Special Points.*—Four cases of amyloidosis, proved by liver biopsy, were encountered in the series. They were the only four patients with proteinuria. Table VIII gives the analysis of the serum proteins separately in these cases. It will be noted that the albumin/ α_2 ratios are all below 3 (Gilliland and Stanton, 1954). The three cases with proteinuria of a moderate nature averaging 2 g. or less a day show changes in their circulating proteins which differ in degree from those which are already present in severe cases of pulmonary tuberculosis. The changes in the fourth case with heavy proteinuria averaging 10 g. a day could be explained by a subsequent worsening of the protein pattern consequent upon protein loss in the urine.

Table IX gives the results in five cases of coexisting diabetes mellitus and three cases of coexisting pregnancy. In each case serum proteins were obtained from individual controls who had a similar degree and duration of infection and were at the same stage of treatment. It will be

TABLE IX.—Serum Proteins in Tuberculosis. Coexisting Diabetes Mellitus (mean and standard error of mean)

	Total Protein	A/G Ratio	Albumin	α_1	α_2	β	γ	Alb./ α_2 Ratio
Tuberculosis + diabetes mellitus (5)	8.17 ±0.29	0.95 ±0.04	3.91 ±0.18	0.46 ±0.06	0.97 ±0.07	1.15 ±0.05	1.62 ±0.11	4.17 ±0.17
Control cases tuberculosis (5)	7.87 ±0.14	1.05 ±0.08	4.02 ±0.21	0.36 ±0.08	0.76 ±0.04	0.90 ±0.08	1.83 ±0.06	5.40 ±0.42
Coexisting Pregnancy								
Tuberculosis + pregnancy (3)	6.57 ±0.23	0.83 ±0.04	2.99 ±0.19	0.50 ±0.02	0.79 ±0.09	0.97 ±0.06	1.31 ±0.19	3.82 ±0.06
Control cases tuberculosis (3)	7.54 ±0.12	0.99 ±0.26	3.63 ±0.49	0.33 ±0.02	0.80 ±0.02	1.09 ±0.05	1.69 ±0.39	4.58 ±0.30

FIG. 6.—Active tuberculosis (67 cases). Comparison of albumin ratio with E.S.R.

seen that simultaneous occurrence of either pregnancy or diabetes mellitus can occasion an even greater alteration of the serum proteins than can pulmonary tuberculosis alone.

6. *E.S.R.*—Fig. 6 illustrates a comparison between the albumin/ α_2 ratio and E.S.R. (Westergren) in the 67 cases of active tuberculosis. The mean and 95% confidence limits of the normal albumin/ α_2 ratio are indicated. The diagram shows that only seven of this series had normal serum proteins, while 50% had normal E.S.R.s. The relative insensitivity of the E.S.R. as an indicator of activity is thus well shown.

Discussion

In many diseases the serum proteins are altered, the general direction being a decrease of albumin concentration and an increase of globulin. These changes are familiarly recognized as alterations in the albumin/globulin ratio, and the standards usually accepted are those derived from chemical precipitation techniques. The simple method of electrophoresis on paper, however, has made possible a more detailed and yet more accurate routine study of the changes.

While most of the observed changes are not in themselves diagnostic of a particular disease, they are indicative of the severity of the clinical state. Thus study of these changes is more likely to yield information of clinical progress than to be of diagnostic help. Among the changes which occur in the serum proteins of patients suffering from pulmonary tuberculosis, attention has been drawn to the lowering of albumin concentrations (Seibert and Nelson, 1942), the rise in α_2 globulins (Seibert *et al.*, 1947; Meyer *et al.*, 1955), and, in certain conditions, a rise in the γ globulins (Volk *et al.*, 1953). Similarly, the rise in protein-bound polysaccharides, as shown by Seibert *et al.* (1947) to occur in the serum of patients with tuberculosis, was thought by them to be related to the activity of the disease and to be mainly due to the rise in concentration of α_2 globulin. Gilliland *et al.* (1954) also found the rise in protein-bound polysaccharides in diabetics to be largely due to the rise in α_2 globulin. Gilliland and Stanton (1954) found a similar rise in concentrations of protein-bound polysaccharide in certain cases of amyloidosis due to tuberculosis. They suggested that, as this was mainly due to a rise in α_2 globulins containing polysaccharides and as there was always an associated fall in albumin concentration, then the albumin/ α_2 ratio could be used as a single index of the degree of change.

Meyer *et al.* (1955) showed that changes in the α_2 globulin correlate with the state of the patient, increasing with activity and decreasing with improvement of the disease. They regard a persistence or reappearance of an increased α_2 globulin as of serious significance. Saifer *et al.* (1954) show that changes in serum protein pattern during isoniazid therapy follow the clinical course of disease and provide an objective method of evaluating the course of the tuberculous process.

This study has shown that there is a simultaneous and consistent lowering of albumin concentration accompanying the rise in α_2 globulin, and thus the albumin/ α_2 ratio provides the most sensitive single index of the serum protein changes. A lowering of this ratio below 3 was originally proposed as a guide to the presence of amyloid disease (Gilliland and Stanton, 1954), which this study would confirm. However, lesser changes in the ratio appear to reflect the extent and activity of the tuberculous infection, and also to mirror the recovery of the patient more closely than do E.S.R.s performed at the same time. An objective evaluation of the severity of the disease and of the patient's progress thus seems possible.

