The
Indian Journal of Tuberculosis

Vol. X New Delhi, June, 1963 No. 3

DIPLOMA COURSES IN TUBERCULOSIS

It is generally accepted that considerable advances have taken place in recent years in the field of medicine and public health and in some respects these are even revolutionary. The question whether these revolutionary ideas have been reflected in the actual teaching of medicine especially in the field of post-graduate education in tuberculosis is doubtful.

Being aware of this the Tuberculosis Association of India had constituted a sub-committee in 1958 to examine whether the present post-graduate courses in India (TDD/DTD) are adequate or need any changes so as to fit into the present day trends of anti-tuberculosis work. Their investigation has revealed that these courses are getting less and less popular, and some of the reasons for this seem to be that the tuberculosis specialists' field is gradually getting less and less and the treatment of tuberculosis is passing into the hands of the general practitioner, especially because of the advent and extensive use of anti-bacterial drugs by all medical practitioners. There is also a tendency on the part of the doctors to avoid taking diploma in tuberculosis as some of them feel that this may prove to be a hindrance for their branching out into wider fields of remunerative practice.

The question has now to be seriously asked, whether the need for these diploma courses still continues. To this it may be said that if there was a need for specialisation some years ago, it is more now, especially because of the advances in our knowledge. What is needed is not the abandonment of specialisation, but to bring into the specialisation, a teaching programme that will reflect not only the advances in knowledge, but also the revolutionary ideas concerning tuberculosis control.

Till recently our approach to tuberculosis was mainly centred round the individual patient, his proper diagnosis and treatment, while the community aspects of control involving the preventive, epidemiological and social aspects were relegated to the background. From the historical point of view these defects could not be easily avoided, as most of the TDD/DTD courses in India were organised or centred round a clinician of repute associated with the university instituting the diploma course, with very few additional persons taking any real interest in the course. This naturally resulted in a tendency for the training programme to be dominated by the clinical approach. What is needed now is a complete re-orientation of the syllabus of the diploma courses. This has to be prepared by a committee of experts consisting of clinicians, epidemiologists, statisticians, public health administrators, pathologists and bacteriologists with special interest in tuberculosis. The teaching programme should not be centred merely round a hospital or a sanatorium, but should be associated with a well-run tuberculosis control centre which is engaged not only in clinical work but also in epidemiological and sociological studies associated with tuberculosis control in the community. It must be admitted that such centres are few in India at present but it is an obligation on the part of the university and the government which undertake a teaching programme to have one or more centres of this type for practical demonstration to the candidates who study for these diplomas. A beginning in this line has been made on a comprehensive basis at the National Tuberculosis Institute in Bangalore. Field studies in tuberculosis control measures have been in progress at Madanapalle for many years. A well organised domiciliary treatment programme for an urban area is being implemented by the New Delhi Tuberculosis Centre. Similar centres should be developed within easy reach of each post-graduate teaching centre. Till such centres are developed one possibility is for the various units at present giving diploma courses to depute their candidates to the existing centres for a period of at least two months, preferably during the latter part of their course. It should be possible to make the necessary adjustments for this at these centres by mutual discussion between the authorities who run these. Without some such reorganisation the efforts put in for these courses will be largely wasted.

TUBERCULOSIS PREVALENCE SURVEY IN TUMKUR DISTRICT

RAJ NARAIN[1], A. GESER[2], M. V. JAMBUNATHAN[3] AND M. SUBRAMANIAN[4]

Introduction

Tumkur District in Mysore State was selected for running pilot control programmes and for evolving standard procedures in the field as well as in the laboratory. A survey was carried out to provide data for planning and assessment of the Control Programmes. The Sample Survey of Tuberculosis in India, Indian Council of Medical Research (1959), referred to hereafter as NTSS, was the first national effort to estimate prevalence rates applicable to different cross sections of the country. This report (Page 54) also states, 'while the figures are able to give an overall idea of the conditions prevalent in each zone, they would not necessarily represent conditions prevalent in limited areas in each zone. Specific control measures for such areas would normally call for more detailed information than can be provided by this survey'. The present survey contributes its mite towards that end.

This survey was carried out during 1960-61 to collect baseline information on the prevalence of infection and radiological and bacteriological cases, in the form of age and sex specific prevalence rates. Further information necessary for a control programme are incidence rates of infection, and of various categories of disease among different groups of people. These could have been collected by a longitudinal survey, but would have entailed a much longer time and a much bigger organization than was available at the time.

