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Prevalence and Early Attack Rate of Tuberculosis among Close Family Contacts of Tuberculous Patients in South India under Domiciliary Treatment with Isoniazid plus PAS or Isoniazid Alone *

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The authors present a report from the Tuberculosis Chemotherapy Centre, Madras, on the prevalence and attack rate of tuberculosis among close family contacts of tuberculous patients in South India undergoing domiciliary chemotherapy either with isoniazid plus PAS or with one of three regimens of isoniazid alone. The report gives (a) the prevalence of tuberculosis among the contacts at the time of diagnosis of the disease in the patients and (b) the incidence of tuberculosis in the contacts during the first year of treatment of the patients. The contacts were divided into four series, corresponding to the four chemotherapeutic regimens of the patients.

The prevalence of active tuberculosis was found to be particularly high among children under five years of age, being 12.0% as compared with 7.6% for all age-groups combined. The incidence of active tuberculosis during the year of treatment of the patients was also found to be highest in the under five years' age-group—a further indication that child contacts are especially vulnerable to infection. The incidence was considerably higher in the first quarter of the year than in the other quarters, and it was lowest in the last quarter. This finding, together with the fact that the attack rates in the four contact series were not related either to the duration of bacteriological positivity in the patients or to the period of excretion of isoniazid-resistant organisms by the patients, suggests that the major risk to contacts in the first year results from exposure to the patient before treatment rather than from exposure during treatment. These results thus confirm the findings in an earlier study by the Centre of the contacts of patients in a controlled comparison of chemotherapy with isoniazid plus PAS at home and in sanatorium.

Previous communications from the Tuberculosis Chemotherapy Centre (Andrews et al., 1960; Ramakrishnan et al., 1961a) have reported the prevalence and the attack rate of tuberculosis in the close family contacts of patients who were treated for one year with isoniazid plus *p*-aminosalicylic acid (PAS) either at home or in sanatorium (Tuberculosis Chemotherapy Centre, 1959). During a 2-year period there was no evidence of special risk to the contacts resulting from treatment of the patients at home. In a further study by the Centre, three regimens of isoniazid alone for one year have been compared with isoniazid plus PAS in a domiciliary investigation (Tuberculosis Chemotherapy Centre, 1960). As part of this investigation, the prevalence and attack rate of tuberculosis in the close family contacts have also been studied, since it is important to know whether the treatment of patients with isoniazid alone exposes their contacts to the risk of infection with isoniazid-resistant organisms. This controversial subject has recently been reviewed by McDermott (1960).

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The patients in the present study were drawn from the lower income groups or the unemployed in Madras City, which is the largest urban community in South India. Living conditions were, with few exceptions, poor, the majority of families being overcrowded, and the nutritional standards low. It was under such conditions (outlined below and described fully elsewhere (Tuberculosis Chemotherapy Centre, 1959, 1960)) that the patients were treated and their family contacts exposed to the risk of infection.

The objects of the present report are to study:

(*a*) the prevalence of tuberculosis in the close family contacts at the time of diagnosis of tuberculosis in the patients in the chemotherapy study; and

(*b*) the incidence of clinical tuberculosis and of tuberculous infection in the close family contacts during the first year of treatment of the patient.

I. PLAN AND CONDUCT OF THE CONTACT STUDY

The plan of the contact study, the routines for the initial and follow-up examinations of the family contacts and the procedure adopted when a radiographic abnormality was found were similar to those in an earlier study, and have already been described in detail (Andrews et al., 1960). The main points are repeated here:

In order to obtain information on the prevalence of clinical tuberculosis and of tuberculous infection among the close family contacts, they were examined by radiography and by tuberculin testing at the time of diagnosis of each index case (see below) accepted for the chemotherapy study. In addition, the contacts were followed intensively by serial radiography and, if indicated, by serial tuberculin testing, to detect the cases of clinical tuberculosis and the tuberculous infections developing among them. This made possible a comparison of the attack rate of tuberculosis, and of the incidence of tuberculous infection, in the close family contacts of the patients in the four different treatment series. The follow-up is planned for five years.

DEFINITIONS OF " INDEX CASE " AND " CONTACT "

The " index case " was defined as the first member of a family suffering from pulmonary tuberculosis to be registered in the Centre. All other members of the family were designated " contacts " of the index case.

THE CONTACTS UNDER STUDY

This study was restricted to 1109 " close family contacts "—namely, those family members, by blood or marriage, living, cooking and feeding in the same house as the index case for at least the three months immediately preceding the start of treatment of the index case (infants less than three months old were included).

There were four contact series (page 374), corresponding to the four patient series in the chemotherapy study which was designed to evaluate the relative merits of three different dosages of isoniazid alone, in comparison with a standard regimen of isoniazid plus PAS (Tuberculosis Chemotherapy Centre, 1960).

INITIAL EXAMINATION OF CONTACTS

Each contact had the following standard examination initially:

(*a*) A full-plate postero-anterior radiograph of the chest (read independently by two of the Centre's doctors).

(*b*) An intracutaneous tuberculin (Mantoux) test made on the flexor aspect of the left forearm with 5 tuberculin units (TU) of a purified protein derivative (PPD) in 0.1 ml of solution. The greatest diameter of palpable induration after 48 or 72 (occasionally 96) hours was measured in millimetres, using a transparent ruler or a caliper gauge, according to the preference of the reader. If there was no induration, or if its maximum diameter was less than 5 mm, a further intracutaneous test with 100 TU of PPD in 0.1 ml of solution was performed on the right forearm. The greatest diameter of induration after 48 or 72 (occasionally 96) hours was again recorded in millimetres. The tuberculin dilutions were prepared from PPD batch RT22; the diluent did not contain Tween 80 (for the full details of the tuberculin, see Andrews et al. (1960)).

All the tuberculin tests were performed in the Centre by the clinic nurses, and the great majority were also read in the Centre by them. The result of each test was recorded on a separate card and transferred subsequently to the contact's record sheet, which was not available to the clinic nurse at the time

the test was read. The staff was trained to read carefully but, to avoid bias, no explanation was given about the special comparison that was in progress between the contact series. (The interpretation of these and the subsequent investigations of the contacts was not complicated by previous BCG vaccination, since the Madras Government's mass vaccination campaign has not yet included Madras City, and the vaccine has scarcely been used there.) Tuberculin tests, like the radiographs, were accepted as examinations on admission, only if taken within a 6-week period before or after the start of treatment for the index case.

The age of each contact was obtained or estimated at the time of admission of the index case to treatment, and these are the ages quoted throughout this report.

Procedure when an abnormality was found at the initial examination

Each contact found to have a radiographic abnormality at the first examination was carefully investigated clinically and bacteriologically by smear and culture of the sputum or by culture of laryngeal swabs for tubercle bacilli. The number of cultures ordered was left to the discretion of the individual clinician. The course of the lesion was followed by means of serial full-plate radiographs, usually taken monthly, but taken more frequently if necessary. If indicated, further 5 TU and 100 TU tests were ordered. Courses of non-tuberculous chemotherapy were given on clinical grounds, if indicated, or as a diagnostic measure.

Any child under the age of three years with an induration of 5 mm or more to the initial 5 TU test was followed particularly closely, even if the radiograph was normal.

FOLLOW-UP EXAMINATION OF CONTACTS

At three, six, nine and 12 months, each contact had the following standard examinations:

(*a*) A 70-mm radiograph (read independently by two of the Centre's doctors); if there was any suspicion of an abnormality, a full-plate radiograph was taken. For children under the age of 5 years, only full-plate radiographs were taken.

(*b*) If the indurations to 5 TU at all the previous tuberculin tests had been less than 20 mm, an intracutaneous test was made with 5 TU and read as at the first examination. If the maximum diameter of induration to this test was less than 5 mm, a 100 TU test was performed. Four months before the end of the first-year study the rules were modified, and all contacts had a 5 TU test at one year irrespective of the size of any earlier indurations. Further, from then on, 5 TU tests were not performed at three, six and nine months and all routine 100 TU testing was stopped.

A radiograph was accepted as a 3-, 6-, or 9-month film only if it was taken within a 6-week period before or after the set date, this date always being calculated from the date of the start of treatment for the index case. A radiograph was accepted as a 12-month film only if it was taken within the period from six weeks before to three months after the set date. In fact, the great majority of radiographs were taken within one month of the set date, and of these, most were taken within two weeks. Tuberculin tests with 5 TU were accepted according to the same criteria.

In addition to the above routine investigations at the set examinations, there were many more opportunities for the staff to observe the contacts, for regular visits were paid to the homes and all the patients attended the Centre weekly and often brought contacts with them, especially contacts who were ill. The contacts were encouraged to attend the Centre for all their medical requirements rather than go to hospitals or private practitioners, and also to come with their domestic and employment problems; the great majority availed themselves of the facilities offered by the Centre. Ailments, the most common of which were feeding difficulties, malnutrition, skin infections, non-tuberculous respiratory infections, gastro-enteritis and intestinal helminthiasis, were usually treated in the Centre, which had facilities for routine blood examinations and urine investigations. When necessary, contacts were referred to hospitals for specialist advice or other investigations.

Procedure when an abnormality was found at a follow-up examination

When a radiographic abnormality appeared for the first time, either at one of the set examinations or at an extra one, a culture of at least one sputum specimen or a pair of laryngeal swabs, processed as a single specimen, was set up. Further full-plate radiographs were ordered as indicated, but usually at monthly intervals. Sometimes, extra 5 TU and 100 TU tests were also performed. If indicated, a course of non-tuberculous chemotherapy was given.

When contacts showed changes in tuberculin sensitivity, suggesting that a recent infection might

have taken place, a full-plate radiograph was taken four to six weeks later and at similar intervals for several months. In addition, at least one pair of laryngeal swabs was examined and, in the case of infants and young children, the health visitor was instructed to see the contact weekly, or the family was asked to bring the contact to the Centre weekly.

SPECIFIC ANTITUBERCULOSIS CHEMOTHERAPY

As explained in an earlier report (Andrews et al., 1960), specific antituberculosis chemotherapy was usually not given to contacts who had an abnormality either at the first or at a subsequent examination unless bacteriological confirmation of tuberculosis had been obtained. Exceptions to this general practice were made, however, in the case of young children who were clinically ill or where lesions showed rapid progression radiographically or were large or disseminate.

ENVIRONMENTAL BACKGROUND OF THE FAMILIES

Some aspects of the socio-economic background of the community from which the families under study were drawn were given in an earlier report (Tuberculosis Chemotherapy Centre, 1960). The salient features are as follows:

The majority of the families were from the poorest section of the community. Since a knowledge of the total family income is of little value unless it is related to the size and to the age and sex composition of the family, the income for each family was calculated in terms of standard units.[1] Very few families had a monthly income of Rs 50 [2] or more per unit; approximately 70% of the families had an income of less than Rs 30 per unit, and over one-third had less than Rs 20 per unit. In assessing the purchasing power of such incomes, reference may be made to Chaudhuri's (1959) estimate that, according to the cost-of-living index in India at that time, the basic income requirement for one adult was Rs 60 to Rs 70 per month. The families lived in very overcrowded conditions, similar to those described in an earlier report (Tuberculosis Chemotherapy Centre, 1959), and segregation of the index case was rarely practicable. The average size of the families was 4.3 members.

[1] An adult male (15 years or over) was counted as one standard unit, an adult female (15 years or over) as 0.8 of a standard unit and a child under 15 years as 0.6 of a standard unit (India, Ministry of Commerce, 1949).

[2] Rs 4.76 = US$1.00.

The patients were instructed in the need for care in coughing and in the disposal of sputum, and were provided with an aluminium sputum mug and a small earthenware stove on which to heat it. Apart from giving simple advice regarding hygiene and, where possible, segregation, no special attempt was made to alter the normal living conditions of the family. Where the illness of a wage earner meant total loss or serious reduction of the family income, a minimal amount of financial assistance was given (Tuberculosis Chemotherapy Centre, 1960). Such assistance, however, rarely raised the family income to its usual level.

The inadequate nature of the diet in terms of total calories and all the major food factors in the community from which the patients were drawn has been reported elsewhere (Tuberculosis Chemotherapy Centre, 1959; Ramakrishnan et al., 1961b [3]).

INDEPENDENT ASSESSMENT OF THE FINDINGS

Since there was a possibility that the interpretation of radiographic appearances by the Centre's staff might be biased by knowledge of the treatment received by the index case, it was decided to obtain an independent assessment for each of the 1109 contacts. Dr J. Frimodt-Møller, who was the independent assessor, proceeded in the following manner:

First, he reviewed the full radiographic series of each contact, being unaware (as during all his subsequent assessments) of the treatment of the index case, and classified each series as normal or abnormal.

Subsequently, he reviewed all the series in which he had originally noted an abnormality, and classified them as follows on the radiographic appearances only:

(1) normal;
(2) non-tuberculous abnormality;
(3) doubtfully tuberculous abnormality;
(4) tuberculous calcification;
(5) inactive tuberculosis;
(6) tuberculosis of doubtful activity; or
(7) active tuberculosis.

The assessor was next asked to review certain series in the light of relevant bacteriological, tuberculin-test, clinical or pathological data which might alter the assessment based only on the radiographic series. The contacts whose series were thus reassessed fell into eight clearly defined groups:

[3] See article on page 339.

(1) those from whom the tubercle bacillus was isolated on culture during the course of the year, if the assessor had made any assessment other than active tuberculosis (8 contacts);

(2) those who had been examined bacteriologically and who had yielded only negative cultures from the time of diagnosis until the end of the year, if the purely radiographic assessment had been a doubtfully tuberculous abnormality, tuberculosis of doubtful activity or active tuberculosis (85 contacts);

(3) those for whom the assessor's classification had been a doubtfully tuberculous abnormality, tuberculous calcification, inactive tuberculosis, tuberculosis of doubtful activity, or active tuberculosis, if all the indurations to 5 TU during the year had been less than 5 mm (10 contacts);

(4) those under the age of three years whose radiographic series had been classified by the assessor as normal, a non-tuberculous abnormality or a doubtfully tuberculous abnormality, if the induration to the initial 5 TU test was 5 mm or more (21 contacts);

(5) those who had shown evidence of tuberculin conversion during the year, that is, all contacts whose induration to the initial 5 TU test was less than 5 mm and in whom the induration to a subsequent 5 TU test was at least 10 mm larger, if the purely radiographic assessment had been normal, a non-tuberculous abnormality or a doubtfully tuberculous abnormality (81 contacts);

(6) those in whom an induration of 5, 6 or 7 mm to the initial 5 TU test had been enhanced in a subsequent 5 TU test by at least 10 mm, if the purely radiographic assessment had been normal, a non-tuberculous abnormality or a doubtfully tuberculous abnormality (69 contacts);

(7) those in whom there were relevant clinical data, including evidence of extrapulmonary tuberculosis (44 contacts);

(8) those who died from any cause during the year (17 contacts).

Some contacts fell into more than one of these groups. When making this reassessment the assessor was given all the bacteriological and tuberculin-test results during the year and all the relevant clinical data, including pathological reports. In all, reassessments were made for 287 of the 1109 contacts; the assessor altered the classification for 21.

It was not considered necessary for the assessor to review the series for the other 822 contacts—for example, those in whom he had diagnosed active tuberculosis and in whom a confirmatory positive bacteriological finding was available; those in whom he had diagnosed inactive tuberculosis and in whom all the culture results were negative; or the large group of contacts classified as normal, in whom the investigations and clinical records had been completely uneventful from the point of view of tuberculous infection.

In addition to classifying the abnormalities, the assessor divided them all into those present initially and those which had developed during the year, noting for the latter the date when the abnormality first became manifest. The abnormalities present initially are reported in section II of this report, which deals with the *prevalence* both of clinical tuberculosis and of tuberculous infection in the contacts; those developing during the course of the year are reported in section III, which deals with the *incidence* of clinical tuberculosis and of tuberculous infection in the contacts.

Finally, the assessor carefully reviewed:

(1) all the cases of active tuberculosis, tuberculosis of doubtful activity and inactive tuberculosis present initially, describing the extent and the character of the lesion; and

(2) all the cases of active tuberculosis and the doubtfully tuberculous abnormalities which became apparent in the course of the year. For these cases he described the first lesion, the date of each subsequent abnormality and the date on which the lesion attained its maximal extent. He briefly summarized the course of each case during the year.

II. PREVALENCE OF TUBERCULOSIS AMONG THE CONTACTS

In all, 341 patients from the same number of families were admitted to the chemotherapy study, the period of intake being from October 1957 to December 1958; 1082 (97.6%) of their 1109 close family contacts were radiographed within six weeks of the patients' admission, a further 25 contacts being radiographed subsequently. Of the 1109 contacts, 494 (44.5%) were males and 615 (55.5%) were females. Considering all the contacts, 18.0% were under five years of age and nearly half—

namely, 45.4%—were under 15 years; only 6.0% were aged 55 years or more. The distributions for the males and females were very similar. The complete data have not been tabulated; the distributions for the 1082 contacts with an initial radiograph are given in Table 2.

FAMILY SIZE

Considering the number of close family contacts in the 341 families, 12 (3.5%) of the index cases had no close family contacts and the great majority of the families—namely, 88.3%—had five or fewer contact members. There were two families with nine contacts, one with 10 and one with 14. The average number of contacts for all the families was 3.3. Thus, including the index case, the average family consisted of 4.3 members.

INITIAL EXAMINATIONS BY RADIOGRAPHY AND TUBERCULIN TESTING

Of the 1109 contacts, 1082 (97.6%) had an acceptable initial radiograph (i.e., one taken within six weeks of the start of treatment for the index case) and the prevalence survey is based on them. Of these, 1052 (94.9%) also had an acceptable 5 TU test (read after two, three or four days). None of these initial radiographs or tuberculin tests was dated more than six weeks before or after the start of treatment of the index case, and nearly all were performed within a few days of the appropriate date.

Twenty-seven contacts (2.4%) did not have an acceptable initial radiograph and so were excluded from the prevalence survey. Of these, only two were not radiographed at any time (one of them, an infant twin, died in the third month). Six had a radiograph taken more than six weeks before the start of treatment of the index case; eight were first radiographed between six weeks and three months after the start of treatment, eight in the second quarter, one in the last quarter, one in the thirteenth month and one in the fourteenth month. Of these 25 initial radiographs, one taken at three months showed active tuberculosis with a negative sputum, and two others, taken at three months and five months, respectively, showed tuberculous calcification. In summary, two contacts were never examined radiographically, and it is considered likely that one of the contacts omitted from the prevalence survey had active tuberculosis at the start of treatment of the index case.

The assessor decided that a contact had tuberculosis at the start of treatment of the index case, and assessed its activity, not only from the initial abnormal radiograph, but also on the basis of the full radiographic series, and all the tuberculin-test results, bacteriological data, and clinical and pathological findings for the year. These data ensure greater precision in the assessment of the prevalence of tuberculosis than would be obtained from a survey based on observations more restricted in number or time.

RADIOGRAPHIC FINDINGS

Table 1 presents the independent assessor's final decision on the initial *radiographic* status of the 1082 contacts. In all, 81.6% had a normal radiograph and a further 3.1% had a non-tuberculous abnormality. Definite tuberculous abnormalities were present in 14.3% of the contacts, 7.4% being classified as active tuberculosis, 0.2% as tuberculosis of doubtful activity, 1.9% as inactive tuberculosis and 4.8% as tuberculous calcification. Considering the sexes separately, 11.3% of the males and 8.1% of the females had a tuberculous abnormality classified as active, doubtfully active or inactive tuberculosis.