Summary

A study of serum protein fractions from 327 patients suffering from pulmonary tuberculosis and 28 unaffected "controls" used as controls was made by electrophoresis on paper.

The data obtained show consistent changes to take place, the albumin concentration falling and the α_2 globulin concentration rising progressively with increasing activity and extent of disease. Conversely, these fractions were restored towards normal as the disease became quiescent and arrested. Treatment with anti-tuberculosis drugs led to a similar effect.

As an index of activity in tuberculosis, the albumin/ α_2 ratio was much more sensitive than the E.S.R.

The albumin/ α_2 ratio provides a useful objective index for assessing activity of disease in patients with tuberculosis.

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SOURCES OF TUBERCULOUS INFECTION IN AN AREA CONTAINING BOVINE TUBERCULOSIS

BY

D. F. van ZWANENBERG, B.M., D.P.H., D.C.H.

C. J. STEWART, M.D., D.Obst.R.C.O.G.

From the Chest Clinic, Ipswich

K. M. HARDING, M.D., D.P.H.

AND

S. T. G. GRAY, M.B., D.P.H.

From the County Health Department, East Suffolk

Case-finding of tuberculosis by the tracing of sources of infection of tuberculin-positive children has been used in many areas. Tattersall (1946, 1952) in particular and MacDougall *et al.* (1953) have advocated this method. Tattersall points out that in areas where the milk is known to be "safe," infection of tuberculin-positive school entrants can often be traced to a human source.

The difficulties of such a method in areas where bovine tuberculosis spread by milk was suspected were thought to be considerable, although on occasion tuberculin-testing of schoolchildren has been done in a limited area to estimate the damage done by a tuberculous cow (Hall, 1950; Kind and Brough, 1954).

During four months in 1954 five cases of tuberculous cervical glands and one case of tuberculous peritonitis were discovered amongst the children of a small market town X (population 7,400). In each case there was a history that the child had been drinking raw milk from one particular dairy. At that time milk from all four dairies in the town had been satisfactory to bacteriological and statutory tests for a number of years. It was decided, therefore, to do a tuberculin survey of the

schoolchildren of this town, on lines similar to those used by Tattersall, in order to determine the sources of infection of the tuberculin-positive children and discover whether that source was human or bovine.

Method

Of the 1,360 schoolchildren, 1,063 were tuberculin-tested, using the multiple puncture technique (Heaf, 1951), by the school medical officer (K. M. H.), who also read the results. The families of the tuberculin-positive children were then tuberculin-tested by the health visitor, using the same technique, so that the result of the whole family could be available when they attended for interview at the chest clinic. At these interviews the parents were questioned (by C.J.S. or D.F.v.Z.) with a view to discovering the source of the child's infection. The whole family was x-rayed; because of the large numbers and the limited local x-ray facilities a special visit of the M.M.R. unit was arranged.

Both the interviewers have worked in the area for more than five years and knew most of the notified cases; they also had had considerable previous experience at interviewing families for the purpose of discovering sources of tuberculous infection. Parents were asked about contact with known or possible cases of pulmonary tuberculosis. Only a definite history of direct contact with a proved case was accepted as a possible source of infection. Parents were also questioned about the milk supply during the child's life, especially as regards the drinking of raw milk from farms, and also the sources of supply in the town itself.

We found 260 of the schoolchildren to be tuberculin-positive. Seven of the children came from a children's home with no recent family contacts. Three children had been investigated recently and the information required was already known. One child had had B.C.G. We interviewed 219 families and 416 adults were x-rayed (1.9 per family). There remain nine families that have defaulted. In the families that have been seen, 44 adults refused x-ray examination, so that 90.4% of adults have been x-rayed.

Results

Table I shows the tuberculin-positive rate at different ages. It also gives the rates for similar ages for the town of Ipswich. Ipswich is the county town, and has practically all its milk pasteurized. As 1,338 Ipswich schoolchildren have been tuberculin-tested by the same technique during this year, this probably gives a fair comparison.

TABLE I.—Tuberculin-positive Rates at Different Ages

Age Groups	Town X	Ipswich
5-6 years	10.9% of 174	6% of 494
7-9 "	18.6% " 377	16% " 73
10-12 "	32.8% " 289	12% " 538
13-15 "	31.4% " 210	29% " 233

Although town X has a higher tuberculin-positive rate than Ipswich, all the information available indicates that there is relatively far more pulmonary tuberculosis in Ipswich. Thus if Ipswich is divided into seven areas of between 7,000 and 10,000 voters in each area (by the electoral roll), then the number of known cases of pulmonary tuberculosis varies from 47.7 to 116 per 10,000 voters in these areas, whereas the figure for town X is 40.7 per 10,000 voters lower than the best area of Ipswich. A similar index worked out for patients with tuberculosis who died or had a direct positive sputum during 1954 varies from 4.6 to 20.7 in Ipswich, but is only 3.7 in town X.

The reverse occurs with non-pulmonary tuberculosis, Ipswich areas having an index of 7.3 to 15.8, whereas town X has 27.8 per 10,000 voters.

Of the 260 tuberculin-positive children, 37 have a definite history of contact with a known case of tuberculosis either in