2. Objectives

The objectives of the survey were to establish for rural and semi-urban areas of Tumkur district (excluding Tumkur town) the following:

1. Age and sex prevalence rates of tuberculous infection;
2. Age and sex prevalence rates of radiologically active tuberculous disease;
3. Age and sex prevalence rates of bacteriologically confirmed tuberculous disease ;
4. Age and sex prevalence of symptoms suggestive of tuberculosis and
5. A correlation between various prevalence rates.

The findings in respect of objective 4 will be dealt with later in a separate paper.

3. Details of the survey

3.1 Study area and population

Tumkur district is situated in the centre of Mysore State, contiguous to Bangalore district. The district headquarter town, viz., Tumkur is on the national highway to Bombay and is 43 miles north-west of Bangalore, the capital of Mysore State. The district has 10 taluks, northernmost taluk Pavagada being completely separated from the rest of the district by parts of Andhra Pradesh. Besides Tumkur, there are 10 municipal towns and 2392 villages in the district. The area of the district is 4091 square miles with an average density of population of 334 persons per square mile (1961 Census). The average altitude is 2,700 ft. above sea-level, and the climate is salubrious throughout the year.

The 1960 population of the district was estimated on the basis of 25 per cent increase in towns and 12.5 per cent increase in the rural population over the corresponding 1951 census figures. The 1951 census figures, the estimated population for 1960 and the actual 1961 census

[1] Epidemiologist, National Tuberculosis Institute, till May 1962; at present, Director, National Tuberculosis Institute.

[2] WHO Epidemiologist, National Tuberculosis Institute, till July 1961; at present, on WHO assignment to Cyprus.

[3] Senior Statistical Officer, National Tuberculosis Institute, till July 1962; at present Professor of Statistics, Karnatak University, Dharwar, India.

[4] Statistical Assistant, National Tuberculosis Institute, till July 1962; at present with Health Statistics Unit, World Health Organisation, South East Asian Regional Offices, New Delhi.

figures (obtained subsequent to the survey) are as follows:

Population of	1951 Census	Estimate of population in 1960	1961 Census
District	1,151,694	...	1,366,722
Rural areas (2392 villages) ...	1,045,797	1,175,000	1,227,392
The 10 towns	69,812	88,000	91,893
Tumkur town	36,085	...	47,437

A sample of 30,000 persons was considered operationally convenient and within the facilities then available and was believed to be able to give sufficient accuracy for the purpose of planning control programmes and their assessment.

The 10 municipal towns and the 2392 villages were treated separately and approximately 3 per cent population in each was included in the sample. The district headquarter Tumkur was excluded.

The sample for the towns was selected in a three-stage sampling as four groups of 525 people each. Four towns were selected at random from amongst the 10 municipal towns without excluding the possibility of selecting the same town more than once. One of the administrative sections of the selected town was chosen at random giving weights to the different sections according to the size of the population. Using the household schedules of a recently conducted municipal census one household in the selected section was randomly chosen. With this household as starting point, the census was carried out following the numerical order of the households until 525 people were registered.

From the inhabited villages as given in the 1951 census handbook, 63 villages were selected as a- simple random sample. Together with the four town blocks, there were 67 units in all, and these constitute the study population. Each one of these units was called a group. One village with a 1951 population of 9 was found depopulated and was excluded. Figure 1 is a map of the district showing the taluks and the location of various groups surveyed.