TABLE 1

INITIAL RADIOGRAPHIC STATUS OF THE CONTACTS
(Final Decision of the Independent Assessor)

Initial radiographic status	Male contacts		Female contacts		All contacts	
	No.	%	No.	%	No.	%
Normal	394[a]	81.1	489[b]	82.0	883	81.6
Non-tuberculous abnormality	11	2.3	23	3.9	34	3.1
Non-tuberculous abnormality plus tuberculous calcification	2	0.4	0	0.0	2	0.2
Tuberculous calcification	19	3.9	31	5.2	50	4.6
Doubtfully tuberculous abnormality	5	1.0	5	0.8	10	0.9
Inactive tuberculosis	12	2.5	9	1.5	21	1.9
Tuberculosis of doubtful activity	2	0.4	0	0.0	2	0.2
Active tuberculosis	41	8.4	39	6.5	80	7.4
Total	486	100.0	596	99.9	1082	99.9

[a] Including one contact who had a tuberculous knee joint initially and developed a lung lesion after one month.

[b] Including one contact who had tuberculous cervical adenitis with a discharge which yielded a positive culture.

The prevalence of all the tuberculous abnormalities in relation to age and sex is set out in Table 2 and in Fig. 1. Two contacts with a normal radiograph are included; one of these had a tuberculous knee joint and the other had bacteriologically confirmed tuberculous cervical adenitis. The prevalence of active tuberculosis for the whole group was 7.6%. There were 23 (12.0%) cases among the 192 children under the age of five years. The prevalence was also high—namely, 10.6%—in the 273 contacts aged 35 years or more. The lowest prevalence was in the 10-14 age-group (2.4%). Considering the sexes separately, the prevalence in the males in the 0-4 age-group was high (19.0%); it was also high in those aged 25 years or more (12.2%); there were no cases in males aged 10-19 years. In contrast, there was no marked association with age in the females. There was a total of 21 cases of inactive tuberculosis and two cases of tuberculosis of doubtful activity. Of these, all except one were aged 25 years or more. Amalgamating the findings for active tuberculosis, tuberculosis of doubtful activity and inactive tuberculosis resulted in a particularly high prevalence—namely, 17.2%—in contacts aged 35 years or more, the males making the larger contribution to this prevalence. Including tuberculous calcification, the total prevalence of tuberculous abnormalities in this group was 24.2%.

BACTERIOLOGICAL FINDINGS

The left-hand section of Table 2 and Fig. 2 show the prevalence of infectious tuberculosis according to age and sex, that is, the proportion of contacts with active tuberculosis initially who also had positive cultures, either initially or at some time during

FIG. 1

PREVALENCE OF TUBERCULOSIS IN THE CONTACTS, ACCORDING TO ACTIVITY, AGE AND SEX

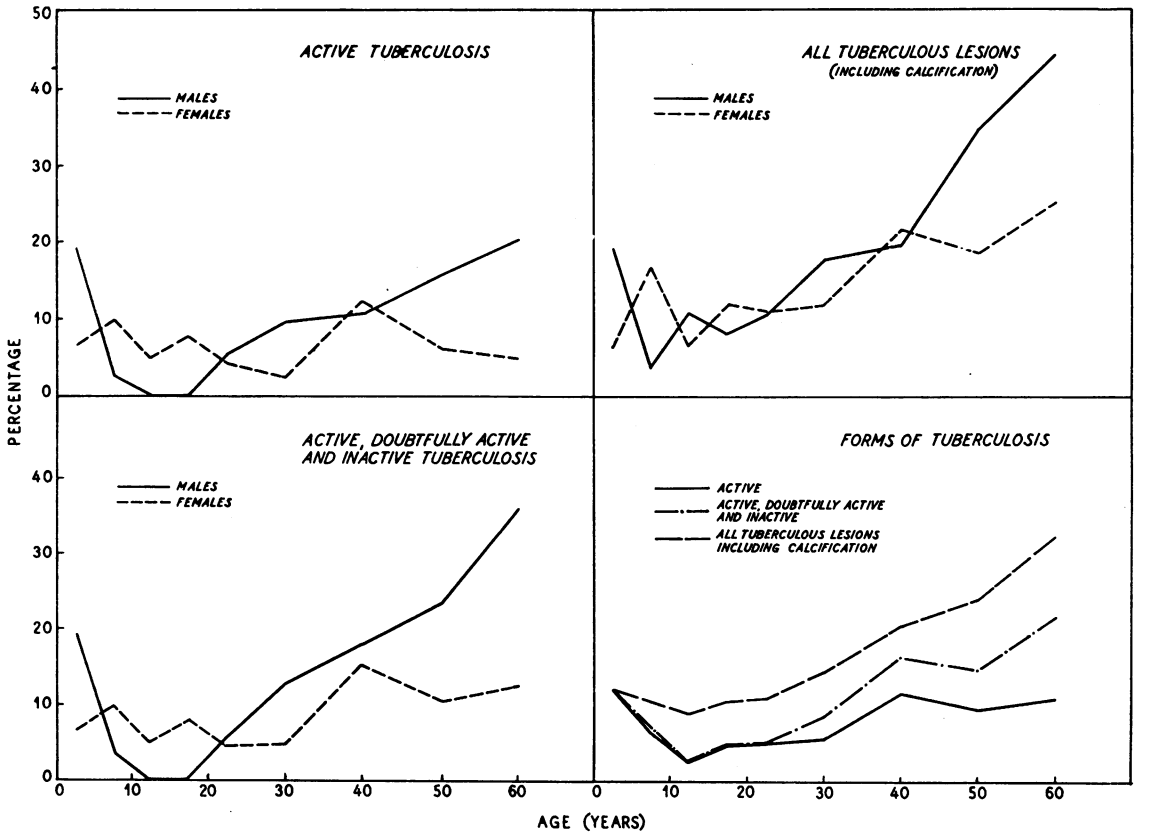


TABLE 2

PREVALENCE OF TUBERCULOSIS IN THE CONTACTS, ACCORDING TO AGE AND SEX

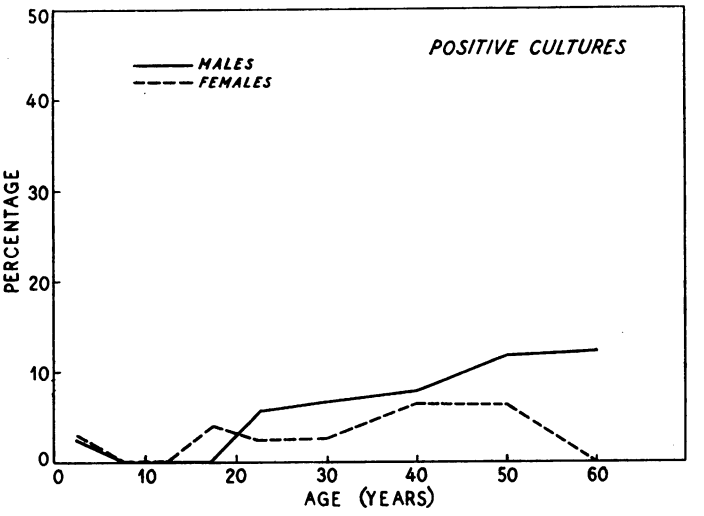
Estimated age (years)	Number of contacts with initial radiograph			Bacteriological findings				Radiographic findings											
				Contacts excreting tubercle bacilli				Contacts with active tuberculosis				Contacts with active, doubtfully active or inactive tuberculosis				All contacts with tuberculous lesions (including calcification)			
	Male	Female	Total	Male	Female	Total		Male		Female		Total		Male		Female		Total		Male		Female		Total	
						No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%
0-4	84	108	192	2	3	5	*2.6*	16[a]	*19*	7	*6*	23	*12.0*	16[a]	*19*	7	*6*	23	*12.0*	16[a]	*19*	7	*6*	23	*12.0*
5-9	83	91	174	0	0	0	*0.0*	2	*2*	9	*10*	11	*6.3*	3	*4*	9	*10*	12	*6.9*	3	*4*	15	*16*	18	*10.3*
10-14	64	60	124	0	0	0	*0.0*	0	*0*	3	*5*	3	*2.4*	0	*0*	3	*5*	3	*2.4*	7	*11*	4	*7*	11	*8.9*
15-19	36	51	87	0	2	2	*2.3*	0	*0*	4	*8*	4	*4.6*	0	*0*	4	*8*	4	*4.6*	3	*8*	6	*12*	9	*10.3*
20-24	38	46	84	2	1	3	*3.6*	2	*5*	2	*4*	4	*4.8*	2	*5*	2	*4*	4	*4.8*	4	*11*	5	*11*	9	*10.7*
25-34	63	85	148	4	2	6	*4.1*	6	*10*	2[b]	*2*	8	*5.4*	8	*13*	4[b]	*5*	12	*8.1*	11	*17*	10[b]	*12*	21	*14.2*
35-44	67	66	133	5	4	9	*6.8*	7	*10*	8	*12*	15	*11.3*	12	*18*	10	*15*	22	*16.5*	13	*19*	14	*21*	27	*20.3*
45-54	26	49	75	3	3	6	*8.0*	4	*15*	3	*6*	7	*9.3*	6	*23*	5	*10*	11	*14.7*	9	*35*	9	*18*	18	*24.0*
55 or more	25	40	65	3	0	3	*4.6*	5	*20*	2	*5*	7	*10.8*	9	*36*	5	*12*	14	*21.5*	11	*44*	10	*25*	21	*32.3*
All ages	486	596	1082	19	15	34	*3.1*	42	*8.6*	40	*6.7*	82	*7.6*	56	*11.5*	49	*8.2*	105	*9.7*	77	*15.8*	80	*13.4*	157	*14.5*

[a] Including one contact who had a tuberculous knee joint initially and developed a lung lesion after one month.

[b] Including one contact who had tuberculous cervical adenitis, with a discharge which yielded a positive culture, and a normal radiograph.

FIG. 2

PREVALENCE OF ACTIVE TUBERCULOSIS WITH POSITIVE CULTURES IN THE CONTACTS, ACCORDING TO AGE AND SEX



the year. It will be seen that 19 (3.9%) of the 486 males and 15 (2.5%) of the 596 females yielded positive cultures. Whereas positive cultures were obtained from two (2.4%) of the males and three (2.8%) of the females less than five years old, no positive cultures were obtained from the contacts aged 5-14 years. The majority of positive cultures were obtained from the contacts aged 25 years or more, the proportions being 8.3% for the 181 males and 3.8% for the 240 females. Of the total of 34 contacts who yielded positive cultures, 24 did so initially and 10 later. Five yielded a positive laryngeal swab culture; 28 had a positive sputum, 14 both on smear and on culture, and 14 on culture only. The remaining contact had a positive culture from a discharge from a cervical gland sinus.

FORMS OF THE INITIAL TUBERCULOUS LESIONS

There were initially 82 cases of active tuberculosis, two cases of tuberculosis of doubtful activity and 21 cases of inactive tuberculosis. The assessor classified both the cases of tuberculosis of doubtful activity and all except one of the cases of inactive tuberculosis as adult-type pulmonary disease (Table 3). Of the 82 cases of active tuberculosis, 43 were classified as adult-type pulmonary disease and the remaining 39 as primary or post-primary type disease, 12 of these being simple hilar gland enlargement.

Considering the active lesions, the assessor classified 34 of the 43 adult and 33 of the 39 primary or post-primary lesions as being progressive. He based his opinion on the type of lesion present initially and also on its course during the year. It may be concluded that a considerable majority (82%) of the 82 lesions were progressive in character whether primary, post-primary or adult. The assessor also classified the extent of the active intrapulmonary lesions. Of the 43 adult-type lesions, 19 were bilateral, 16 were cavitated (five extensively so) and 23 occupied an area greater than two posterior rib interspaces.[1] Of the 22 primary or post-primary intrapulmonary lesions, all except two were unilateral; only one was cavitated, but five occupied an area greater than two posterior rib interspaces.

A positive culture was obtained in 28 of the 43 contacts with adult-type disease and six of the 39 contacts with primary or post-primary disease. In all, 3.1% of the 1082 contacts with an initial radiograph yielded positive cultures.

Of the 43 contacts with adult-type disease, only two (children aged seven and eight) were less than 15 years old. Of the 39 with primary or post-primary disease, 23 were less than five years old, nine were between the ages of five and 10 years, four were

[1] Defined as the area represented by the fourth and fifth posterior interspaces and the intervening rib, as seen on a postero-anterior radiograph.

TABLE 3

FORMS OF THE INITIAL TUBERCULOUS LESIONS (EXCLUDING TUBERCULOUS CALCIFICATION)

Independent assessment of initial radiographic status	All tuberculous lesions	Adult-type disease (pulmonary)	Primary and post-primary type disease	Form of primary or post-primary type disease					
				Orthopaedic tuberculosis	Pleural effusion	Hilar gland enlargement plus a pulmonary lesion	Pulmonary lesion	Hilar gland enlargement	Tuberculous cervical adenitis
Active tuberculosis	82	43	39	1	3 [a]	13	8	12	2 [b]
Tuberculosis of doubtful activity	2	2	0	0	0	0	0	0	0
Inactive tuberculosis	21	20	1	0	0	0	1	0	0
Total	105	65	40	1	3	13	9	12	2

[a] Including one contact who had a pulmonary lesion and one who had a hilar gland enlargement.
[b] Including one contact who had bilateral hilar gland enlargement.

between 10 and 20 years of age, and the remaining three were 22, 32 and 35 years old, respectively.

As already explained (page 364), the cases of active tuberculosis among the contacts were not automatically given antituberculosis chemotherapy. Of the 82 cases of initially active tuberculosis, 31 had received antituberculosis chemotherapy previously or did so at some time during the year. Of these, 23 had adult and eight primary or post-primary disease.

It may be concluded that most of the tuberculous lesions detected in the prevalence survey were progressive and many were in need of treatment.

RESULTS OF DRUG-SENSITIVITY TESTS

Streptomycin-, PAS- and isoniazid-sensitivity tests were performed as a matter of routine on any positive diagnostic culture from the contacts. The results of PAS-sensitivity tests are not reported here because of the difficulty experienced in interpreting them (Selkon et al., 1960; Tuberculosis Chemotherapy Centre, 1960). Of the 34 contacts who yielded positive cultures, results of streptomycin-sensitivity tests were available for 32, and all except one were sensitive; the resistant strain was isolated from a contact who had received previous chemotherapy which included streptomycin. Isoniazid-sensitivity tests were performed on cultures from 33 contacts, and three were resistant. Two of the contacts with resistant strains had a history of previous chemotherapy which included isoniazid. There was no history of previous chemotherapy in the third, who had a mixed population of sensitive and resistant organisms. This contact had four strains tested; two were fully sensitive, one grew on 0.2 μg/ml but not on 1 μg/ml of isoniazid and was not retested (a result regarded as doubtfully resistant by the Centre) and one was clearly resistant, growing on 1 μg/ml isoniazid. (The strains from this contact's index case were fully sensitive.)

FAMILIES WITH TUBERCULOUS CONTACTS INITIALLY IN ADDITION TO THE INDEX CASE

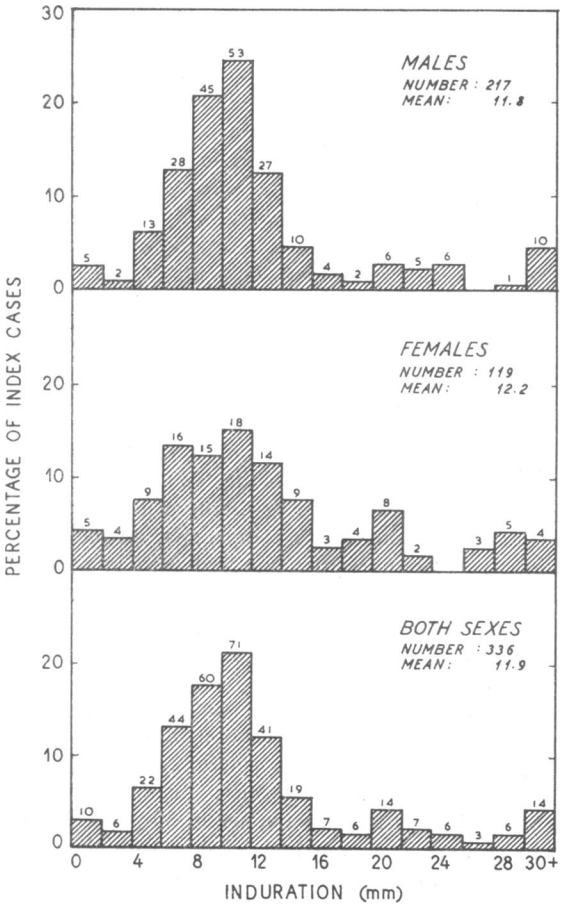
There were 329 families with one or more contacts among the 341 families in this study, their average size being 4.4 members including the index case. For two families with a total of six contacts, all the initial radiographs were taken more than six weeks before the start of treatment for the index case. These families have, therefore, been excluded from the prevalence survey. Of the remaining 327 families, 84 (25.7%) had initially at least one contact with active, doubtfully active or inactive tuberculosis in addition to the index case. Of these 84 families, 17 had two such contacts and two had three such contacts. A total of 66 families (20.2%) had one or more contacts with *active* tuberculosis initially in addition to the index case; of these, 14 had two such contacts and one had three such contacts.

TUBERCULIN SENSITIVITY TO 5 TU IN THE INDEX CASES

In determining, for any community, the minimum diameter of induration which indicates tuberculous infection, a useful approach is to study the results of tuberculin tests on a group of tuberculous patients in the same community (Edwards & Guld, 1951; WHO Tuberculosis Research Office, 1955; Edwards, Edwards & Palmer, 1959). Such results are available for the index cases (all of whom were excreting tubercle bacilli), on whom a 5 TU test was performed as a matter of routine during their pretreatment investigations, concurrently with the initial examinations of their close family contacts. The findings for the index cases are set out in Fig. 3 for males and females, separately and combined. Very few patients had indurations of less than 5 mm. These distributions and a scrutiny of the figures on which they are based (not tabulated here) suggest that an induration of 5 mm or more indicates tuberculous infection.

FIG. 3

DISTRIBUTION OF INDURATIONS TO THE INITIAL 5 TU TEST IN THE *INDEX CASES*, ACCORDING TO SEX



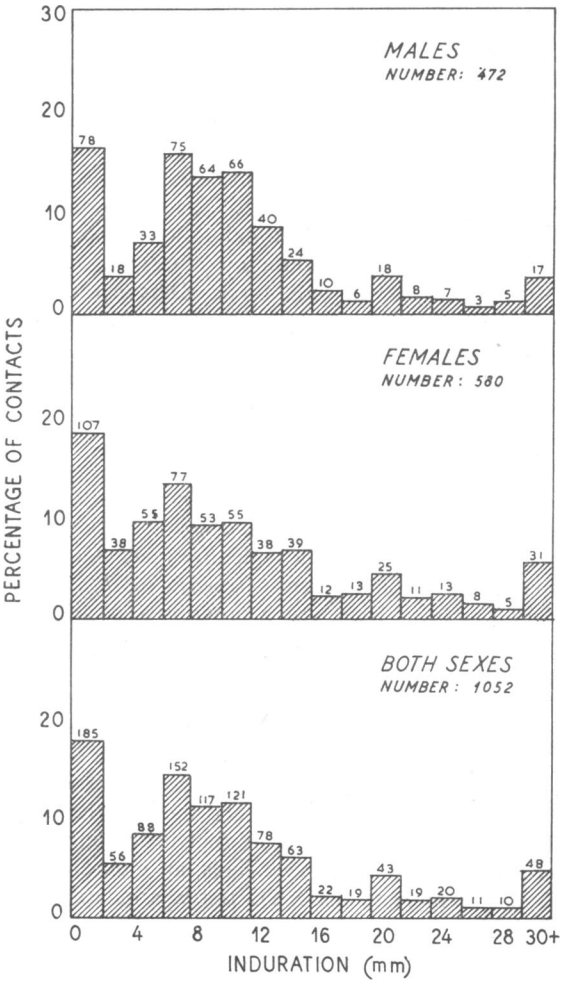
The number above each block indicates the number examined

TUBERCULIN SENSITIVITY TO 5 TU IN THE CONTACTS

Of the 1109 close family contacts, 1052 had an initial 5 TU test read two, three or four days later. Fig. 4 shows the distributions of the size of indura-

FIG. 4

DISTRIBUTION OF INDURATIONS TO THE INITIAL 5 TU TEST IN THE CONTACTS, ACCORDING TO SEX



The number above each block indicates the number examined

TABLE 4

RESULTS OF INITIAL 5 TU TESTS IN THE CONTACTS UNDER FIVE YEARS OF AGE

Diameter of induration (mm)	Age-group of contact											
	Under 6 months		6 months-		1 year-		2 years-		3 years-		4-5 years	
	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%
0-4	17	(89)[a]	21	68	19	51	23	68	28	64	13	52
5-7	0	(0)	5	16	5	14	0	0	4	9	2	8
8-9	2	(11)	3	10	1	3	1	3	5	11	1	4
10-14	0	(0)	2	6	5	14	5	15	3	7	3	12
15 or more	0	(0)	0	0	7	19	5	15	4	9	6	24
Total	19	100	31	100	37	101	34	101	44	100	25	100

[a] The parentheses indicate percentages based on fewer than 25 observations.

tion to the 5 TU test for the males and females, separately and combined. The data on which the histograms are based have not been tabulated here, but considering both sexes, 25.0% had indurations of less than 5 mm, 45.7% had indurations of less than 8 mm, and 56.8% had indurations of less than 10 mm. The percentages with indurations of less than 10 mm were practically the same for the males and females, although there were fewer males than females with indurations of less than 5 mm (21.4%, as compared with 27.9%) and more with indurations of 5-9 mm (35.4%, as compared with 29.0%).

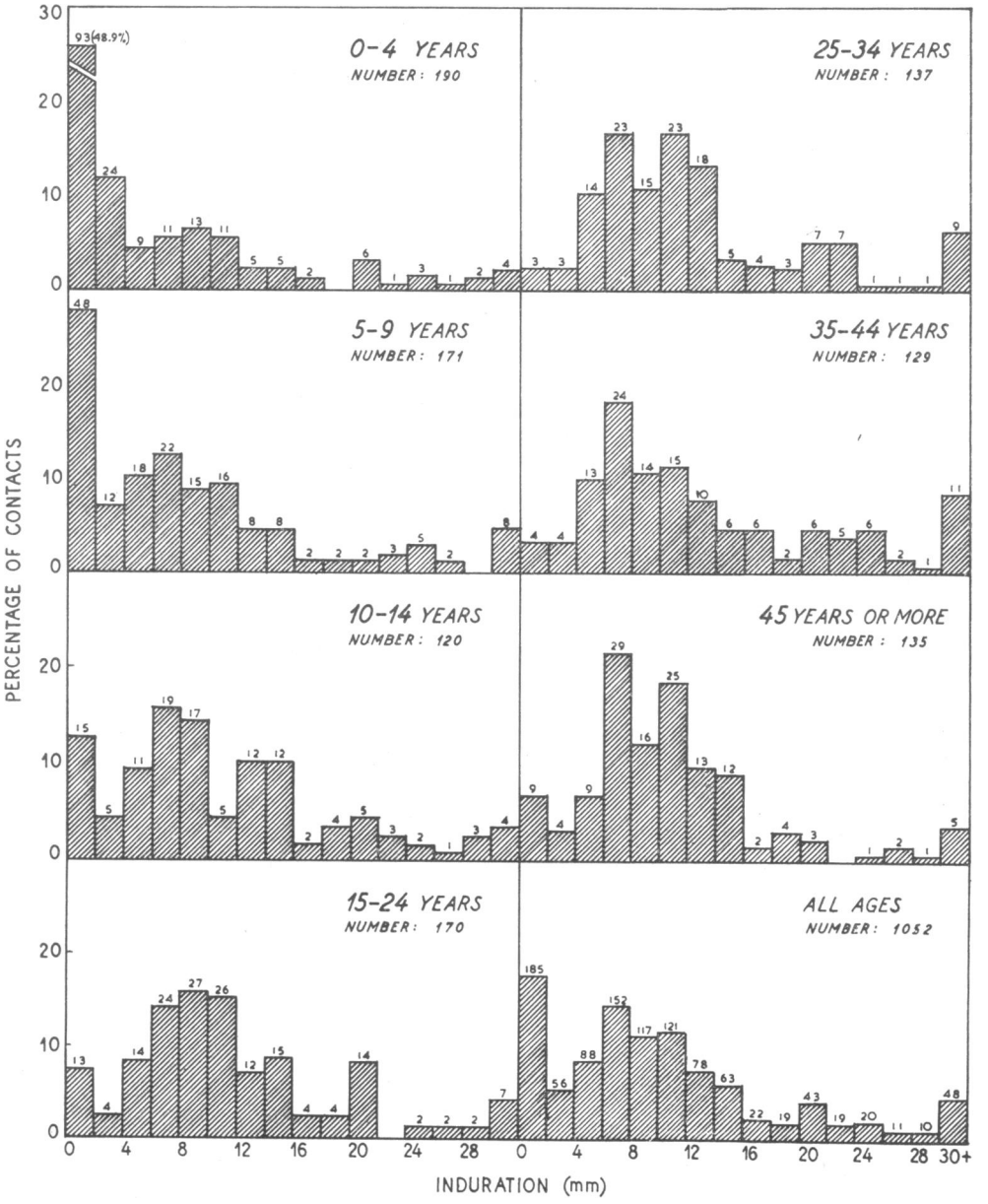
Fig. 5 shows the distribution of the size of induration to 5 TU, according to age. (The data on which the histograms are based have not been tabulated here.) In the 190 contacts under five years of age, the majority of indurations—namely, 63.7%—were 4 mm or less. There was a progressive decrease in the proportion of contacts with indurations of 0-4 mm with increase in age, to 36.3% at ages 5-9 years, 20.0% at ages 10-14, and 10.6% at ages 15-24; there was little further change in the older age-groups. There were relatively few indurations in the 1-4 mm range at any age. Considering the shapes of the distributions in Fig. 4 and 5 and those of the index cases (Fig. 3), it seems likely that in this group of contacts, as with the index cases, an induration of 5 mm or more to the 5 TU test was indicative of tuberculous infection, a conclusion consistent with that reached for an earlier group of patients and contacts (Andrews et al., 1960).

In Table 4 the results of the initial 5 TU test in contacts under five years of age are considered in detail. The proportion of children who showed indurations of 5 mm or more was 24% of 50 contacts under one year of age, 49% of 37 aged 1-2 years, 32% of 34 aged 2-3 years, 36% of 44 aged 3-4 years and 48% of 25 aged 4-5 years. There is, therefore, evidence that infection was occurring chiefly in children under two years of age and this remains true if the criterion of infection is taken as an induration of either 8 mm or more or 10 mm or more.

Fig. 6 presents graphically the percentage of contacts positive initially according to three different criteria for a positive reaction—namely, an induration of 5 mm or more to the 5 TU test (the level indicated by the above distribution and used as a standard in some BCG campaigns); an induration of 8 mm or more (the standard used in the mass BCG-vaccination campaigns in India); and an induration of 10 mm or more (a standard now used in the mass BCG campaigns in many other countries). With all three criteria the graphs ascend steeply. At 20 years, approximately 89% of the contacts had a positive reaction by the 5 mm criterion, 68% by the 8 mm criterion and 52% by the 10 mm criterion. There was a further increase to approximately 58% by the age of 30 years with the 10 mm criterion, but little change with the 5 mm and 8 mm criteria. (It should be noted that RT22, the batch of tuberculin PPD used in this study, is

FIG. 5

DISTRIBUTION OF INDURATIONS TO THE INITIAL 5 TU TEST IN THE CONTACTS, ACCORDING TO AGE



The number above each block indicates the number examined

FIG. 6

PERCENTAGE OF CONTACTS WHO WERE POSITIVE TO THE INITIAL 5 TU TEST, BY AGE, ACCORDING TO THREE DIFFERENT CRITERIA FOR A POSITIVE REACTION

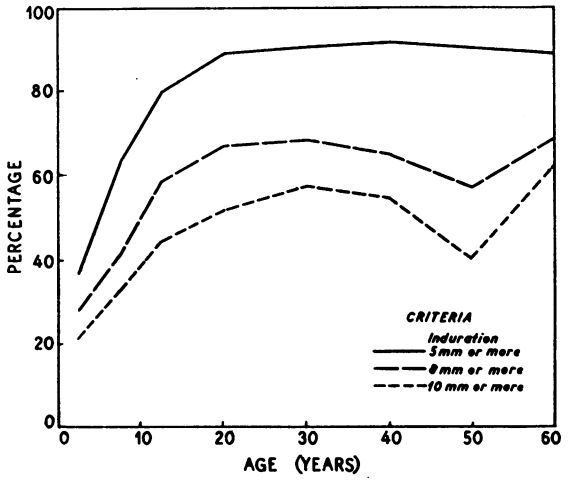
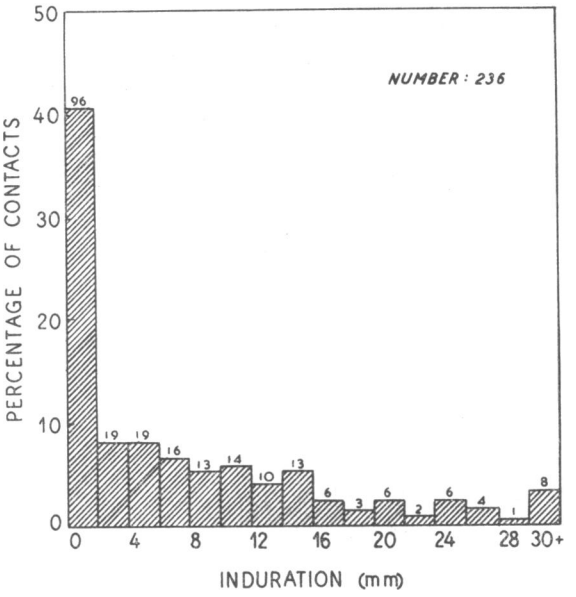


FIG. 7

DISTRIBUTION OF INDURATIONS TO THE INITIAL 100 TU TEST IN THOSE CONTACTS WITH 0-4 MM INDURATION TO THE INITIAL 5 TU TEST



The number above each block indicates the number examined

rather weaker than the International Standard PPD (Guld et al., 1958; Andrews et al., 1960).) With a contact group with a prevalence of active tuberculosis of 7.6%, the criterion of 5 mm or more, according to which 90% of the group were positive at the age of 20, appears to represent the most likely indicator of tuberculous infection.

TUBERCULIN SENSITIVITY TO 100 TU IN THE CONTACTS

It remains to consider the findings of the 100 TU test in those contacts who had an induration of less than 5 mm to the initial 5 TU test. Of 236 contacts tested, 125 (53.0%) had an induration of less than 5 mm to the 100 TU test, whereas 73 (30.9%) had an induration of 10 mm or more (Fig. 7). Although the indurations were, in general, small, there were some contacts who reacted with indurations of large diameter to this strong dose of tuberculin.

III. ATTACK RATE OF TUBERCULOSIS IN THE CONTACTS OF PATIENTS IN THE FOUR TREATMENT SERIES

There were 1109 contacts in the four contact series, which corresponded to the four index patient series, namely:

PH series. The index cases received an average of 4.6 mg/kg body-weight isoniazid and 0.23 g/kg PAS (sodium salt) daily, in two doses by mouth.

HI-1 series. The index cases received an average of 8.7 mg/kg isoniazid daily, alone, in one dose by mouth.

HI-2 series. The index cases received an average of 8.7 mg/kg isoniazid daily, alone, in two doses by mouth.

H series. The index cases received an average of 4.6 mg/kg isoniazid daily, alone, in two doses by mouth.

The treatment of the index cases had been determined by random allocation (Tuberculosis Chemotherapy Centre, 1960) and the contacts were assigned to the four series under study as a consequence of this random process.

There were 294 contacts of 92 PH patients, 247 contacts of 72 HI-1 patients, 266 contacts of 73 HI-2 patients and 302 contacts of 92 H patients.

It was necessary to exclude a number of contacts before the attack rates of tuberculosis in the four series could be compared—namely, (*a*) the 27 contacts (11 PH, 6 HI-1, 3 HI-2, 7 H) with no acceptable initial radiograph; (*b*) two contacts (1 HI-2, 1 H) who received antituberculosis chemotherapy during the year, but for whom, in the independent assessor's opinion, there was inadequate evidence on which to make a diagnosis of active tuberculosis; (*c*) the 115 contacts (31 PH, 21 HI-1, 27 HI-2, 36 H) who had an *initial* abnormality classified as active tuberculosis, tuberculosis of doubtful activity, inactive tuberculosis or a doubtfully tuberculous abnormality (and who could not therefore contribute to the attack rate); and (*d*) the 84 contacts in 28 families (23 in eight PH, eight in four HI-1, 23 in six HI-2 and 30 in 10 H families) who were excluded because there was at least one other source of infection in the family. This last group was excluded because it was considered desirable to make as pure a comparison as possible between the four series in terms of exposure to infectious tuberculosis before treatment and during the year; moreover, the data are thereby presented in a form similar to those in an earlier study from the Centre (Andrews et al., 1960; Ramakrishnan et al., 1961a).

After all these exclusions there remain 881 close family contacts from 292 families—229 from 81 PH, 212 from 66 HI-1, 212 from 65 HI-2 and 228 from 80 H families.

COMPARABILITY OF THE FOUR SERIES

Before comparing the attack rate of tuberculosis in the four series of contacts in the course of the year, it is necessary (*a*) to verify that, as a result of the random allocation process, the four series were similar initially and (*b*) to determine whether the four series were investigated with equal intensity by radiography, tuberculin testing and bacteriology during the year.

Age distribution of the contacts

Of the 229 PH contacts 39.3% were males, as compared with 47.2% of the 212 HI-1, 42.5% of the 212 HI-2 and 44.7% of the 228 H contacts. Table 5 shows the age distribution for the four series of contacts: 46.7% of the PH, 48.6% of the HI-1, 45.3% of the HI-2 and 43.4% of the H contacts were under the age of 15 years. The proportions of contacts aged 45 years or more in the four series were 11.8%, 11.3%, 8.5% and 14.0%, respectively.

Size of the family contact groups

The final section of Table 5 shows the distribution of the families according to the number of contacts contributing to the comparison. The large majority of families—namely, 95% of the PH, 89% of the HI-1, 89% of the HI-2 and 91% of the H families—had five or fewer contacts. The average numbers of contacts per family were 2.8, 3.2, 3.3 and 2.8, respectively.

Results of the initial radiographic examination

The prevalence of non-tuberculous abnormalities and of tuberculous calcifications in the initial radiographs (not tabulated here) can be used to compare the four series of contacts. Of the 229 PH contacts, 3.1% had a non-tuberculous abnormality and 8.7% had tuberculous calcification, as compared with 4.7% and 5.2%, respectively, for the HI-1, 4.2% and 5.7% for the HI-2, and 3.5% and 2.6% for the H contacts. Thus, the four series were reasonably similar in respect of non-tuberculous abnormalities, while in respect of tuberculous calcification, the PH series showed a higher and the H series a lower prevalence than the other two series.

Results of the initial tuberculin tests

The middle section of Table 5 shows the results of the initial 5 TU tests. Indurations of 0-4 mm were observed in 32.6% of the PH, 25.7% of the HI-1, 25.7% of the HI-2 and 24.4% of the H contacts. There were no important differences between the distributions, and considering the contacts with large indurations (15 mm or more), the proportions were 17.9%, 19.9%, 24.3% and 17.2%, respectively. The distributions (not tabulated here) of the 100 TU test results in 63 PH, 49 HI-1, 45 HI-2 and 45 H contacts with indurations of 0-4 mm to 5 TU were similar.

Intensity of radiographic examination during the year

Table 6 sets out the numbers of contacts in the four series who had radiographs taken at each of the four set examinations during the year—namely, at three, six and nine months and at one year. At each set examination the proportions were similar and 90% or more, except for the H series at nine months (86.7%). The coverage at 12 months was particularly high, being 97.3% for the PH, 96.2%

TABLE 5

INITIAL COMPARISON OF THE CONTACTS AND THE FAMILY GROUPS

		PH contacts		HI-1 contacts		HI-2 contacts		H contacts	
		No.	%	No.	%	No.	%	No.	%
Estimated age (years)	0-4	47	20.5	35	16.5	30	14.2	36	15.8
	5-14	60	26.2	68	32.1	66	31.1	63	27.6
	15-24	28	12.2	36	17.0	36	17.0	48	21.1
	25-34	37	16.2	24	11.3	31	14.6	28	12.3
	35-44	30	13.1	25	11.8	31	14.6	21	9.2
	45 or more	27	11.8	24	11.3	18	8.5	32	14.0
	Total	229	100.0	212	100.0	212	100.0	228	100.0
Diameter of induration to initial 5 TU test (mm)	0-4	73	32.6	53	25.7	53	25.7	54	24.4
	5-7	47	21.0	41	19.9	41	19.9	52	23.5
	8-9	21	9.4	24	11.7	27	13.1	22	10.0
	10-14	43	19.2	47	22.8	35	17.0	55	24.9
	15-19	17	7.6	12	5.8	14	6.8	15	6.8
	20-24	10	4.5	14	6.8	19	9.2	8	3.6
	25 or more	13	5.8	15	7.3	17	8.3	15	6.8
	Total tested	224	100.1	206	100.0	206	100.0	221	100.0
		PH families		HI-1 families		HI-2 families		H families	
		No.	%	No.	%	No.	%	No.	%
Number of close family contacts in the comparison	1	18	22	16	24	13	20	26	32
	2	17	21	7	11	13	20	10	12
	3	20	25	15	23	12	18	18	22
	4	18	22	10	15	9	14	14	18
	5	4	5	11	17	11	17	5	6
	6	3	4	7	11	5	8	3	4
	7 or 8	1	1	0	0	2	3	4	5
	Total	81	100	66	101	65	100	80	99

for the HI-1, 94.8% for the HI-2 and 94.7% for the H contacts.

The first section of Table 7 sets out, for the four series, the total number of radiographs taken during the course of the year (apart from the initial radiograph), whether these were taken at the four set examinations or were extra radiographs. The contacts who developed tuberculosis and were admitted to treatment during the year are classified according to the number of radiographs taken up to the date of the start of treatment only, since from then on a prescribed and intensive routine of investigation was followed. The great majority—namely, 87.8% of the PH, 90.1% of the HI-1, 88.7% of the HI-2 and 88.6% of the H contacts—had from three to six examinations. The average numbers of radiographs for the four series were 4.4, 4.2, 4.3 and 4.2, respectively.