3.2 Methods

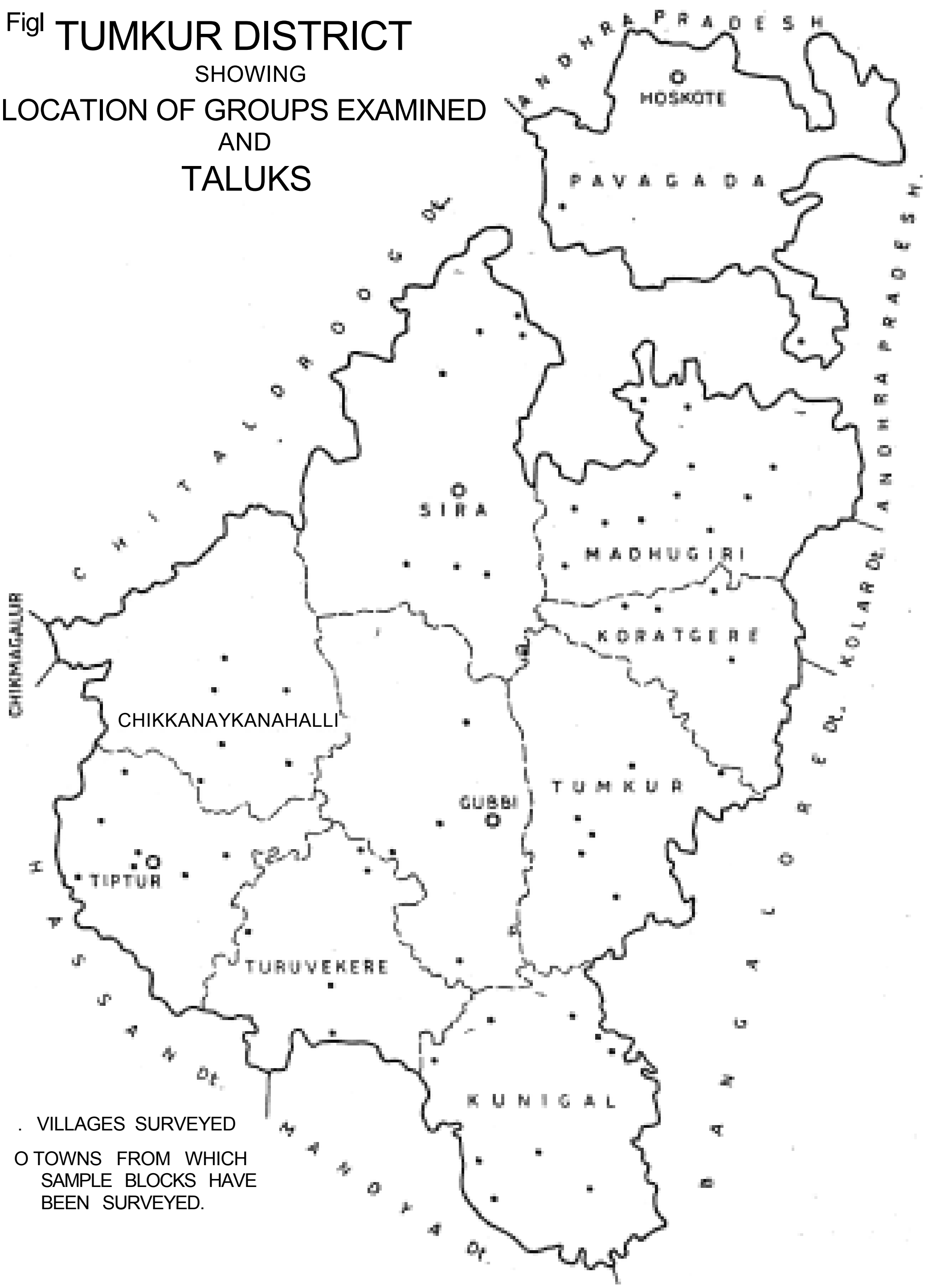
Co-operation of local officers of the district was secured by addressing one of their routine meetings under the presidentship of the Deputy Commissioner. The District Medical Officer and the staff of the National Tuberculosis Institute, explained in detail the necessity for and the requirements of the survey.

Before the actual commencement of the survey of any village, a preparatory visit was made by the Planner-Organiser, and/or the Medical Officer—Field Teams, accompanied by either of the two team leaders (see Appendix I). A meeting of the inhabitants was convened with the help of the village headman (Shanbhogue or Patel). The objectives and the procedure of the survey and the part to be played by the villagers were explained. The date and time of starting was settled in consultation with them.

In each of the 62 villages, every house was numbered. A map of the village showing the number and location of each house was prepared. A census of the total population of the village was taken by a house-to-house visit by the census takers of the field team. A similar procedure was adopted in each of the four town blocks. For each individual in the 66 groups a card was prepared giving information regarding group number, individual number, name, age, sex, father's name or husband's name, household number and relation to the head of the household. All the persons normally resident in the village (permanent residents), whether present at the time of registration or temporarily absent as well as visitors temporarily present in the village were included in the census and registered. Definitions of terms are given in Appendix II.

All the available individuals in the registered population were given a Mantoux test with 0.1 c.c. of 1 TU RT 23 with $0.05°/_{00}$ tween 80 on the mid-volar surface of left forearm. Before giving the test, both deltoid regions were examined for the presence of a previous BCG scar, definite or doubtful, and the findings recorded on the individual cards. Three to four days after the test, the longitudinal diameter of induration of the tuberculin test was measured and recorded in millimetres.* At the

* Longitudinal diameter of induration was measured because of the considerably greater support provided by the length of the volar aspect of the forearm to the transparent scale which, when held by one hand, shakes much less than when similarly held along the breadth of the forearm.