TABLE 6

PERCENTAGE OF CONTACTS WITH RADIOGRAPHS TAKEN AT THE FOUR SET EXAMINATIONS DURING THE YEAR

Months after initial examination	PH contacts			HI-1 contacts			HI-2 contacts			H contacts		
	Total surviving contacts	Radiographed		Total surviving contacts	Radiographed		Total surviving contacts	Radiographed		Total surviving contacts	Radiographed	
		No.	%		No.	%		No.	%		No.	%
3	227	214	*94.3*	212	200	*94.3*	212	196	*92.5*	228	216	*94.7*
6	225	210	*93.3*	211	196	*92.9*	211	198	*93.8*	227	208	*91.6*
9	225	211	*93.8*	210	189	*90.0*	211	192	*91.0*	226	196	*86.7*
12	225	219	*97.3*	208	200	*96.2*	210	199	*94.8*	225	213	*94.7*

TABLE 7

INTENSITY OF EXAMINATION OF THE CONTACTS DURING THE YEAR

		PH contacts		HI-1 contacts		HI-2 contacts		H contacts	
		No.	%	No.	%	No.	%	No.	%
Number of radiographs taken [a]	0-2	12	*5.2*	11	*5.2*	14	*6.6*	16	*7.0*
	3	14	*6.1*	21	*9.9*	15	*7.1*	24	*10.5*
	4	129	*56.3*	118	*55.7*	115	*54.2*	132	*57.9*
	5	44	*19.2*	41	*19.3*	45	*21.2*	34	*14.9*
	6	14	*6.1*	11	*5.2*	13	*6.1*	12	*5.3*
	7 or more	16	*7.0*	10	*4.7*	10	*4.7*	10	*4.4*
Average number of radiographs		4.4		4.2		4.3		4.2	
Number of culture examinations	0	160	*69.9*	148	*69.8*	159	*75.0*	166	*72.8*
	1-2	34	*14.8*	31	*14.6*	29	*13.7*	40	*17.5*
	3-4	13	*5.7*	22	*10.4*	12	*5.7*	14	*6.1*
	5-6	12	*5.2*	8	*3.8*	9	*4.2*	4	*1.8*
	7 or more	10	*4.4*	3	*1.4*	3	*1.4*	4	*1.8*
Average number of cultures [b]		3.5		2.9		3.0		2.6	
Number of 5 TU tests	0	0	*0.0*	0	*0.0*	2	*0.9*	3	*1.3*
	1	20	*8.7*	18	*8.5*	35	*16.5*	21	*9.2*
	2	38	*16.6*	41	*19.3*	20	*9.4*	31	*13.6*
	3	42	*18.3*	26	*12.3*	40	*18.9*	28	*12.3*
	4	45	*19.7*	48	*22.6*	46	*21.7*	70	*30.7*
	5	69	*30.1*	73	*34.4*	62	*29.2*	67	*29.4*
	6 or more	15	*6.6*	6	*2.8*	7	*3.3*	8	*3.5*
Average number of tests		3.7		3.6		3.4		3.7	
	Total	229	*100.0*	212	*100.0*	212	*100.0*	228	*100.0*

[a] Excluding the initial radiograph.

[b] For those contacts with one or more examinations.

TABLE 8
INCIDENCE OF NEW RADIOGRAPHIC ABNORMALITIES DURING THE YEAR IN THE CONTACTS

Type of abnormality	PH contacts		HI-1 contacts		HI-2 contacts		H contacts	
	No.	%	No.	%	No.	%	No.	%
No new abnormality	201	87.8	194	91.5	198	93.4	217	95.2
New non-tuberculous abnormality	16	7.0	5	2.4	4	1.9	4	1.8
Doubtfully tuberculous abnormality	1	0.4	0	0.0	1	0.5	0	0.0
Active tuberculosis	11	4.8	13	6.1	9	4.2	7	3.1
Total	229	100.0	212	100.0	212	100.0	228	100.1

Intensity of bacteriological investigation during the year

The numbers of culture examinations for tubercle bacilli are set out in the middle section of Table 7. Again, investigations performed after the start of treatment on contacts who developed tuberculosis have not been included. The majority of contacts—namely, 69.9% of the PH, 69.8% of the HI-1, 75.0% of the HI-2 and 72.8% of the H series—had no bacteriological investigations; the proportions with either one or two examinations were 14.8%, 14.6%, 13.7% and 17.5%, respectively. The average number of cultures for those who had one or more culture examinations was 3.5 for the PH, 2.9 for the HI-1, 3.0 for the HI-2 and 2.6 for the H contacts, the higher average in the PH series being due to the intensive investigation of 22 contacts, who had five or more cultures examined. Further analyses (not tabulated here) showed that the separate proportions of sputum and laryngeal swab cultures in the four series were also similar.

Intensity of tuberculin testing during the year

The numbers of 5 TU tests that were performed in the course of the year are set out in the final section of Table 7. The distributions for the four series were reasonably similar, the average numbers of tests being 3.7, 3.6, 3.4 and 3.7, respectively. The majority of each series—namely, 68.1%, 69.3%, 69.8% and 72.4%, respectively—had three to five tests. An analysis of the 100 TU tests (not tabulated here) also showed a similar intensity of investigation of the four series.

In summary, the groups of contacts were similar not only initially, but also in the intensity with which they were studied in the course of the year.

ATTACK RATE OF TUBERCULOSIS AMONG THE CONTACTS

Table 8 shows the incidence of new radiographic abnormalities, as observed by the independent assessor. Radiographically active tuberculosis developed during the course of the year in 11 (4.8%) of the PH, 13 (6.1%) of the HI-1, nine (4.2%) of the HI-2 and seven (3.1%) of the H contacts. None of the differences between the four treatment series attained statistical significance.

Attack rate of tuberculosis, according to age, sex and initial 5 TU test result

The distributions of all the cases of active tuberculosis by age and sex are shown separately for the four treatment series in Table 9. Four (9%) of 47 PH, eight (23%) of 35 HI-1, three (10%) of 30 HI-2 and three (8%) of 36 H contacts under the age of five years developed active tuberculosis during the year. At ages 5-9, 6% of 33, 5% of 42, 9% of 35 and 3% of 30, respectively, in the four series developed active tuberculosis. The incidence in the older age-groups was smaller. Considering all the cases, 18 were under the age of five years, representing an attack rate of 12% in this age-group. Of these 12 were less than three years old. At the other extreme, three were aged 45 years or more, an attack rate of 3%. The amalgamated results for the four treatment series are illustrated in Fig. 8.

TABLE 9

ATTACK RATE OF TUBERCULOSIS DURING THE YEAR IN THE CONTACTS, ACCORDING TO AGE AND SEX

Sex	Estimated age (years)	Number of contacts in the comparison				Contacts who developed active tuberculosis							
		PH	HI-1	HI-2	H	PH		HI-1		HI-2		H	
						No.	%	No.	%	No.	%	No.	%
Both sexes	0-4	47	35	30	36	4	9	8	23	3	10	3	8
	5-9	33	42	35	30	2	6	2	5	3	9	1	3
	10-14	27	26	31	33	0	0	0	0	0	0	1	3
	15-24	28	36	36	48	2	7	2	6	1	3	2	4
	25-34	37	24	31	28	1	3	0	(0) [a]	1	3	0	0
	35-44	30	25	31	21	0	0	1	4	0	0	0	(0)
	45 or more	27	24	18	32	2	7	0	(0)	1	(6)	0	0
	Total	229	212	212	228	11	4.8	13	6.1	9	4.2	7	3.1
Male	0-4	14	15	15	16	2	(14)	3	(20)	2	(13)	2	(12)
	5-9	13	25	12	17	1	(8)	1	4	1	(8)	1	(6)
	10 or more	63	60	63	69	3	5	0	0	0	0	2	3
Female	0-4	33	20	15	20	2	6	5	(25)	1	(7)	1	(5)
	5-9	20	17	23	13	1	(5)	1	(6)	2	(9)	0	(0)
	10 or more	86	75	84	93	2	2	3	4	3	4	1	1

[a] The parentheses indicate percentages based on fewer than 25 observations.

TABLE 10

ATTACK RATE OF TUBERCULOSIS DURING THE YEAR IN THE CONTACTS, ACCORDING TO INDURATION TO THE INITIAL 5 TU TEST

Diameter of induration to initial 5 TU test (mm)	Number of contacts in the comparison					Contacts who developed active tuberculosis									
	PH	HI-1	HI-2	H	All series	PH		HI-1		HI-2		H		All series	
						No.	%	No.	%	No.	%	No.	%	No.	%
0-4	73	53	53	54	233	6	8	8	15	3	6	1	2	18	7.7
5-7	47	41	41	52	181	0	0	1	2	1	2	2	4	4	2.2
8-9	21	24	27	22	94	1	(5)[a]	1	(4)	1	4	2	(9)	5	5.3
10-14	43	47	35	55	180	3	7	1	2	3	9	1	2	8	4.4
15-19	17	12	14	15	58	1	(6)	1	(8)	0	(0)	0	(0)	2	3.4
20 or more	23	29	36	23	111	0	(0)	1	3	1	3	1	(4)	3	2.7
Total [b]	224	206	206	221	857	11	4.9	13	6.3	9	4.4	7	3.2	40	4.7

[a] The parentheses indicate percentages based on fewer than 25 observations.

[b] There were 24 contacts (5 PH, 6 HI-1, 6 HI-2, 7 H) for whom initial 5 TU test results were not available ; none developed tuberculosis during the year.

FIG. 8

ATTACK RATE OF TUBERCULOSIS IN THE CONTACTS, ACCORDING TO AGE AND SEX

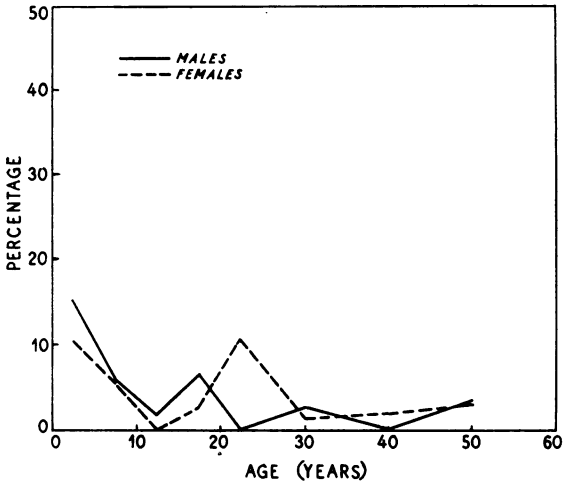
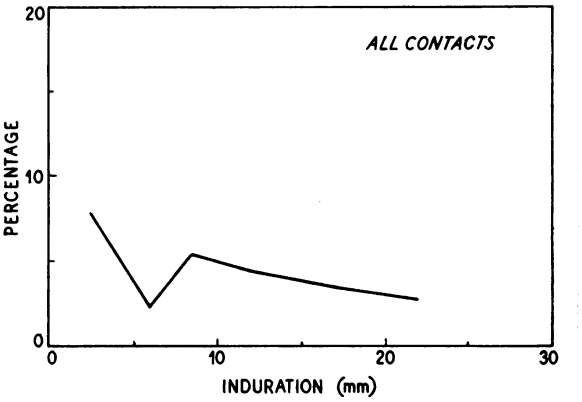


FIG. 9

ATTACK RATE OF TUBERCULOSIS IN THE CONTACTS, ACCORDING TO INDURATION TO THE INITIAL 5 TU TEST



The attack rate of tuberculosis according to the diameter of induration to the initial 5 TU test is given in Table 10 and Fig. 9. Of those contacts with an induration of 0-4 mm initially (regarded as a negative tuberculin reaction in this study), six (8%), of the 73 PH, eight (15%) of the 53 HI-1, three (6%) of the 53 HI-2 and one (2%) of the 54 H contacts developed active tuberculosis during the year. In the 5-7 mm group (regarded as a weak positive reaction) there were no cases among 47 contacts in the PH series, one (2%) among 41 in the HI-1, one (2%) among 41 in the HI-2 and two (4%) among 52 in the H series. Among those with reactions of 8 mm or more, five (4.8%) of 104 PH, four (3.6%) of 112 HI-1, five (4.5%) of 112 HI-2 and four (3.5%) of 115 H contacts developed tuberculosis. Thus, cases arose both in tuberculin-negative and in tuberculin-positive contacts; in the PH, HI-1 and HI-2 series the attack rate was higher in the tuberculin-negative group.

Forms of tuberculous lesions

The forms of the active tuberculous lesions developing during the year are presented in Table 11. Two of 11 PH, two of 13 HI-1, two of nine HI-2 and none of seven H contacts developed adult-type disease. All of these contacts had had indurations of 7 mm or more to the initial 5 TU test. There was one case of miliary pulmonary tuberculosis (in an H contact) and one contact in each series had a pleural effusion, one (HI-2) having a pulmonary lesion as well. Five of the PH, seven of the HI-1, four of the HI-2 and three of the H contacts had progressive primary lesions. One contact (HI-1) yielded two positive cultures but had a normal radiographic series throughout. Another (H) had the radiographic appearances of a primary pulmonary complex even though there was a calcified focus at the opposite base.

In three families (1 PH, 1 HI-1, 1 HI-2), two cases of active tuberculosis occurred during the year. In the PH family, one contact (T 6814) developed simple primary disease and the other (T 6813) a large pleural effusion. In the HI-1 family, one contact (T 4407) developed simple primary and the other (T 4408) progressive primary tuberculosis. In the HI-2 family, both contacts (T 5732 and T 5733) had progressive primary disease, one with a pleural effusion. One HI-1 family had three cases of active tuberculosis occurring during the year. Of these, one (T 5191) developed progressive primary disease, the second (T 5190) developed an adult-type lesion and the third (T 5221) yielded two positive cultures but had a normal radiographic series. (For details, see Appendix 1.)

Month of first abnormality

Table 12 shows the cases of active tuberculosis according to the month of first abnormality. Considering the 39 contacts who developed radiographically active tuberculosis, the interval between the last normal and the first abnormal radiograph was one month or less in 12, two months in six and three

TABLE 11

FORMS OF THE ACTIVE TUBERCULOUS LESIONS DEVELOPING DURING THE YEAR IN THE CONTACTS

	All active tuberculous lesions	Adult-type disease	Primary and post-primary type disease	Form of primary or post-primary type disease				
				Miliary pulmonary tuberculosis	Pleural effusion	Progressive primary	Simple primary	Other
PH contacts	11	2	9	0	1	5	3	0
HI-1 contacts	13	2	11	0	1	7	2	1 [a]
HI-2 contacts	9	2	7	0	1 [b]	4	2	0
H contacts	7	0	7	1	1	3	1	1 [c]

[a] Normal radiographic series and two positive cultures.
[b] With a progressive primary complex.
[c] Gland and lung lesion with calcified focus in the opposite base, visible in all the radiographs.

months in 18. In only three contacts was the interval longer than three months—namely, four, nine and nine months, respectively (see Appendix 1). It was thus possible to date the appearance of the lesions with considerable precision.

Among the negative reactors who developed tuberculosis, three of six PH, four of eight HI-1, two of three HI-2 and the one H contact developed a lesion in the first three months after the start of treatment of the index case. Among the positive reactors to 5 TU initially who developed tuberculosis, one of five PH, one of five HI-1, three of six HI-2 and four of six H contacts developed a lesion in the first three months. Thus, 10 of 18 lesions in the negative reactors and nine of 22 in the positive reactors appeared in the first three months—that is,

TABLE 12

NUMBER OF CONTACTS WHO DEVELOPED ACTIVE TUBERCULOSIS, ACCORDING TO THE MONTH OF THE FIRST RADIOGRAPHIC ABNORMALITY OR POSITIVE BACTERIOLOGICAL FINDING

Diameter of induration to initial 5 TU test (mm)	Contact series	Number of contacts in the comparison [a]	Contacts who developed active tuberculosis		Interval between entry to the study and the start of the illness (months)												Average number of months that the index cases were bacteriologically positive [b]	Average number of months that the index cases excreted isoniazid-resistant organisms [b]	Average score for bacteriological positivity of the index cases [b]	Average score for isoniazid-resistant organisms excreted by the index cases [b]
			No.	%	1	2	3	4	5	6	7	8	9	10	11	12				
0-4	PH	73	6	*8.2*	0	1	2	0	0	1	0	0	2	0	0	0	2.9	0.9	9.1	3.3
	HI-1	53	8	*15.1*	1	0	3	1	0	1	0	0	1	0	1	0	5.0	3.1	21.6	14.8
	HI-2	53	3	*5.7*	1	1	0	0	0	0	0	1	0	0	0	0	4.9	3.1	18.3	12.4
	H	54	1	*1.9*	0	0	1	0	0	0	0	0	0	0	0	0	5.4	3.5	17.5	11.4
5 or more	PH	151	5	*3.3*	0	1	0	1	1	1	0	0	1	0	0	0	3.1	1.0	10.2	3.5
	HI-1	153	5	*3.3*	0	0	1	0	0	0	0	1	2	0	0	1	4.8	3.0	20.0	12.8
	HI-2	153	6	*3.9*	0	0	3	0	0	1	1	0	1	0	0	0	5.6	4.1	23.8	18.5
	H	167	6	*3.6*	2	0	2	1	0	0	0	0	1	0	0	0	6.7	5.0	27.2	21.0

[a] There were 24 contacts (5 PH, 6 HI-1, 6 HI-2, 7 H) for whom no initial 5 TU test results were available ; none developed tuberculosis during the year.
[b] Excluding periods in hospital or sanatorium.

19 of the 40 lesions developed in the first quarter, as compared with eight in the second quarter, 11 in the third and two in the fourth.

Results of drug-sensitivity tests

There were nine contacts (2 PH, 3 HI-1, 2 HI-2, 2 H) who yielded positive cultures before the start of their treatment. Nine had results of streptomycin-sensitivity tests and eight (four with indurations of 0-4 mm and four with indurations of 5 mm or more to the initial 5 TU test) had results of isoniazid-sensitivity tests. All the results were sensitive.

RELATIONSHIP BETWEEN THE NUMBER OF MONTHS THE INDEX CASES WERE BACTERIOLOGICALLY POSITIVE AND THE ATTACK RATE IN THE CONTACTS

The number of months that each index case was bacteriologically positive during the year was calculated. The average number of months of bacteriological positivity of the index cases is set out in Table 12 for the four contact series. It will be seen that for the contacts with initial indurations of 0-4 mm, the average number of months of bacteriological positivity of the index cases was 2.9 for the PH, 5.0 for the HI-1, 4.9 for the HI-2 and 5.4 for the H series. The attack rates for the four contact series were 8.2%, 15.1%, 5.7% and 1.9%, respectively; these figures bear no obvious relation to the months of bacteriological positivity of the index cases. Considering the contacts with initial indurations of 5 mm or more, the average number of months of infectivity of the index cases was 3.1 for the PH, 4.8 for the HI-1, 5.6 for the HI-2 and 6.7 for the H series, whereas the attack rates for the four contact series were 3.3%, 3.3%, 3.9% and 3.6%, respectively. These figures also bear no relation to the months of bacteriological positivity of the index cases. Similar conclusions were drawn from analyses which, in addition to the number of months of bacteriological positivity, also took into account the grading of sputum positivity (Table 12). (When the culture was positive, a 3+ direct smear result was scored as 4, 2+ as 3, 1+ as 2 and negative as 1; a negative culture result was scored as 0. For details of grading on smear, see Tuberculosis Chemotherapy Centre, 1960.)

A further analysis was undertaken to study the attack rate of tuberculosis during the year in the contacts according to the number of months of bacteriological positivity of the index cases. The results are presented in the left-hand section of Table 13, in which the three isoniazid series have been combined in order to increase the numbers. In the PH series, 6% of 31 contacts whose index cases were infectious for less than one month developed active tuberculosis during the year, as com-

TABLE 13

ATTACK RATE OF TUBERCULOSIS IN THE CONTACTS, ACCORDING TO THE NUMBER OF MONTHS OF BACTERIOLOGICAL POSITIVITY OF THE INDEX CASES AND THE NUMBER OF MONTHS THAT ISONIAZID-RESISTANT ORGANISMS WERE EXCRETED

Number of months of bacteriological positivity of the index cases [a]	PH			HI-1, HI-2 and H			Number of months the index cases excreted isoniazid-resistant organisms [a]	PH			HI-1, HI-2 and H		
	All contacts	Contacts who developed active tuberculosis		All contacts	Contacts who developed active tuberculosis			All contacts	Contacts who developed active tuberculosis		All contacts	Contacts who developed active tuberculosis	
		No.	%		No.	%			No.	%		No.	%
½	31	2	6	44	5	11	0	186	8	4	306	20	7
1-	162	7	4	294	16	5	½-	18	1	(6)[b]	63	5	8
4-	8	0		67	4	6	4-	5	1		80	1	1
7-	12	1	6	74	2	3	7-	14	0	8	87	1	1
10-12	16	1		173	2	1	10-12	6	1		116	2	2
Total	229	11	4.8	652	29	4.4	Total	229	11	4.8	652	29	4.4

[a] Excluding periods in hospital or sanatorium.

[b] The parentheses indicate that this percentage is based on fewer than 25 observations.

pared with 7% of 28 contacts whose index cases were infectious for seven months or more. For the isoniazid series, 11% of 44 contacts whose index cases were infectious for less than one month developed tuberculosis during the year, as compared with 1% of 173 contacts whose index cases were infectious for 10 months or more. Thus, the attack rates of tuberculosis in the contacts were not related to the number of months of bacteriological positivity of the index cases. Further analyses (not tabulated here) revealed that this conclusion applied both to the initially tuberculin-negative and to the initially tuberculin-positive contacts.

RELATIONSHIP BETWEEN THE NUMBER OF MONTHS THE INDEX CASES EXCRETED ISONIAZID-RESISTANT ORGANISMS AND THE ATTACK RATE IN THE CONTACTS

The number of months that each index case excreted isoniazid-resistant organisms was calculated and this was related to the attack rates of tuberculosis (Table 12). Considering the contacts with initial indurations of 0-4 mm, the average number of months of exposure to isoniazid-resistant organisms was 0.9 for the PH contacts, who had an attack rate of 8.2%; 3.1 for the HI-1 contacts, who had an attack rate of 15.1%; 3.1 for the HI-2 contacts, who had an attack rate of 5.7%; and 3.5 for the H contacts, who had an attack rate of 1.9%. Considering the contacts with initial indurations of 5 mm or more, the average number of months of exposure to isoniazid-resistant organisms was 1.0 for the PH contacts, who had an attack rate of 3.3%; 3.0 for the HI-1 contacts, who also had an attack rate of 3.3%; 4.1 for the HI-2 contacts, whose attack rate was 3.9%; and 5.0 for the H contacts, who had an attack rate of 3.6%. It may be concluded that the attack rates, both in the tuberculin-negative and in the tuberculin-positive contacts, were not obviously related to the average number of months that the index cases excreted isoniazid-resistant organisms. Further analyses, taking into account the degree of sputum positivity and expressing the results as a score, led to similar conclusions (Table 12).

A further analysis was undertaken to study the attack rate of tuberculosis during the year in the contacts according to the number of months that the index cases excreted isoniazid-resistant organisms. The results are presented in the right-hand section of Table 13. It will be seen that there was no association in the isoniazid series and a very slight suggestion of an association in the PH series. When separate analyses were undertaken for initially tuberculin-negative and initially tuberculin-positive contacts, no association was observed.

DIFFERENCES BETWEEN THE ATTACK RATES IN THE FOUR SERIES

The attack rates of tuberculosis were similar in the four series for the contacts who had an induration of 5 mm or more to the initial 5 TU test; there were, however, large differences in the corresponding attack rates for the contacts with an induration of 0-4 mm (Table 12). Analyses (not tabulated here) were therefore undertaken to see if there were any pretreatment differences in the sex or age distributions of the index cases, the pretreatment disease status (as assessed by the extent of cavitation, the total extent of the radiographic lesion and the bacterial content of sputum) or the virulence in the guinea-pig of the pretreatment strains from the index cases, which could account for the differences in the attack rates. In addition, the accommodation per family member was also investigated. There were no substantial differences between the four series associated with the differences in the attack rates.

DOUBTFULLY TUBERCULOUS LESIONS

The independent assessor classified two contacts (1 PH, 1 HI-2) as having developed doubtfully tuberculous lesions. The PH contact, a male aged four years, developed a transient pulmonary lesion at nine months; he had no induration to the initial 5 TU test, a 17 mm induration to the initial 100 TU test, no induration to 5 TU at three months, 2 mm at six months, 9 mm at nine months and 5 mm at one year. Five cultures were all negative for tubercle bacilli. The HI-2 contact, a female aged 35 years, developed an intrapulmonary lesion at one month which had not resolved completely by the end of the year. The initial 5 TU test gave an induration of 40 mm. One sputum specimen was examined and this was negative both on smear and on culture.

NON-TUBERCULOUS PULMONARY LESIONS DEVELOPING DURING THE YEAR

The independent assessor reported 29 non-tuberculous abnormalities, 16 (7.0%) in PH contacts, five (2.4%) in HI-1, four (1.9%) in HI-2 and four (1.8%) in H contacts. The differences between the PH and the three isoniazid series attain statistical

significance ($P<0.05$). However, this is probably the result of an extreme chance fluctuation, since there is no reason to believe that the treatment the index case received had a bearing on the development of non-tuberculous abnormalities in the contacts. The great majority of the lesions—namely, 14, four, four and three, respectively—were diagnosed by the assessor as pneumonic episodes. Thirteen of the 29 contacts were males.

CRITERIA OF TUBERCULIN CONVERSION DURING THE YEAR

Since the results of tuberculin tests may show large technical variation (see, for example, Frimodt-Møller, 1960), it is difficult to determine for certain, from the findings of serial tuberculin testing, whether conversion from tuberculin insensitivity to tuberculin sensitivity has occurred. The main approach adopted in the present analysis has therefore been to identify the contacts who, following a small diameter of induration to the initial 5 TU test, showed large increases of induration in a subsequent test which seemed likely to indicate that a recent tuberculous infection had occurred. An induration of 0-4 mm to the 5 TU test in the present study was taken to indicate that the contact had not acquired sensitivity to tuberculin as a result of tuberculous infection (see page 372). The principal definition of conversion from tuberculin insensitivity to sensitivity used in this study is an increase in induration of at least 10 mm in any 5 TU test at a set examination during the year, from an initial induration of 0-4 mm. A second, slightly less restrictive, definition is an increase in induration of 8 mm or more at any subsequent set examination, also from an initial induration of 0-4 mm. A subsidiary approach adopted has been to identify the two groups of contacts who had an induration of 5-7 mm to the initial 5 TU test and who showed either an increase in induration of 10 mm or more, or an increase of 8 mm or more, at any later set examination.

INCIDENCE OF TUBERCULIN CONVERSION AMONG THE CONTACTS

Table 14 shows the incidence of conversions among the contacts in the four series according to age. The upper half of the table relates to the contacts who had an initial induration of 0-4 mm to 5 TU. Of 71 PH contacts 44% showed an increase in induration of 10 mm or more at some time during the year, as compared with 33% of 52 HI-1, 42% of 53 HI-2 and 31% of 54 H contacts; the proportions

TABLE 14

INCIDENCE OF TUBERCULIN CONVERSION DURING THE YEAR IN THE CONTACTS, ACCORDING TO AGE

Diameter of induration to initial 5 TU test (mm)	Estimated age (years)	Total contacts with 5 TU tests at one or more set examinations [a]				Contacts in whom the induration to any 5 TU test at a set examination exceeded the initial induration by :							
						10 mm or more				8 mm or more			
		PH	HI-1	HI-2	H	PH	HI-1	HI-2	H	PH	HI-1	HI-2	H
						No. %	No. %	No. %	No. %	No. %	No. %	No. %	No. %
0-4	0-4	35	26	25	22	9 *26*	7 *27*	9 *36*	3 *(14)*[b]	11 *31*	8 *31*	9 *36*	3 *(14)*
	5-14	25	18	16	17	14 *56*	5 *(28)*	6 *(38)*	5 *(29)*	14 *56*	5 *(28)*	7 *(44)*	7 *(41)*
	15 or more	11	8	12	15	8 *(73)*	5 *(62)*	7 *(58)*	9 *(60)*	10 *(91)*	6 *(75)*	9 *(75)*	10 *(67)*
	Total	71	52	53	54	31 *44*	17 *33*	22 *42*	17 *31*	35 *49*	19 *37*	25 *47*	20 *37*
5-7	0-4	4	2	2	2	2 *(50)*	1 *(50)*	0 *(0)*	0 *(0)*	2 *(50)*	1 *(50)*	2 *(100)*	0 *(0)*
	5-14	11	14	12	17	4 *(36)*	9 *(64)*	4 *(33)*	8 *(47)*	4 *(36)*	9 *(64)*	4 *(33)*	8 *(47)*
	15 or more	30	25	27	31	7 *23*	14 *56*	11 *41*	12 *39*	14 *47*	15 *60*	16 *59*	16 *52*
	Total	45	41	41	50	13 *29*	24 *59*	15 *37*	20 *40*	20 *44*	25 *61*	22 *54*	24 *48*

[a] That is, the examinations at three, six and nine months and one year.

[b] The parentheses indicate percentages based on fewer than 25 observations.

who showed conversion by the 8 mm definition were 49%, 37%, 47% and 37%, respectively.

The lower half of Table 14 shows the corresponding figures for the contacts with an induration of 5-7 mm to the initial 5 TU test. Of 45 PH contacts, 29%, as compared with 59% of 41 HI-1, 37% of 41 HI-2 and 40% of 50 H contacts, showed an increase in induration of 10 mm or more; the corresponding proportions with an increase in induration of 8 mm or more were 44%, 61%, 54% and 48%, respectively. It may be concluded that there were no consistent differences between the four contact series and that a considerable number of conversions occurred by both definitions in all of them. Further, it will be seen from the table that the conversions were not confined to the younger age-groups.

It is of value to study the frequency with which conversions occurred in relation to the total number of contacts who had been tested by the 3-, 6- and 9-month and 1-year examinations (Table 15). By three months 63 PH contacts had been tested and 21% showed tuberculin conversion by the 10 mm definition, as compared with 22% of 50 HI-1, 18% of 49 HI-2 and 18% of 50 H contacts. By one year the percentages had increased to 44% of 71 PH, 33% of 52 HI-1, 42% of 53 HI-2 and 31% of 54 H contacts. Thus, nearly half of the PH and HI-2 and over half of the HI-1 and H conversions occurred in the first three months. Considering the 8 mm definition, the proportions of conversions in the first three months were 29%, 24%, 31% and 22%, respectively, for the four series, and 49%, 37%, 47% and 37%, respectively, by one year.

Considering the contacts with initial indurations of 5-7 mm, 21% of 43 PH contacts showed an increase in induration of 10 mm or more in the first three months, as compared with 17% of 35 HI-1, 13% of 39 HI-2 and 23% of 39 H contacts. By one year, the proportions had increased to 29%, 59%, 37% and 40%, respectively. The corresponding proportions for an increase in induration of 8 mm or more at three months were 26%, 23%, 21% and 26%, respectively, and at one year 44%, 61%, 54% and 48%, respectively.

It may be concluded that conversions occurred in all the four quarters of the year, the highest incidence of conversion being in the first quarter.

TUBERCULIN CONVERSIONS AMONG CONTACTS WHO DEVELOPED TUBERCULOUS OR DOUBTFULLY TUBERCULOUS LESIONS

Combining the four series, a total of 18 (7.7%) cases of active tuberculosis developed among the 233 contacts who had had an induration of 0-4 mm to the initial 5 TU test (Table 10). Of these, 15 showed conversion by the 10 mm definition and one

TABLE 15

CUMULATIVE PERCENTAGES OF CONTACTS WHO SHOWED TUBERCULIN CONVERSION BY THREE, SIX AND NINE MONTHS AND ONE YEAR

Diameter of induration to initial 5 TU test (mm)	Period (months)	Total contacts with 5 TU tests at one or more set examinations [a]				Contacts in whom the induration to any 5 TU test at a set examination exceeded the initial induration by :							
						10 mm or more				8 mm or more			
		PH	HI-1	HI-2	H	PH	HI-1	HI-2	H	PH	HI-1	HI-2	H
						No. %	No. %	No. %	No. %	No. %	No. %	No. %	No. %
0-4	0-3	63	50	49	50	13 *21*	11 *22*	9 *18*	9 *18*	18 *29*	12 *24*	15 *31*	11 *22*
	0-6	64	51	53	53	18 *28*	14 *27*	15 *28*	11 *21*	23 *36*	16 *31*	20 *38*	13 *25*
	0-9	65	52	53	54	25 *38*	17 *33*	16 *30*	14 *26*	30 *46*	18 *35*	21 *40*	17 *31*
	0-12	71	52	53	54	31 *44*	17 *33*	22 *42*	17 *31*	35 *49*	19 37	25 *47*	20 *37*
5-7	0-3	43	35	39	39	9 *21*	6 *17*	5 *13*	9 *23*	11 *26*	8 *23*	8 *21*	10 *26*
	0-6	44	40	40	47	11 *25*	11 *28*	10 *25*	10 *21*	14 *32*	13 *32*	15 *38*	14 *30*
	0-9	44	40	41	48	12 *27*	21 *52*	14 *34*	16 *33*	16 *36*	22 *55*	21 *51*	20 *42*
	0-12	45	41	41	50	13 *29*	24 *59*	15 *37*	20 *40*	20 *44*	25 *61*	22 *54*	24 *48*

[a] That is, the examinations at three, six and nine months and one year.

more showed an increase in induration of 9 mm. One of the remaining two contacts had no induration initially and an induration of 7 mm at nine months. The other (aged two years) showed no induration to 5 TU at any of the five tests during the year.

There were four cases of active tuberculosis among the 181 contacts in the four series with indurations of 5-7 mm to 5 TU initially; two showed an increase in induration of 10 mm or more, the third had an 8 mm increase and the fourth, who had a 5 mm induration initially, had an 8 mm induration at one month and a 6 mm induration at 12 months.

One contact who developed a doubtfully tuberculous abnormality during the year had no induration to the initial 5 TU test, but an induration of 9 mm at nine months.

DEATHS OF CONTACTS DURING THE YEAR

During the year there were 13 deaths, four in the PH contacts, four in the HI-1, two in the HI-2 and three in the H contacts. All the PH, one of the HI-1, one of the HI-2 and all three H contacts were under three years old. The independent assessor reviewed each death in the light of all the available data and the full clinical history, and decided that none of the deaths was tuberculous in origin. Radiographs taken a short time before death were available in the majority of cases. Considering the children under the age of three years, radiographs were available for the four PH contacts one, two, three and seven weeks, respectively, before death, for the HI-1 contact one week before death, for the HI-2 contact three weeks before death, and for the three H contacts two, three and four weeks, respectively, before death. All these radiographs were classified as normal by the independent assessor. Of these young contacts, one (PH) had an induration of 5 mm and another (H) an induration of 8 mm to the initial 5 TU test; the rest had no induration. One contact showed tuberculin conversion by the 10 mm criterion—namely, a PH contact, aged one year, who probably died of oedema of the glottis. The tuberculin test was 0 mm initially and 10 mm at three months (one week before death).

In summary, although it is very difficult to be sure of the cause of death, especially in infants and young children, under the conditions that obtain in Madras, the independent assessor did not consider, on the available evidence, that any contact had died of tuberculosis.

BIRTHS DURING THE YEAR

In the course of the year there were 26 births, seven into the PH families, five into the HI-1, five into the HI-2 and nine into the H families, representing additions to the total of 881 close family contacts in the comparison. The numbers of births that occurred in the first six months were three, three, none and six, respectively, in the four series.

All the newborn were alive, and all except four (2 PH, 1 HI-2, 1 H) were radiographed, at the end of the year. Twenty were normal and two (1 PH, 1 HI-2) had non-tuberculous abnormalities. The four contacts who were not radiographed were aged 10 days, three weeks, 13 weeks and 18 weeks, respectively, at the end of the year. At 12 months, a 5 TU test was performed on four PH, three HI-1, four HI-2 and eight H newborn contacts. All were negative except for one (HI-2) who had an induration of 6 mm (two tests in the second year, however, gave no induration). The numbers of newborn contacts who had 100 TU tests at the end of the year were one, two, two and four, respectively. Only one (H) showed any induration and this measured 5 mm. There was thus no evidence that any of the newborn infants had a tuberculous infection during the course of the year of treatment for the index case.

ATTACK RATE OF TUBERCULOSIS IN FAMILIES WITH MORE THAN ONE INFECTIOUS MEMBER INITIALLY

As already explained (page 375), 28 families, containing 84 contacts (23 PH, 8 HI-1, 23 HI-2, 30 H) with no initial evidence of tuberculosis (apart from calcification), were excluded from the above comparison because one or more members, in addition to the index case, were excreting tubercle bacilli at the prevalence survey. Of these contacts, six (3 PH, 1 HI-2, 2 H) developed active tuberculosis during the year (Appendix 1, Table I). The PH contacts (all aged three years) developed radiographic abnormalities at one, three and 12 months, respectively, the HI-2 contact (aged 25 years) at nine months and the H contacts (aged four months and two-and-a-half years) at two and three months, respectively. The two early cases in the PH contacts were tuberculin-negative initially and the late case was tuberculin-positive, as was the HI-2 contact and one of the H contacts. If the findings in the contacts considered in this section are amalgamated with those for the main comparison, the attack rates in the tuberculin-negative contacts are 10.1% for the PH

series, 14.8% for the HI-1, 5.2% for the HI-2 and 3.4% for the H series. In the tuberculin-positive contacts the attack rates are 3.6%, 3.1%, 4.1% and 3.6%, respectively.

Considering the tuberculin-test results, six PH, one HI-1, five HI-2 and five H contacts had an induration of 0-4 mm to the initial 5 TU test. By the end of the year two, none, two and one, respectively, had an increase in induration of 10 mm or more and a further contact (HI-2) had an increase of 8 mm. Considering the two PH, two HI-2 and 10 H contacts with an initial induration of 5-7 mm to the 5 TU test, two, one and two, respectively, had an increase in induration of 10 mm or more and two, one and four, respectively, had an increase of 8 mm or more.

There was one death in the 28 families. An H contact aged 10 months died of acute septicaemia at the end of five months. There was no induration to the 5 TU and 100 TU tests on admission or at three months, and the radiographs on admission and at three months (eight weeks before death) were normal.

There were three births into the 28 families (1 HI-1, 1 HI-2, 1 H); none of the newborn contacts showed any evidence of a tuberculous infection during the year.

DEATHS OF CONTACTS EXCLUDED FROM THE STUDY OF THE ATTACK RATE OF TUBERCULOSIS

There were two deaths among the 27 contacts with no initial radiographic examination. Twins (HI-1) who were two months old on admission to the study died within three months of marasmus and acute diarrhoea. One of these had a normal radiograph four weeks before death and had no induration to a 5 TU test at the same time; the other was neither radiographed nor tuberculin-tested.

Of the 115 contacts who had tuberculous or doubtfully tuberculous lesions initially, one (PH) died. He was aged six months on admission and had an active tuberculous lesion, but died of gastroenteritis one week after the last radiograph had been taken. The independent assessor considered that the death was non-tuberculous.

IV. DISCUSSION

Andrews et al. (1960) have previously reported from the Centre on the prevalence of clinical tuberculosis and tuberculous infection among the close family contacts of patients with newly-diagnosed, infectious pulmonary tuberculosis, drawn from a poor and overcrowded section of a large urban community in South India. The present study gives corresponding information on a further 1109 close family contacts of 341 patients drawn from the same community.

A chest radiograph was taken for 97.6% of the contacts at the time of diagnosis of the index case. The prevalence of active tuberculosis was 7.6% (8.6% for the males and 6.7% for the females). It was high in children under five years of age (12.0%). These figures are slightly higher than those obtained in the earlier study (Andrews et al., 1960) in which the prevalence was 6.8% for the full population and 9.2% for children under five years of age. In the present study, 20 out of 21 cases of inactive tuberculosis were in contacts aged 25 years or more, a prevalence of 4.8%, as compared with 10 out of 11 cases in the earlier (1960) study, a prevalence of 4.3%.