Figl TUMKUR DISTRICT SHOWING LOCATION OF GROUPS EXAMINED AND TALUKS

. VILLAGES SURVEYED

O TOWNS FROM WHICH SAMPLE BLOCKS HAVE BEEN SURVEYED.

time of measurement, the reader had no knowledge of the presence or absence of previous BCG scar in the examinee (vide infra).

At the time of the tuberculin test, all individuals 10 years of age or above were offered a single 70 mm. photo-fluorogram by a mobile X-ray unit temporarily stationed at a convenient place in the village.

No village included in the random sample was given up because it was inaccessible. This was possible not only because of more mobile and lighter X-ray units than were available for the NTSS but also due to a daring use of vehicles for reaching the village sometimes through knee-deep water and sometimes on non-existent tracts. Some villages completely inaccessible during the monsoons were surveyed after the rains, the teams being kept busy in other villages in the meantime.

The X-ray films were developed in the NTI and read by two X-ray readers independently. Any X-ray picture found abnormal was categorised according to a classification based mainly on the one used in NTSS (Appendix III). For each picture read as abnormal, including non-tubercular pathology and for each technically inadequate picture, for which another X-ray picture could not be repeated, a 'spot' specimen of sputum of the individual concerned was collected at the time of tuberculin test reading. Persons who could not be X-rayed due to physical disability or other reasons were also eligible for sputum examination. To avoid any possible bias, care was taken to see that the tuberculin test reader did not know before the actual reading of the test, whether a particular individual had been marked for sputum collection or not. In fact, all cards were handled, not by the tuberculin test reader, but by the laboratory technician acting as the secretary. It was only after recording of the tuberculin reading of all the tested persons present in the house that sputum of any eligible individuals of the house was collected. All sputum samples were brought to the NTI, cooled by ice in the containers (no cooling in winter months), and were stored in a refrigerator before being sent to the Union Mission Tuberculosis Sanatorium, Arogyavaram (UMTS) for a direct smear and a culture examination as the NTI laboratory did not start functioning till some time after the survey.

To suit the convenience of the examinees, most of whom would be away in the fields or at work during the day, examinations were carried out mostly late in the evenings, but sometimes also early in the mornings. This naturally meant hard work at odd hours for the survey teams.

3.3 Staff and time taken

The survey was carried out by two teams, each with its own complement of census takers, testers, readers, laboratory and X-ray technicians, mobile X-ray unit, transport and other staff and working in different areas (Appendix I).

The survey was started on 23rd August 1960, with testing and X-ray examination, while tuberculin test reading and collection of sputa in the last village was completed on 6th February 1961.

3.4 Population surveyed

In the 66 groups, a total of 34,746 persons were registered, 17,652 males and 17,094 females (Table 1). This includes 2779 temporarily absent and 1589 temporarily present. The defacto population, i.e., the permanent residents and those temporarily present total 31,967. The results presented in this paper refer only to the defacto population in the sample groups. Age distribution by sex of the defacto population is given in Table 2 and Fig. 2. The distribution of the 1951 population of the district (by age and sex) was drawn from the

TABLE 1

Sex distribution of the registered population by various categories

	Males	Females	Total
Permanent residents (present)	15,684	14,694	30,378
Temporarily present (T.P.)	599	990	1,589
Total Defacto population	16,283	15,684	31,967
Temporarily absent (T.A.)	1,369	1,410	2,779
Total Registered population	17,652	17,094	34,746

TABLE 2

Age-sex distribution of the defacto† population

Age	Defacto population		Distribution per 1 ,000 persons	
	Male	Female	Male	Female
0 - 9	4584	4643	143	145
10-19	3562	3140	111	98
20-29	2512	2924	79	92
30-39	2071	1831	65	57
40-49	1463	1348	46	42
50- 59	1123	1039	35	33
60+	959	756	30	24
Total	16274	15681	...	...

† Excludes 12 persons whose ages had not been mentioned. These persons could not be contacted; nor was any examination carried out for them.