The total prevalence of active, doubtfully active and inactive tuberculosis was 9.6%, 3.3% and 12.5% among contacts under 10 years, 10-19 years and 20 years or more, respectively, as compared with 7.3%, 1.4% and 13.8% in the earlier (1960) study. The prevalence of infectious tuberculosis at all ages was 3.1% in the present series, as compared with 4.2% in the earlier (1960) study.

The prevalence of active tuberculosis in both studies is considerably higher than that in the general Indian population in large cities observed in the national sample survey between 1955 and 1958 (Indian Council of Medical Research, 1959), in which the prevalence of " active and probably active " tuberculosis in those aged five years or more ranged from 1.5% to 2.1% in six cities, as compared with a prevalence of active tuberculosis at these ages of 6.6% in the present study and 6.3% in the earlier study (Andrews et al., 1960). These rather high figures for the prevalence of active disease among contacts are similar to the 5.7% reported by Warawedkar & Shah (1958) in family contacts of tuberculous patients in Bombay. It may be concluded that the examination of urban family

contact groups will yield many cases of tuberculosis.

In the earlier study (Andrews et al., 1960; Ramakrishnan et al., 1961a), the attack rate of tuberculosis in the contacts whose index cases were isolated for a year in sanatorium was compared with that of the contacts whose index cases were treated in their homes. *All* the contacts were at risk of contracting tuberculosis from two sources of infection: first, exposure to the index case *before* the start of treatment; secondly, exposure to other cases in the overcrowded urban environment in which the families lived. In addition, the contacts of the patients treated at home were exposed to a third source—namely, the patient *during* treatment. It was found that of these three risks the biggest was the exposure to the index case *before* the start of treatment and that both exposure to infection *during* treatment with effective chemotherapy and the risk of the urban environment were relatively unimportant. The present study has yielded further information on the relative importance of the above three sources of infection. In particular, it has given further information on the influence of continued exposure to infection from the index case, because four chemotherapeutic regimens of different effectiveness were under domiciliary study.

The index cases in the present study were allocated at random to treatment with a standard combination of isoniazid (3.9-5.5 mg/kg) plus PAS sodium (0.2-0.3 g/kg) (PH regimen) or to treatment with one of three different regimens of isoniazid alone—namely, isoniazid in a moderate dosage (7.8-9.6 mg/kg) taken as one dose a day (HI-1 regimen) or as two doses a day (HI-2 regimen), and isoniazid in a small dosage (3.9-5.5 mg/kg) taken as two doses a day (H regimen). The contacts were assigned as a result of this random process to the PH, HI-1, HI-2 and H series, and the relative importance of the three sources of infection has been studied in the 229 PH, 212 HI-1, 212 HI-2 and 228 H contacts in families in which the index case was the only infectious member initially. The four series of contacts were similar at the time of diagnosis of the index cases (though the PH series had more tuberculous calcifications (8.7%) and the H series less (2.6%) than the other two series) and were studied with similar intensity by radiography, tuberculin testing and bacteriology during the year. There was a very high coverage at the set 3-monthly radiographic examinations, and at the end of the year 96% of the surviving contacts had a radiograph taken.

Of the three sources of infection referred to above, the environment, as in the earlier study (Andrews et al., 1960; Ramakrishnan et al., 1961a), appears to have been relatively unimportant during a year of follow-up. Thus, of the total number of 40 cases, 19 appeared in the first quarter, eight in the second, 11 in the third and two in the last. The general decline during the year and the relatively small number of cases in the last quarter suggest that the urban environment made a relatively small contribution to the total of cases.

Considering the second source of risk—namely, infection from the index case during the year of treatment—the *tuberculin-negative* PH contacts, who were exposed to an average period of 2.9 months of bacteriological positivity of the index cases, had an attack rate of 8.2%. In contrast, the tuberculin-negative H contacts had an attack rate of only 1.9%, although the average period of positivity of their index cases was nearly twice as long—namely, 5.4 months. Considering the *tuberculin-positive* contacts, the attack rate during the year was similar for all four contact series, being 3.3% both for the PH and for the HI-1 series, 3.9% for the HI-2 and 3.6% for the H series; these percentages bear no relation to the average numbers of months of bacteriological positivity of the index cases, which were 3.1, 4.8, 5.6 and 6.7 months, respectively, for the four series. It may therefore be concluded that exposure to infection *during* treatment also played a relatively minor role in the development of contact cases in the year of follow-up; this finding is again in keeping with that reached in the earlier study in the same community (Andrews et al., 1960; Ramakrishnan et al., 1961a).

Exposure to the index cases *before* the start of treatment is the only other possible source of infection, and it seems likely that this has, in fact, been responsible for many of the cases. Thus, 19 of the 40 cases were diagnosed, on the basis of a radiographic abnormality or bacteriological findings, as having manifest tuberculosis in the first three months. It is clear that for these cases the radiographic lesion must have been present for days or even weeks before the date of diagnosis and that the likely date of *infection* was some weeks earlier still—that is, in all probability, in the period before the diagnosis of the index case. In addition to the nine cases which arose in initially tuberculin-positive contacts in the first three months, it is likely that most of the ten initially tuberculin-negative contacts who developed overt tuberculosis in the first three months were, in

fact, infected *before* the diagnosis of the index case. Thus, Andrews et al. (1960) and Ramakrishnan et al. (1961a) found that six tuberculin-negative contacts of patients treated in sanatorium developed tuberculosis in a 2-year period, *all* of them in the first three months of treatment of the index case. The index case had been isolated in sanatorium from the start of treatment, so that these six contacts were, in all likelihood, already infected and actually incubating the disease when the patient was admitted to sanatorium.

During the year there were major differences between the four contact series in the number of months of exposure to index cases excreting isoniazid-resistant organisms. The differences, like the differences in length of exposure to infection from the index cases, whether with isoniazid-sensitive or with isoniazid-resistant organisms, were unrelated to the attack rates for the four series during the year. Further, of the contacts who developed the disease during the year, nine yielded positive cultures; eight of these, four from initially tuberculin-positive and four from initially tuberculin-negative contacts, were tested for sensitivity to isoniazid and all were sensitive. There is thus, so far, no evidence that the cases that arose in the year were the result of infection by patients excreting isoniazid-resistant organisms. It is, however, clearly too early to dismiss the possibility that this is a long-term risk.

It is possible that, in addition to the reduced infectivity resulting from the treatment of the patients, the attempts which the Centre's staff made to reduce the infectivity of the index cases by instruction on coughing and sputum disposal and, where practicable, by simple measures of isolation of the index case within the home, may have played some part in the declining attack rate of tuberculosis in the contacts. Brieger's (1944) observations on the Papworth families have shown the value of such instruction, in the pre-chemotherapeutic era.

The vulnerability of young contacts to tuberculosis is of particular interest. In the present study, in addition to a prevalence of active tuberculosis of 12.0% in the contacts under five years of age, 18 of the 40 contacts who developed tuberculosis during the year were under five years of age and 26 were under 10 years. The attack rate in children under five years of age was 12.2% and in those aged 5-9 years was 5.7%. The attack rates in the first year of follow-up in the earlier study (Andrews et al., 1960) were 14.9% and 6.4% in the corresponding age-groups. Child contacts are thus especially vulnerable. It is regrettable that in the majority of epidemiological investigations in the developing countries, all children under the age of five years are excluded from radiographic examination because of the technical difficulties with the currently available miniature mass radiography equipment. By excluding this age-group, in addition to missing many cases requiring treatment, a most valuable epidemiological index is lost.

The distribution of indurations to 5 TU of PPD in the *index cases* at the time of diagnosis suggests that, as in the earlier study (Andrews et al., 1960), an induration of 5 mm or more was indicative of tuberculous infection (RT 22, the PPD used, was a particularly weak batch—Guld et al., 1958). It is of interest that the mean sizes of indurations found in the Madras series in tuberculous patients, like those reported by Frimodt-Møller (1960) from Madanapalle, 160 miles (256 km) away, are considerably smaller than those reported from patients in most other countries (WHO Tuberculosis Research Office, 1955).

The distributions of indurations to the initial 5 TU tests for the contacts indicate that the criterion for the index cases also provided a satisfactory division of the contacts into those uninfected with tuberculosis and those with a present or past tuberculous infection.

The members of the staff of the Centre (and other workers) who have had experience in reading tuberculin reactions in other parts of the world have found that the reactions are less easy to read in South India. Even so, retesting can be used as a basis for comparison between the groups in the present study. The observed incidence of conversions from tuberculin insensitivity to tuberculin sensitivity (defined for the purpose of this study in several ways, the principal definition being an increase in diameter of induration of 10 mm or more from an initial induration of 0-4 mm) showed no important differences between the four series. There was evidence that more conversions occurred in the first quarter of the year than in the subsequent quarters.

In earlier reports from the Centre, the possible role of chemoprophylaxis and of BCG vaccination in preventing tuberculosis in contacts was discussed (Andrews et al., 1960; Ramakrishnan et al., 1961a). The present study has confirmed that the attack rate of tuberculosis in family contacts, especially young ones, is sufficiently high to make it feasible to undertake controlled studies of chemo-

prophylaxis without the necessity of admitting very large numbers of contacts to the investigation. In planning such studies it would be necessary to ensure that the contacts did not take the index cases' medicaments and so invalidate the comparisons. Conversely, if comparisons of chemotherapeutic regimens were being made in the index cases, they might be invalidated if the index cases took the contacts' medicaments.

The present study is continuing with a very high rate of contact follow-up examination, so that information on the longer-term attack rates is already ensured. The findings will be the subject of further reports.

V. SUMMARY

1. A total of 341 South Indian patients with pulmonary tuberculosis in a comparison of four chemotherapeutic regimens at home had 1109 close family contacts, that is, relatives living, cooking and feeding with them for at least the three months immediately prior to diagnosis.

2. The living conditions and dietary standards were poor, the families being drawn from the lower income groups in Madras City.

3. The contacts were studied to determine (*a*) the prevalence of tuberculosis among them at the time of diagnosis of the index case and (*b*) the incidence of tuberculosis during the first year of a 5-year follow-up.

4. Of the 1109 contacts, 494 (44.5%) were males; 45.4% were children under the age of 15 years.

5. In the prevalence survey, 97.6% of the 1109 contacts had an acceptable radiographic examination. At an independent assessment, active tuberculosis was found in 8.6% of the males and 6.7% of the females, inactive or doubtfully active tuberculosis in 2.9% of the males and 1.5% of the females and tuberculous calcification in 4.3% of the males and 5.2% of the females. In all, 3.9% and 2.5%, respectively, were excreting tubercle bacilli.

6. Of the 82 cases of active tuberculosis, 43 had adult-type and 39 primary or post-primary type disease; 67 of the lesions were classified as progressive.

7. An initial tuberculin test with 5 TU of PPD was performed on 94.9% of the contacts. The distribution of the diameters of induration suggested that 5 mm or more indicated tuberculous infection. (The distribution of indurations to 5 TU for the index cases suggested the same criterion.)

8. Using this criterion, 89% of the contacts in the 15-24 age-group had already had a tuberculous infection; with an 8 mm criterion the proportion was 68%; with a 10 mm criterion it was 52%, but rose to 58% in the 25-34 age-group.

9. Some small positive reactions which might indicate a non-tuberculous infection were encountered, though not frequently.

10. In the study of the attack rates, the main comparison was between 229 contacts of patients treated with isoniazid plus PAS (PH contacts), 212 contacts of patients treated with a moderate dosage of isoniazid taken in one dose a day (HI-1 contacts), 212 contacts of patients treated with the same moderate dosage of isoniazid, but in two doses a day (HI-2 contacts), and 228 contacts of patients treated with a small daily dosage of isoniazid in two doses a day (H contacts).

11. These four contact series were similar at the start of treatment for the index cases (apart from initial calcification) and were followed up with equal intensity by radiography, tuberculin testing and bacteriology. The coverage by radiographic examination at three, six and nine months and at one year in the four series combined was 94%, 93%, 90% and 96%, respectively.

12. During the year active tuberculosis developed in 40 contacts—namely, 11 in the PH, 13 in the HI-1, nine in the HI-2 and seven in the H series. Of these, six, eight, three and one, respectively, were initially tuberculin-negative and five, five, six and six, respectively, were initially tuberculin-positive. Of these, 40 contacts, 18 were under five years of age and eight were between five and 10 years. The annual attack rate was 12.2% under the age of five years and 5.7% in the 5-9 years' age-group.

13. The attack rates in the tuberculin-negative contacts were 8.2% for the PH series, 15.1% for the HI-1, 5.7% for the HI-2 and 1.9% for the H series. In the tuberculin-positive contacts, the attack rates were 3.3%, 3.3%, 3.9% and 3.6%, respectively.

14. The attack rates in the four series were not related either to the average numbers of months of bacteriological positivity of the index cases or to the average numbers of months that the index cases excreted isoniazid-resistant organisms; this suggests that exposure to the index case *during treatment* was not an important source of infection during the year.

15. There were 19 cases whose onset was in the first quarter, eight in the second, 11 in the third and two in the last quarter; the general decline and the low figure in the final quarter suggest that the outside urban environment was not a major source of cases.

16. Exposure to the index case *before* the start of treatment was considered to be the important source of cases during the year.

17. Nine contacts who developed tuberculosis yielded positive cultures; eight were tested for isoniazid sensitivity and all were sensitive.

18. Serial tuberculin tests were made during the year. Tuberculin conversions occurred to a similar extent in all four series, particularly in the first three months.

19. It is concluded that the examination of close family contacts at the time of diagnosis of the index case is a valuable method of case-finding and that the major risk to the contacts during a year of follow-up resulted from exposure to the index cases *before* the start of treatment.

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RÉSUMÉ

Poursuivant la comparaison de la contagiosité pour les contacts des cas de tuberculose avérés, traités durant la première année, les uns en sanatorium, les autres à domicile, les auteurs examinent les résultats d'une étude qui a porté sur 1109 contacts de 341 malades de l'Inde méridionale. Par contacts on entend les personnes de l'entourage familial ayant vécu, ayant préparé et consommé leurs repas au même foyer que la personne reconnue atteinte de tuberculose, cela pendant au moins trois mois avant que le diagnostic du cas avéré ait été posé. Les conditions de vie de toutes ces personnes étaient peu satisfaisantes, les familles examinées provenant des secteurs sociaux les moins favorisés de Madras.

Les points suivants ont été étudiés chez les contacts: *a*) la fréquence globale de la tuberculose au moment où le cas principal a été découvert; *b*) la fréquence des nouveaux cas durant la première des cinq années de surveillance prévues. Sur ces 1109 contacts, 494 (44,5%) étaient des hommes, 45,4% des enfants de moins de 15 ans. Lors de l'enquête sur la fréquence globale, l'examen radiographique était acceptable chez 97,6% des 1109 contacts. Lors d'une évaluation, indépendante de cet examen, on trouva une tuberculose active chez 8,6% des hommes et 6,7% des femmes, une tuberculose inactive ou d'activité douteuse chez 2,9% des hommes et 1,5% des femmes et des calcifications chez 4,3% des hommes et 5,2% des femmes; 3,9% des hommes et 2,5% des femmes excrétaient des bacilles tuberculeux. Parmi les 82 cas de tuberculose active, 43 présentaient la forme adulte et 39 la forme primaire ou post-primaire; 67 lésions furent classées comme progressives.

Un premier test tuberculinique a été effectué sur 94,9% des contacts avec 5 UI de PPD. La distribution des diamètres de la réaction indiquait que 5 mm ou plus dénonçaient une infection tuberculeuse. Sur la base de ce critère, on a pu établir que 89% des contacts du groupe d'âge de 15-24 ans avaient déjà été infectés de tuberculose; en prenant comme critère 8 mm, on obtenait 68%, et avec 10 mm, 52% (58% dans le groupe d'âge de 25-34 ans).

Dans l'étude des cas nouveaux, la recherche porta sur 229 contacts de malades traités par l'isoniazide + PAS (contacts PH), 212 contacts de malades traités avec une dose modérée d'isoniazide une fois par jour (contacts HI-1), 212 contacts traités par la même dose modérée, mais administrée en deux fois (contacts HI-2), et 228 contacts traités par une faible dose quotidienne, adminis-

trée en deux fois (contacts H). Ces quatre groupes étaient semblables lorsque fut entrepris le traitement du cas avéré, et ils furent suivis avec une égale régularité par des examens radiographiques et bactériologiques et des tests tuberculiniques.

Au cours de l'année la tuberculose se manifesta chez 40 contacts, soit 11 dans le groupe PH, 13 dans le groupe HI-1, 9 dans le groupe HI-2 et 7 dans le groupe H. Parmi eux, six, huit, trois, et un, respectivement, étaient au départ tuberculino-négatifs, et cinq, cinq, six, et six, respectivement, étaient tuberculino-positifs. De ces 40 contacts, 18 n'avaient pas 5 ans, et 8 étaient entre 5 et 10 ans. La fréquence annuelle des nouveaux cas était de 12,2% en-dessous de 5 ans et de 5,7% entre 5 et 10 ans. Chez les tuberculino-négatifs, le taux d'infection nouvelle était de 8,2% pour le groupe PH, 15,1% pour HI-1, 5,7% pour HI-2 et 1,9% pour H. Parmi les tuberculino-positifs au départ, ces taux étaient respectivement de 3,3%, 3,3%, 3,9% et 3,6%.

Le taux des infections nouvelles dans les quatre séries n'était en rapport ni avec le nombre moyen de mois de positivité bactériologique chez les cas avérés, ni avec le nombre moyen de mois durant lesquels le cas avéré excrétait des bacilles résistants à l'isoniazide. Cela indiquerait que le contact avec le cas avéré *pendant le traitement* n'a pas été une source importante d'infection durant l'année.

Il y eut 19 cas qui débutèrent au cours du premier quart de l'année, 8 durant le deuxième, 11 durant le troisième, et 2 durant le quatrième. Le déclin général et le chiffre faible du quatrième quart suggèrent que le milieu urbain extérieur n'a pas été une source importante d'infection. L'exposition au cas avéré *avant* le début du traitement a été considéré comme la source importante d'infection durant l'année. Neuf des contacts qui présentèrent une infection tuberculeuse donnèrent des cultures positives; huit sur les huit qui furent soumises au test de sensibilité à l'isoniazide se montrèrent sensibles à ce produit. Des tests tuberculiniques en série furent effectués durant l'année. Des conversions se produisirent dans les quatre groupes, surtout dans les trois premiers mois.

En conclusion, les auteurs estiment que l'examen des contacts au moment où l'on pose le diagnostic du cas avéré est une méthode de dépistage fructueuse, et que l'essentiel de la contagion a lieu avant ce moment-là.

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APPENDIX 1

Appendix 1 (Tables A to I) summarizes the results of the examinations of the contacts who developed definite tuberculosis during the course of the year. Tables A to H give the findings for the families in which the only source of infection initially was the index case, and Table I refers to the families who had at least one other source of infection initially, in addition to the index case. The dating of the radiographic abnormalities and their descriptions were made by the independent assessor, as were the summaries in the last column.

APPENDIX 2

Appendix 2 (Tables J to M) presents, for the four series of contacts separately, the relationship between the initial 5 TU test and the last available 5 TU test in the year, i.e., if a 12-month test was not performed, the 9-month or, failing this, the 6-month or, failing this, the 3-month test. Of the 207 available tests in the PH contacts (Table J), 160 (77%) were performed at 12 months, 12 (6%) at nine months, 17 (8%) at six months and 18 (9%) at three months. Of the 188 available tests in the HI-1 contacts (Table K), 130 (69%) were performed at 12 months, 20 (11%) at nine months, 16 (9%) at six months and 22 (12%) at three months. Of the 172 available tests for the HI-2 contacts (Table L), 103 (60%) were performed at 12 months, 29 (17%) at nine months, 26 (15%) at six months and 14 (8%) at three months. Of the 200 available tests for the H contacts (Table M), 136 (68%) were performed at 12 months, 36 (18%) at nine months, 13 (6%) at six months and 15 (8%) at three months. In considering these tables it is important to recall that it was only late in the study that a 5 TU test was performed at one year on all contacts as a routine, that is, irrespective of the size of the induration to the previous tests. In the earlier stages all testing was stopped once an induration of 20 mm or more had been encountered. Hence, contacts with large indurations were not always given an opportunity to demonstrate " reversion " to smaller indurations.

TABLE A

PH CONTACTS WITH AN INITIAL INDURATION OF 0-4 MM TO 5 TU WHO DEVELOPED AN ACTIVE TUBERCULOUS LESION DURING THE YEAR (INDEX CASE WAS ONLY SOURCE OF INFECTION IN THE FAMILY INITIALLY)

Registration numbers of contact (T No.) and of index case (A No.)	Sex and age (years)	Radiographic findings (all early normal and important abnormal radiographs)				Tuberculin-test results			Culture results (sputum and laryngeal swab)				Summary
		Interval from date of start of treatment of the index case (mths)	Independent assessment of radiographs			Interval from date of start of treatment of the index case (mths)	Diameter of induration (mm)		Before any chemotherapy for contact [c]		After start of chemotherapy for contact		
			Normal or abnormal [a]	Type of abnormality	Extent (rib interspaces) [b]		5 TU	100 TU	No. positive	No. negative	No. positive	No. negative	
T 4391 (A 118)	Female 1½	0	N			0	0	0	1	6	No chemotherapy		Progressive primary disease; regressive without chemotherapy
		3	A	Lung lesion	Less than 1	3	28	—					
		6	M	Lung lesion larger	Less than 1								
T 4501 (A 120)	Female 7/12	0	N			0	2	0	2	5	0	7	Progressive primary disease; regressed under chemotherapy
		1	N			2	7	—					
		2	A	Bilateral glands and bilateral lung lesions	More than 2	3	0	4					
						4	11	—					
		3	I	Lung lesions larger	More than 2								
		4	M	Lung lesions larger	More than 2								
T 6722 (A 314)	Male 4	0	N			0	0	17	0	1	No chemotherapy		Progressive primary disease; regressive without chemotherapy; development of fresh lesion; regressive without chemotherapy
		3	A	Gland and bilateral lung lesions	More than 2	12	40	—					
		10	I	Fresh lung lesion	Less than 1								
T 6813 (A 330)	Female 23	0	N			0	0	7	0	5	No chemotherapy		Post-primary disease
		9	A	Large pleural effusion		12	16	—					
T 6814 (A 330)	Female 6	0	N			0	0	0	0	0	No chemotherapy		Simple primary disease
		9	A	Gland		12	14	—					
T 6672 (A 342)	Male 5	0	N			0	0	0	0	13	No chemotherapy		Progressive primary disease; regressive without chemotherapy
		1	N			1	0	0					
		3	N			3	0	7					
		6	A	Lung lesion	1-2	6	48	—					
		9	M	Lung lesion larger and gland	1-2	9	13	—					
						12	9	—					

[a] N = normal ; A = first abnormality ; I = increased or fresh abnormality ; M = maximal abnormality.
[b] For definition, see footnote on page 369.
[c] By chemotherapy is meant *antituberculosis* chemotherapy.

TABLE B

PH CONTACTS WITH AN INITIAL INDURATION OF 5 MM OR MORE TO 5 TU WHO DEVELOPED AN ACTIVE TUBERCULOUS LESION DURING THE YEAR (INDEX CASE WAS ONLY SOURCE OF INFECTION IN THE FAMILY INITIALLY)

Registration numbers of contact (T No.) and of index case (A No.)	Sex and age (years)	Radiographic findings (all early normal and important abnormal radiographs)				Tuberculin-test results			Culture results (sputum and laryngeal swab)				Summary
		Interval from date of start of treatment of the index case (mths)	Independent assessment of radiographs			Interval from date of start of treatment of the index case (mths)	Diameter of induration (mm)		Before any chemotherapy for contact [c]		After start of chemotherapy for contact		
			Normal or abnormal [a]	Type of abnormality	Extent (rib interspaces) [b]		5 TU	100 TU	No. positive	No. negative	No. positive	No. negative	
T 3317 (A 17)	Male 15	0	N			0	10	—	0	2	0	6	Simple primary disease ; regressed under chemotherapy
		3	N			4	25	—					
		4	N			7	22	—					
		4 [d]	N										
		5	A	Gland									
		8	M	Gland larger									
T4352 (A 107)	Male 34	0	N			0	11	—	0	0	No chemotherapy		Simple primary disease ; regressive without chemotherapy
		3	N			3	15	—					
		6	A	Gland		6	35	—					
T 5034 (A 174)	Female 50	0	N			0	14	—	0	0	No chemotherapy		Progressive adult-type disease ; regressive without chemotherapy
		4	A	Lung lesion	Less than 1	4	14	—					
		7	I	Lung lesion larger	Less than 1	7	16	—					
		10	M	Lung lesion larger	Less than 1								
T 5747 (A 261)	Male 56	0	N			0	18	—	0	5	No chemotherapy		Progressive adult-type disease ; regressive without chemotherapy ; fresh lung lesion
		3	N			3	9	—					
		6	N			6	12	—					
		9	A	Lung lesion	More than 2	9	12	—					
		11	I	Fresh lung lesion	Less than 1	12	13	—					
T 6396 (A 286)	Male 10/12	0	N			0	8	—	0	7	No chemotherapy		Progressive primary disease ; regressive without chemotherapy
		1	N			2	11	—					
		2	A	Gland and lung lesion	1-2	2 [e]	15	—					
		3	M	Lung lesion larger	1-2	6	18	—					
						9	16	—					
						12	20	—					

[a] N = normal ; A = first abnormality ; I = increased or fresh abnormality ; M = maximal abnormality.
[b] For definition, see footnote on page 369.
[c] By chemotherapy is meant *antituberculosis* chemotherapy.
[d] 19 days after the previous radiograph.
[e] Four days after the previous 5 TU test.

TABLE C

HI-1 CONTACTS WITH AN INITIAL INDURATION OF 0-4 MM TO 5 TU WHO DEVELOPED AN ACTIVE TUBERCULOUS LESION DURING THE YEAR (INDEX CASE WAS ONLY SOURCE OF INFECTION IN THE FAMILY INITIALLY)

Registration numbers of contact (T No.) and of index case (A No.)	Sex and age (years)	Radiographic findings (all early normal and important abnormal radiographs)				Tuberculin-test results			Culture results (sputum and laryngeal swab)				Summary
		Interval from date of start of treatment of the index case (mths)	Independent assessment of radiographs			Interval from date of start of treatment of the index case (mths)	Diameter of induration (mm)		Before any chemotherapy for contact [c]		After start of chemotherapy for contact		
			Normal or abnormal [a]	Type of abnormality	Extent (rib interspaces) [b]		5 TU	100 TU	No. positive	No. negative	No. positive	No. negative	
T 3557 (A 39)	Female 3	0	N			0	2	—	0	5	0	9	Progressive primary disease; complete resolution under chemotherapy
		1	N			1 [d]	—	18					
		3	A	Lung lesion	More than 2	3	12	—					
T 4407 (A 110)	Male 4	0	N			0	0	20	0	2	No chemotherapy		Simple primary disease
		3	N			3	0	0					
		4	N			6	0	0					
		6	N			9	7	—					
		9	N										
		11	A	Gland									
T 4408 (A 110)	Male 2	0	N			0	0	7	0	4	No chemotherapy		Progressive primary disease; regressive without chemotherapy; fresh lung lesion
		3	A	Gland and lung lesion	Less than 1	3	7	—					
		3 [e]	I	Gland larger		6	21	—					
		4	M	Gland larger									
		11	I	Fresh lung lesion	1-2								
T 4909 (A 159)	Female 21	0	N			0	0	12	0	3	No chemotherapy		Progressive primary disease
		3	A	Gland and lung lesion	Less than 1	3	14	—					
		7	I	Gland larger		7	15	—					
		9	I	Gland larger		9	33	—					
		12	M	Gland larger									
T 5191 (A 183)	Female 2	0	N			0	0	0	0	0	No chemotherapy		Progressive primary disease
		3	N			3	0	0					
		6	N			6	0	—					
		9	A	Lung lesion	Less than 1	9	0	—					
		10	I	Lung lesion larger	More than 2	10	0	0					
		11	M	Lung lesion larger	More than 2	12	0	0					

TABLE C (concluded)

Registration numbers of contact (T No.) and of index case (A No.)	Sex and age (years)	Radiographic findings (all early normal and important abnormal radiographs)				Tuberculin-test results			Culture results (sputum and laryngeal swab)				Summary
		Interval from date of start of treatment of the index case (mths)	Independent assessment of radiographs			Interval from date of start of treatment of the index case (mths)	Diameter of induration (mm)		Before any chemotherapy for contact [c]		After start of chemotherapy for contact		
			Normal or abnormal [a]	Type of abnormality	Extent (rib interspaces) [b]		5 TU	100 TU	No. positive	No. negative	No. positive	No. negative	
T 5569 (A 210)	Female 3	0	N			0	0	28	0	1	No chemotherapy		Progressive primary disease; regressive without chemotherapy
		3	N			3	18	—					
		6	A	Gland		6	25	—					
		10	M	Lung lesion	More than 2	12	32	—					
T 5883 (A 242)	Male 6	0	N			0	0	4	1	5	No chemotherapy		Pleural effusion; complete resolution without chemotherapy
		1	A	Small pleural effusion		2	0	2					
						3	0	0					
						6	10	—					
						9	0	—					
						12	7	—					
T 5916 (A 245)	Female 1½	0	N			0	3	0	4	1	0	4	Progressive primary disease; regressed under chemotherapy
		3	N			3	15	—					
		4	A	Lung lesion	1-2	6	7	—					
		7	M	Gland and bilateral lung lesions	More than 2								

[a] N = normal ; A = first abnormality ; I = increased or fresh abnormality ; M = maximal abnormality.

[b] For definition, see footnote on page 369.

[c] By chemotherapy is meant *antituberculosis* chemotherapy.

[d] 39 days after the previous 5 TU test.

[e] Seven days after the previous radiograph.

TABLE D

HI-1 CONTACTS WITH AN INITIAL INDURATION OF 5 MM OR MORE TO 5 TU WHO DEVELOPED AN ACTIVE TUBERCULOUS LESION DURING THE YEAR (INDEX CASE WAS ONLY SOURCE OF INFECTION IN THE FAMILY INITIALLY)

Registration numbers of contact (T No.) and of index case (A No.)	Sex and age (years)	Radiographic findings (all early normal and important abnormal radiographs)				Tuberculin-test results			Culture results (sputum and laryngeal swab)				Summary
		Interval from date of start of treatment of the index case (mths)	Independent assessment of radiographs			Interval from date of start of treatment of the index case (mths)	Diameter of induration (mm)		Before any chemotherapy for contact [c]		After start of chemotherapy for contact		
			Normal or abnormal [a]	Type of abnormality	Extent (rib interspaces) [b]		5 TU	100 TU	No. positive	No. negative	No. positive	No. negative	
T 3894 (A 71)	Female 36	0	N			0	17	—	0	0	No chemotherapy		Progressive adult-type disease
		3	N			3	14	—					
		6	N			6	8	—					
		9	A	Lung lesion	Less than 1	9	10	—					
		12	M	Lung lesion larger	Less than 1	12	5	—					
T 5120 (A 180)	Male 1	0	N			0	5	—	0	3	No chemotherapy		Simple primary disease ; regressive without chemotherapy
		3	N			3	0	—					
		6	N			6	0	—					
		9	A	Gland		9	20	—					
T 5190 (A 183)	Female 20	0	N			0	10	—	0	0	No chemotherapy		Progressive adult-type disease
		3	N			3	20	—					
		6	N			12	12	—					
		9	N										
		10	N										
		12	A	Lung lesion	1-2								
T 5221 (A 183)	Female 5	0-12	N (10 films)	See summary		0	9	—	2	9	No chemotherapy		Positive cultures at 3 and 8 months
						3	15	—					
						6	13	—					
						9	15	—					
						12	14	—					
T 5606 (A 220)	Female 2	0	N			0	20	—	0	12	No chemotherapy		Progressive primary disease ; regressive without chemotherapy
		1	N			11	15	—					
		3	N			12	15	—					
		4	N										
		6	N										
		8	A	Gland and lung lesion	Less than 1								
		9	M	Lung lesion larger	1-2								

[a] N = normal ; A = first abnormality ; M = maximal abnormality.
[b] For definition, see footnote on page 369.
[c] By chemotherapy is meant *antituberculosis* chemotherapy.

TABLE E

HI-2 CONTACTS WITH AN INITIAL INDURATION OF 0-4 MM TO 5 TU WHO DEVELOPED AN ACTIVE TUBERCULOUS LESION DURING THE YEAR (INDEX CASE WAS ONLY SOURCE OF INFECTION IN THE FAMILY INITIALLY)

Registration numbers of contact (T No.) and of index case (A No.)	Sex and age (years)	Radiographic findings (all early normal and important abnormal radiographs)				Tuberculin-test results			Culture results (sputum and laryngeal swab)				Summary
		Interval from date of start of treatment of the index case (mths)	Independent assessment of radiographs			Interval from date of start of treatment of the index case (mths)	Diameter of induration (mm)		Before any chemotherapy for contact [c]		After start of chemotherapy for contact		
			Normal or abnormal [a]	Type of abnormality	Extent (rib interspaces) [b]		5 TU	100 TU	No. positive	No. negative	No. positive	No. negative	
T 3903 (A 72)	Male 10/12	0-6	N (10 films)			0	0	0	0	10	No chemotherapy		Progressive primary disease; regressive without chemotherapy
		7	N			1	45	—					
		8	A	Lung lesion	1-2	3	35	—					
T 5732 (A 226)	Male 3	0	N			0	0	0	0	10	No chemotherapy		Progressive primary disease with pleural effusion; regressive without chemotherapy
		1	A	Lung lesion	1-2	2	9	—					
		5	I	Moderate pleural effusion		6	0	—					
		9	I	Fresh lung lesion	1-2	9	7	—					
						12	15	—					
T 5733 (A 226)	Female 10/12	0	N			0	0	0	3	3	0	7	Progressive primary disease; regressed under chemotherapy; positive cultures at 2, 3 and 4 months
		1	N			3	11	—					
		3	N										
		4	A	Lung lesion (see summary)	Less than 1								
		4 [d]	M	Lung lesion larger	Less than 1								

[a] N = normal ; A = first abnormality ; I = increased or fresh abnormality ; M = maximal abnormality.

[b] For definition, see footnote on page 369.

[c] By chemotherapy is meant *antituberculosis* chemotherapy.

[d] 14 days after the previous radiograph.

TABLE F

HI-2 CONTACTS WITH AN INITIAL INDURATION OF 5 MM OR MORE TO 5 TU WHO DEVELOPED AN ACTIVE TUBERCULOUS LESION DURING THE YEAR (INDEX CASE WAS ONLY SOURCE OF INFECTION IN THE FAMILY INITIALLY)

Registration numbers of contact (T No.) and of index case (A No.)	Sex and age (years)	Radiographic findings (all early normal and important abnormal radiographs)				Tuberculin-test results			Culture results (sputum and laryngeal swab)				Summary
		Interval from date of start of treatment of the index case (mths)	Independent assessment of radiographs			Interval from date of start of treatment of the index case (mths)	Diameter of induration (mm)		Before any chemotherapy for contact [c]		After start of chemotherapy for contact		
			Normal or abnormal [a]	Type of abnormality	Extent (rib interspaces) [b]		5 TU	100 TU	No. positive	No. negative	No. positive	No. negative	
T 3181 (A 56)	Female 60	0	N			0	11	—	0	4	No chemotherapy		Progressive adult-type disease ; regressive without chemotherapy
		3	N			3	40	—					
		6	N			10	5	—					
		9	A	Lung lesion	Less than 1								
		10	M	Lung lesion larger and lesion in other lung	Less than 1								
T 4487 (A 121)	Female 19	0	N			0	10	—	0	0	No chemotherapy		Simple primary disease ; calcified without chemotherapy
		3	A	Lung lesion	Less than 1	3	12	—					
						6	13	—					
						12	6	—					
T 5131 (A 179)	Female 9	0	N			0	23	—	0	5	No chemotherapy		Progressive primary disease ; regressive without chemotherapy ; fresh lung lesion
		1	N										
		2	N										
		5	N										
		7	A	Gland and lung lesion	Less than 1								
		8	M	Bilateral glands and bilateral lung lesions	More than 2								
		12	I	Fresh lung lesion	Less than 1								
T 5789 (A 232)	Male 7	0	N			0	10	—	0	3	No chemotherapy		Simple primary disease ; regressive without chemotherapy
		3	A	Gland		3	6	—					
						6	5	—					
						9	25	—					
						12	21	—					

TABLE F (concluded)

Registration numbers of contact (T No.) and of index case (A No.)	Sex and age (years)	Radiographic findings (all early normal and important abnormal radiographs)				Tuberculin-test results			Culture results (sputum and laryngeal swab)				Summary
		Interval from date of start of treatment of the index case (mths)	Independent assessment of radiographs			Interval from date of start of treatment of the index case (mths)	Diameter of induration (mm)		Before any chemotherapy for contact [c]		After start of chemotherapy for contact		
			Normal or abnormal [a]	Type of abnormality	Extent (rib interspaces) [b]		5 TU	100 TU	No. positive	No. negative	No. positive	No. negative	
T 6246 (A 275)	Female 25	0	N			0	7	—	3	2	1	1	Progressive adult-type disease; regressed under chemotherapy
		3	N			3	0	12					
		6	A	Lung lesion	Less than 1	6	18	—					
		9	I	Lung lesion larger	Less than 1	9	13	—					
		11	M	Lung lesion larger	Less than 1								
T 6785 (A 324)	Female 5	0	N			0	8	—	0	4	No chemotherapy		Progressive primary disease
		3	A	Gland		3	15	—					
		12	M	Lung lesion	1-2	6	9	—					
						8	7	—					
						14	5	—					

[a] N = normal ; A = first abnormality ; I = increased or fresh abnormality ; M = maximal abnormality.

[b] For definition, see footnote on page 369.

[c] By chemotherapy is meant *antituberculosis* chemotherapy.

TABLE G

H CONTACTS WITH AN INITIAL INDURATION OF 0-4 MM TO 5 TU WHO DEVELOPED AN ACTIVE TUBERCULOUS LESION DURING THE YEAR (INDEX CASE WAS ONLY SOURCE OF INFECTION IN THE FAMILY INITIALLY)

Registration numbers of contact (T No.) and of index case (A No.)	Sex and age (years)	Radiographic findings (all early normal and important abnormal radiographs)				Tuberculin-test results			Culture results (sputum and laryngeal swab)				Summary
		Interval from date of start of treatment of the index case (mths)	Independent assessment of radiographs			Interval from date of start of treatment of the index case (mths)	Diameter of induration (mm)		Before any chemotherapy for contact [c]		After start of chemotherapy for contact		
			Normal or abnormal [a]	Type of abnormality	Extent (rib interspaces) [b]		5 TU	100 TU	No. positive	No. negative	No. positive	No. negative	
T 6967 (A 335)	Male 9	0	N			0	0	0	0	5	No chemotherapy		Progressive primary disease; regressive without chemotherapy
		3	N			3	22	—					
		3 [d]	A	Gland		9	28	—					
		6	M	Gland and lung lesion	More than 2	12	10	—					

[a] N = normal ; A = first abnormality ; M = maximal abnormality.