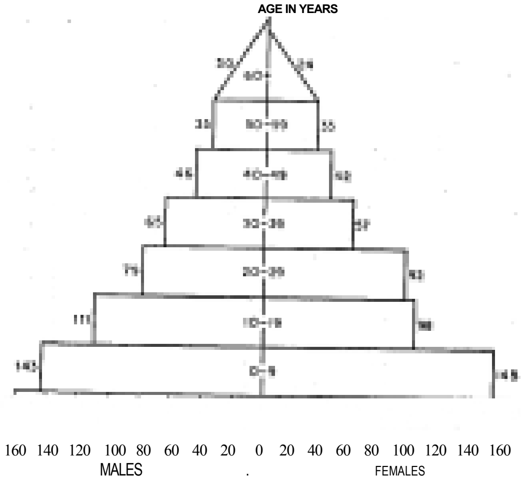
TABLE 3

Coverages for various examinations

	No	Percentage of defacto population	Percentage of eligible
Defacto population ...	31967	100.0	...
Tested ...	30431	95.2	95.2
Read ...	28994	90.7	95.3
Eligible for X-ray ...	22740	71.7	...
X-rayed ...	21021	65.8	92.4
Eligible for sputum examination ...	2441	7.6	...
Persons sputum examined	2333	7.3	95.5

FC.Z.AGE PYRAMID OF OEFACTO POPULATION SURVEYED IN TUMKUR DISTRICT

AGE IN YEARS



figures in District Census Handbook (1951) and on comparison, no appreciable difference between these two distributions was noticeable.

3.5 Coverages

The coverages of the defacto population obtained in respect of the various stages of the survey are given in Table 3. Coverages vary from 92 per cent to 95 per cent of the eligibles.

3.6 Comparison with NTSS

The general procedures adopted in the present survey were more or less the same as in the NTSS except for the following differences:

1. A tuberculin test was offered to all in the sample.
2. Sampling technique was different. Villages and towns were selected at random from the entire district without any stratification according to size. The sampling ratio was 2.8 per cent as compared to about 0.2 per cent of the eligible population in the NTSS.
3. No village included in the random sample was given up because it was 'inaccessible'.
4. Towns or villages of the size 5,000-10,000 were excluded in the NTSS but not from the present survey. However, the headquarter town, Tumkur, was excluded.
5. As the present survey was for mainly control purposes, only persons 10 years of age and above were eligible for the X-ray examination. In the NTSS all persons 5 years of age and above were eligible for such an examination.
6. In the present survey a spot sample of sputum was examined by one direct smear for microscopy and a culture after homogenisation and centrifuging, while in the NTSS from each eligible person, two laryngeal swab cultures and if sputum was available

two direct smears for microscopy and two sputum swab cultures were obtained.

4. Results of tuberculin tests

4.1 Tuberculin reactions

Distributions of tuberculin reactions by millimetre size in eleven age groups, separately for males and females, among those without any previous BCG scars are given in Tables 4, 5. The frequency of bigger reactions as also of intermediate reactions increases in each succeeding age group. Histograms for tuberculin reactions in different age groups for the two sexes among those with no evidence of previous vaccination are shown in Fig. 3. The five year age groups in this figure do not show a clear line of demarcation between what may be called positive and negative reactors. In Fig. 4 distributions of reactions for each of the age groups 0-9 and 0-14 are shown. The distributions are what is usually called 'bimodal' with one mode near 0 mm. and the other between 22-24 mm. In age group 0-9 the 'line' of separation into unimodal distributions

TABLE 4

Distribution of persons without previous BCG scars by each millimetre of tuberculin induration in various age groups

MALES

Size of Tuberculin induration \ Age Group	0-4	5-9	10-14	15-19	20-24	25-29	30-34	35-39	40-44	45-49	50+	Total
0	1,394	718	324	124	108	99	72	69	58	74	267	3,307
1	313	158	63	14	8	5	4	2	3	6	2	578
2	235	278	166	55	32	27	20	8	13	7	24	865
3	90	151	114	60	36	29	21	19	11	9	31	571
4	30	90	92	42	51	32	27	11	9	13	26	423
5	4	38	43	39	29	29	11	7	11	12	32	255
6	12	42	54	41	41	52	24	23	13	12	41	355
7	5	27	48	43	38	48	44	23	16	21	57	370
8	4	14	35	35	34	41	23	25	19	16	50	296
9	2	3	18	30	38	33	27	19	4	24	49	247
10	3	5	14	27	33	31	27	28	11	15	47	241
11	2	3	18	25	30	36	34	32	20	19	67	286
12	2	11	15	23	40	47	44	41	22	30	88	363
13	1	8	16	19	28	40	42	39	17	27	64	301
14	2	9	17	24	33	47	42	35	22	27	82	340
15	1	7	15	16	43	63	55	35	33	40	72	380
16	3	11	24	19	37	70	57	57	34	39	99	450
17	6	7	13	22	39	53	57	56	35	35	91	414
18	5	12	29	25	46	46	43	49	45	48	78	426
19	5	13	18	29	35	37	35	32	26	27	47	304
20	6	21	19	26	34	36	39	31	23	25	59	319
21	5	11	34	27	37	36	41	34	23	33	80	361
22	5	29	34	20	22	23	28	24	23	22	63	293
23	5	15	30	18	23	17	14	25	8	18	39	212
24	4	22	31	10	14	23	24	23	20	14	39	224
25	—	13	18	16	8	11	12	12	11	12	25	138
26	2	17	17	9	9	9	7	11	9	5	46	141
27	1	8	18	13	7	2	5	8	6	3	16	87
28	1	7	15	5	1	5	5	3	7	—	15	64
29	1	3	5	7	3	5	1	2	2	2	12	43
30*	—	3	14	—	2	5	5	5	3	4	17	58
Total	2,149	1,754	1,371	863	939	1,037	890	788	557	639	1,725	12,712