[b] For definition, see footnote on page 369.

[c] By chemotherapy is meant *antituberculosis* chemotherapy.

[d] 11 days after the last normal radiograph.

TABLE H

H CONTACTS WITH AN INITIAL INDURATION OF 5 MM OR MORE TO 5 TU WHO DEVELOPED AN ACTIVE TUBERCULOUS LESION DURING THE YEAR (INDEX CASE WAS ONLY SOURCE OF INFECTION IN THE FAMILY INITIALLY)

Registration numbers of contact (T No.) and of index case (A No.)	Sex and age (years)	Radiographic findings (all early normal and important abnormal radiographs)				Tuberculin-test results			Culture results (sputum and laryngeal swab)				Summary
		Interval from date of start of treatment of the index case (mths)	Independent assessment of radiographs			Interval from date of start of treatment of the index case (mths)	Diameter of induration (mm)		Before any chemotherapy for contact [c]		After start of chemotherapy for contact		
			Normal or abnormal [a]	Type of abnormality	Extent (rib interspaces) [b]		5 TU	100 TU	No. positive	No. negative	No. positive	No. negative	
T 3366 (A 20)	Female 23	0	N			0	5	—	0	2	No chemotherapy		Progressive disease; complete resolution without chemotherapy (calcified focus at opposite base throughout)
		3	A	Gland and lung lesion	Less than 1	1	3	—					
		7	M	Lung lesion larger	Less than 1	3	7	—					
						8	8	—					
						10	13	—					
						12	6	—					
T 3784 (A 58)	Male 15	0	N			0	35	—	0	4	No chemotherapy		Pleural effusion; complete resolution without chemotherapy
		3	N										
		4	A	Small pleural effusion									
		5	M	Effusion larger									
T 5547 (A 212)	Male 13	0	N			0	13	—	0	0	No chemotherapy		Simple primary disease
		3	N			6	8	—					
		6	N			9	3	40					
		9	A	Gland		12	13	—					
		12	M	Gland larger									
T 6016 (A 256)	Female 2/12	0	N			0	9	—	1	0	0	9	Miliary tuberculosis; fresh lobar involvement; regressed under chemotherapy
		1	A	Miliary tuberculosis		1 [d]	—	11					
		2	M	Maximal maturation of lesions									
		7	I	Fresh lung lesion	More than 2								
T 6438 (A 288)	Male 8/12	0	N			0	5	6	2	2	0	12	Progressive primary disease; regressed under chemotherapy
		1	A	Lung lesion	More than 2	1	8	14					
		1 [e]	I	Lung lesion larger	More than 2	12	6	—					
		4	M	Lung lesion larger and gland	More than 2								
T 6448 (A 295)	Male 3	0-3	A (6 films)	Foreign body and residual changes		0	8	—	0	10	No chemotherapy		Progressive primary disease; regressive without chemotherapy
						3	6	—					
		3 [f]	I	Lung lesion and bilateral glands	More than 2	6	11	—					
						9	23	—					
						12	18	—					

[a] N = normal ; A = first abnormality ; I = increased or fresh abnormality ; M = maximal abnormality.
[b] For definition, see footnote on page 369.
[c] By chemotherapy is meant *antituberculosis* chemotherapy.
[d] 45 days after the previous 5 TU test.
[e] Seven days after the previous radiograph.
[f] 14 days after the previous radiograph.

TABLE I

CONTACTS WHO DEVELOPED AN ACTIVE TUBERCULOUS LESION DURING THE YEAR, BUT WHO WERE IN CONTACT WITH ANOTHER SOURCE OF INFECTION IN THE FAMILY INITIALLY

Registration numbers of contact (T No.) and of index case (A No.)	Sex and age (years)	Radiographic findings (all early normal and important abnormal radiographs)				Tuberculin-test results			Culture results (sputum and laryngeal swab)				Summary
		Interval from date of start of treatment of the index case (mths)	Independent assessment of radiographs			Interval from date of start of treatment of the index case (mths)	Diameter of induration (mm)		Before any chemotherapy for contact [c]		After start of chemotherapy for contact		
			Normal or abnormal [a]	Type of abnormality	Extent (rib interspaces) [b]		5 TU	100 TU	No. positive	No. negative	No. positive	No. negative	
T 4128 (A 95) (PH series)	Female 3	0	N			0	0	0	0	0	No chemotherapy		Simple primary disease; complete resolution without chemotherapy
		3	A	Gland		3	5	—					
						6	0	0					
						9	0	0					
						12	0	—					
T 4451 (A 116) (PH series)	Female 3	0	N			0	15	—	0	3	No chemotherapy		Simple primary disease
		3	N			3	10	—					
		6	N			6	16	—					
		10	N			10	14	—					
		12	A	Gland									
T 5614 (A 218) (PH series)	Female 3	0	N			0	0	17	0	11	No chemotherapy		Progressive primary disease
		1	A	Gland and lung lesion	1-2	3	5	—					
		5	I	Lung lesion larger	More than 2	5	18	—					
		7	I	Lung lesion larger	More than 2	6	22	—					
		9	I	Lung lesion larger	More than 2	12	14	—					
		12	M	Lung lesion larger	More than 2								
T 5974 (A 254) (HI-2 series)	Male 25	0	N			0	7	—	0	0	No chemotherapy		Progressive adult-type disease
		4	N			7	10	—					
		7	N			9	9	—					
		9	A	Lung lesion	Less than 1	12	10	—					
		12	M	Lung lesion larger	1-2								
T 3457 (A 27) (H series)	Male 2½	0	N			0	12	—	0	5	No chemotherapy		Progressive primary disease; regressive without chemotherapy
		3	A	Gland and lung lesion	Less than 1	3	6	—					
		5	M	Gland larger		4	28	—					
		10	I	Fresh lung lesion	Less than 1	12	22	—					
T 6104 (A 260) (H series)	Female 4/12	0	N			0	2	—	0	3	1	10	Miliary tuberculosis; complete resolution under chemotherapy
		2	A	Miliary tuberculosis and bilateral glands		2	4	18					
		4	M	Maximal maturation									

[a] N = normal ; A = first abnormality ; I = increased or fresh abnormality ; M = maximal abnormality.
[b] For definition, see footnote on page 369.
[c] By chemotherapy is meant *antituberculosis* chemotherapy.

TABLE J

INDURATION TO THE INITIAL 5 TU TEST RELATED TO INDURATION TO THE LATEST 5 TU TEST DURING THE YEAR IN THE PH CONTACTS

Diameter of induration to the initial 5 TU test (mm)	Diameter of induration to the latest 5 TU test during the year (mm)																															Total
	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30 or more	
0	25	—	2	1	2	2	1	1	—	1	2	1	2	—	1	1	3	1	1	—	—	—	1	—	—	—	—	—	2	1	2	53
1	1	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	2
2	3	—	—	1	—	1	1	—	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	7
3	—	—	—	1	—	1	1	—	—	—	—	—	—	—	—	—	1	—	—	—	—	—	—	—	—	—	—	—	—	—	1	5
4	2	—	—	—	—	1	—	—	—	—	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	4
5	2	—	—	—	—	5	2	1	—	1	—	1	—	—	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	13
6	1	—	1	—	1	2	—	1	2	2	2	2	—	—	1	1	1	—	—	—	—	—	2	—	—	1	—	—	—	—	2	22
7	—	—	—	—	—	1	1	—	1	1	—	1	—	—	1	1	—	—	—	—	1	—	—	1	—	—	—	—	—	—	1	10
8	—	—	—	—	—	—	—	1	1	1	1	2	—	—	1	—	—	—	—	—	4	—	1	—	1	—	—	—	—	—	—	13
9	—	—	—	—	—	—	1	—	—	1	—	1	2	—	—	—	—	—	—	1	—	—	1	—	—	1	—	—	—	—	—	8
10	2	—	—	—	—	—	—	—	1	2	1	1	1	1	—	3	—	—	—	—	1	—	1	—	—	—	—	—	—	—	—	14
11	—	—	—	—	—	—	—	1	—	1	—	—	—	—	—	—	—	—	—	—	—	—	1	—	—	1	—	—	—	—	1	5
12	—	—	1	1	—	—	—	—	1	2	3	—	—	1	—	—	—	—	—	—	1	—	—	—	—	—	1	—	—	1	2	14
13	—	—	—	—	—	—	—	—	—	—	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	1	2
14	—	—	—	—	—	—	—	—	—	—	—	—	1	—	—	1	1	1	1	—	—	—	—	—	—	—	—	—	—	—	1	6
15	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	1	1	2	—	—	2	—	—	—	—	1	7
16	—	—	—	—	—	—	—	—	—	—	—	—	1	—	—	—	—	—	—	—	—	—	—	—	—	1	1	—	—	—	—	3
17	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	1	—	—	1	—	—	—	—	—	—	—	—	—	—	1	3
18	—	—	—	—	—	—	—	—	—	1	—	—	—	1	—	—	—	—	—	—	—	—	—	—	—	1	—	—	—	—	—	3
19	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	1
20	—	—	—	—	—	—	—	—	—	—	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	1	—	—	—	2
21	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	1	—	—	—	—	—	—	—	—	—	—	1
22	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	1	—	—	—	—	—	1
23	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	1	—	—	—	—	—	—	—	—	—	—	—	—	1
25	—	—	—	—	—	—	—	—	—	—	—	—	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	1
26	—	—	—	—	—	—	—	—	—	—	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	1
30 or more	—	—	—	—	—	—	—	—	1	—	—	1	—	—	—	—	—	—	—	—	—	—	2	—	—	—	—	—	—	—	1	5
Total	36	1	4	4	3	13	7	5	8	13	13	10	8	3	5	8	7	2	3	2	9	1	11	1	1	8	2	1	2	2	14	207

TABLE K

INDURATION TO THE INITIAL 5 TU TEST RELATED TO INDURATION TO THE LATEST 5 TU TEST DURING THE YEAR IN THE HI-1 CONTACTS

Diameter of induration to the initial 5 TU test (mm)	Diameter of induration to the latest 5 TU test during the year (mm)																																
	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30 or more	Total
0	15	—	2	—	1	3	—	2	2	1	—	—	—	—	—	1	—	—	—	—	1	1	—	1	1	—	—	—	—	—	2	33
1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
2	2	—	—	—	1	—	—	—	—	1	—	—	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	5
3	1	—	—	—	—	1	1	1	—	—	—	—	—	—	—	—	—	—	—	1	1	—	—	—	—	—	—	—	—	—	—	6
4	2	—	—	1	—	3	—	—	—	1	—	—	—	—	—	—	—	—	—	—	—	—	1	—	—	—	—	—	—	—	—	8
5	—	—	—	—	1	2	—	—	—	—	—	—	—	—	—	1	—	—	—	—	2	—	—	—	—	—	1	—	—	—	1	8
6	2	—	—	—	1	—	2	—	1	—	1	1	1	—	—	—	—	—	—	—	1	—	—	2	—	—	—	—	1	—	2	15
7	1	—	—	—	1	1	2	2	—	—	3	1	—	1	—	—	—	—	—	—	1	2	—	—	—	—	—	—	1	—	2	18
8	—	—	—	—	—	1	—	1	—	1	1	—	1	—	—	—	—	—	—	—	2	1	1	—	2	1	—	—	1	—	—	13
9	1	—	—	—	—	1	—	—	—	—	2	—	—	—	2	—	—	—	1	—	1	2	1	—	—	—	—	—	—	—	—	11
10	—	—	—	—	—	—	1	—	—	—	1	2	4	—	1	—	2	1	—	—	1	—	—	1	—	1	—	—	1	—	3	19
11	—	—	—	—	—	—	—	—	1	1	—	—	1	1	—	—	1	—	—	1	—	—	1	—	—	1	—	—	—	—	—	8
12	1	—	—	—	—	1	1	—	—	—	2	1	—	—	—	1	1	—	—	—	—	—	1	—	—	—	—	1	—	—	—	10
13	—	—	—	—	—	—	1	—	—	—	—	—	1	—	—	1	—	—	—	—	—	—	—	—	1	—	—	—	—	—	—	4
14	—	—	—	—	—	—	—	—	—	—	—	—	2	—	—	—	1	—	—	—	—	1	—	—	—	—	—	—	—	—	—	4
15	—	—	—	—	—	—	1	—	—	1	—	—	—	1	—	2	—	—	—	—	1	—	—	—	—	—	—	—	—	—	1	7
16	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	1	—	—	—	—	—	—	—	—	—	1
17	—	—	—	—	—	1	—	—	—	—	—	—	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	2
18	—	—	—	—	—	—	—	—	—	—	—	—	1	—	—	—	—	—	—	—	1	—	—	—	—	—	—	—	—	—	—	2
19	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
20	—	—	—	—	—	—	1	—	—	—	—	—	1	1	—	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	4
21	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	1	—	—	—	—	—	—	1	—	—	—	—	—	—	—	—	2
22	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	1	—	—	—	—	—	1
25	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	1	1
30 or more	—	—	—	—	—	—	—	1	—	—	—	—	—	—	—	—	2	—	1	—	1	—	—	—	—	—	—	—	—	—	1	6
Total	25	—	2	1	5	14	10	7	4	6	10	5	14	4	3	8	7	1	2	2	13	8	6	4	4	4	1	1	4	—	13	188

TABLE L

INDURATION TO THE INITIAL 5 TU TEST RELATED TO INDURATION TO THE LATEST 5 TU TEST DURING THE YEAR IN THE HI-2 CONTACTS

Diameter of induration to the initial 5 TU test (mm)	Diameter of induration to the latest 5 TU test during the year (mm)																															
	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30 or more	Total
0	18	—	1	1	—	2	2	2	1	—	—	2	2	—	—	1	1	1	—	—	3	—	—	—	1	1	—	—	—	—	1	40
1	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	1
2	5	—	—	—	—	—	—	—	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	1	—	—	—	—	7
3	1	—	—	—	—	—	—	—	—	—	2	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	3
4	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	2
5	2	—	—	1	—	—	2	1	—	—	1	1	—	—	—	—	1	—	—	—	—	—	—	—	1	1	—	—	—	—	—	11
6	—	—	1	—	—	2	—	1	—	1	—	1	2	3	—	1	—	—	—	—	1	—	1	—	—	—	—	—	—	—	1	15
7	2	—	—	—	—	—	1	2	—	—	1	1	1	2	—	—	—	—	1	—	1	—	—	—	—	1	—	1	—	—	1	15
8	—	—	—	—	—	2	4	2	2	—	2	—	2	1	—	—	—	—	—	—	1	—	—	—	—	1	1	—	—	—	—	18
9	—	—	—	—	—	—	—	1	—	—	3	—	1	—	—	—	1	—	—	1	1	—	—	—	—	—	—	—	—	—	—	8
10	1	—	—	1	—	—	2	1	1	—	1	2	—	1	—	—	1	—	—	—	—	1	—	—	1	—	—	—	—	—	—	13
11	—	—	—	—	—	1	—	—	—	—	1	—	1	1	—	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	1	6
12	—	—	—	2	—	—	—	—	1	1	—	—	—	—	—	2	—	—	—	—	1	—	—	—	—	—	—	—	—	—	—	7
13	—	—	—	—	—	—	—	—	—	—	—	—	—	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	2	3
14	—	—	—	—	—	—	—	—	—	—	1	—	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	1	3
15	—	—	—	—	—	—	—	—	—	2	—	—	—	1	—	—	1	1	—	—	—	—	—	—	—	—	—	—	—	—	2	7
16	—	—	—	—	—	—	—	—	1	1	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	3
17	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
18	—	—	—	—	—	—	—	—	—	—	—	1	—	—	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	1	3
19	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
20	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	1	—	1	—	—	—	—	—	—	—	—	2
23	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	1	—	—	1
26	—	—	—	—	—	—	—	—	—	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	1
28	—	—	—	—	—	—	—	—	—	—	—	—	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	1
30 or more	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	2	2
Total	31	—	2	5	—	7	11	10	7	6	13	8	11	10	1	5	6	2	1	1	9	1	2	—	3	4	2	1	1	—	12	172

TABLE M

INDURATION TO THE INITIAL 5 TU TEST RELATED TO INDURATION TO THE LATEST 5 TU TEST DURING THE YEAR IN THE H CONTACTS

Diameter of induration to the initial 5 TU test (mm)	Diameter of induration to the latest 5 TU test during the year (mm)																															
	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30 or more	Total
0	19	—	2	—	—	3	1	—	2	—	3	—	1	—	—	1	—	—	—	—	—	—	—	—	—	1	—	—	—	—	1	34
1	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	2
2	2	—	—	—	—	—	—	—	—	1	—	—	—	—	—	—	—	—	—	—	1	1	—	—	—	—	—	—	—	—	—	5
3	3	—	—	—	—	1	1	—	—	1	—	—	—	—	—	—	—	—	1	—	2	—	—	—	—	—	—	—	—	—	—	9
4	2	—	—	—	—	—	—	—	1	—	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	4
5	2	—	—	—	1	3	3	—	1	1	1	—	—	—	1	—	1	—	—	—	2	—	1	—	—	1	—	—	—	—	2	20
6	1	—	1	—	—	1	2	—	1	—	1	—	—	—	—	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	2	10
7	1	—	—	1	—	2	2	1	—	1	2	—	—	—	2	1	1	—	—	—	2	—	—	—	—	—	—	1	—	—	3	20
8	—	—	—	—	—	1	—	—	—	1	2	—	—	1	1	—	—	1	1	—	1	—	1	1	—	—	—	—	—	—	—	11
9	—	—	—	—	—	—	—	—	2	—	2	—	1	—	2	—	1	—	—	—	—	—	—	—	—	—	—	—	—	—	1	9
10	—	—	—	—	1	—	2	—	1	—	3	1	2	3	1	1	—	—	1	—	2	—	1	—	1	—	—	—	—	—	1	21
11	—	—	—	—	—	—	—	—	—	—	1	—	2	—	1	1	—	—	2	—	—	—	—	—	—	—	—	—	—	—	1	8
12	—	—	—	—	—	—	—	2	3	1	1	—	—	1	2	—	—	—	—	—	1	—	1	—	—	—	—	—	—	—	1	13
13	—	—	1	—	—	—	1	—	—	—	1	—	—	1	—	—	—	—	1	—	—	—	—	—	—	—	—	—	—	—	—	5
14	—	—	—	—	—	—	—	—	2	1	1	1	—	—	—	—	—	—	—	—	—	—	1	—	—	—	—	—	—	—	—	6
15	—	—	—	—	—	—	—	1	—	—	1	—	2	—	1	—	—	—	—	—	—	—	1	—	1	1	—	—	—	—	1	9
16	—	—	—	—	—	—	—	—	—	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	1	2
17	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	1	—	—	—	—	—	—	—	—	1
18	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	1	—	—	—	—	—	—	—	—	—	1	—	—	—	—	—	2
19	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	1	—	—	—	—	—	—	—	—	1
20	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	1	—	—	—	—	—	—	—	—	—	—	—	1	2
22	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	1	—	—	1	—	—	—	—	—	—	—	—	2
25	—	—	—	—	—	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	1
30 or more	—	—	—	—	—	—	—	—	—	—	—	—	1	—	—	—	—	—	—	—	—	1	—	—	—	—	—	—	—	—	1	3
Total	31	—	4	1	2	12	12	4	13	8	20	2	9	6	11	6	4	1	7	1	11	2	9	1	2	4	—	1	—	—	16	200