* 16 persons for whom the presence or absence of a BCG scar was not stated have been excluded from Tables 4, 5, 10 and 11.

TABLE 5

Distribution of persons without previous BCG scars by each millimetre of tuberculin induration in various age groups

FEMALES

Size of tuberculin induration / Age Group	0-4	5-9	10-14	15-19	20-24	25-29	30-34	35-39	40-44	45-49	50*	Total
0	1,413	799	354	184	221	210	155	114	92	113	377	4032
1	284	190	64	35	33	13	14	7	4	8	13	665
2	244	304	179	87	113	78	41	28	20	27	52	1173
3	83	161	135	83	95	82	41	40	31	22	42	815
4	29	79	94	68	76	75	39	32	28	16	40	576
5	6	35	56	53	52	52	25	16	19	15	29	358
6	5	31	60	41	66	52	30	29	24	20	45	403
7	6	28	45	33	46	39	34	34	18	12	56	351
8	1	11	26	22	40	33	24	21	16	14	37	245
9	2	5	24	9	32	35	20	21	11	13	31	203
10	4	9	11	8	21	25	18	14	12	15	31	168
11		5	8	11	22	23	13	20	15	15	40	172
12	1	9	11	20	29	21	30	12	17	16	43	209
13		4	16	13	19	25	15	14	18	12	35	17f
14	4	12	11	4	17	22	23	14	14	18	44	183-
15		8	9	14	25	27	16	25	15	12	45	196
16	6	17	11	14	41	49	31	21	29	18	46	283
17	8	13	14	19	26	39	28	22	20	24	54	267
18	5	19	15	16	29	36	32	27	18	26	51	274
19	4	15	15	17	26	28	27	25	18	10	45	230
20	3	19	21	16	35	23	19	26	10	22	34	228
21	5	14	36	21	40	34	34	33	35	18	56	326
22	3	21	36	29	42	42	30	22	26	14	54	319
23	4	21	30	21	32	32	29	24	27	32	58	310
24	2	17	37	18	35	38	31	23	21	24	40	286
25	2	13	28	12	30	32	25	16 '	16	10	35	219
26	2	14	23	22	27	21	14	22	16	14	35	210
27	...	11	22	8	12	17	13	11	3	9	15	.121
28	...	7	11	8	11	10	7	14	12	9	26	,115
29	2	7	11	6	4	10	8	2	5	6	13	74
30*	...	12	21	6	10	22	17	14	14	10	,v42	,.168
Total ...	212S	1910	1434	918	1307	1245	883	743	'624	594	~1S64	13350

* 16 persons for whom the presence or absence of a BCG scar was not stated have been excluded from Tables 4, 5, 10 and 11.

could be anywhere between 8 and 16 mm. In age group 0-14, this line of separation could be between 10-16 mm. Thus these histograms do not give a clear or definite line of separation between positive and negative reactors. This difficulty of defining any clear line of demarcation between a negative and a positive reaction in some communities is well recognised. Perhaps no sharp line of demarcation exists for these communities.

4.2 Definition of a positive reaction

In an attempt to define a positive reaction, the following hypothesis was propounded. If a sharp line of demarcation between 'positive' and 'negative' reactors exists, the positive reactors at this level would possibly show the est correlation with the prevalence of radiological and bacillary disease in the several age groups. To examine this hypothesis correlation co-efficients between infection rates at various levels with the radiological and bacteriological case rates in village groups were calculated. Further, so that non-specific allergy, waning of allergy or some similar factors) may not reduce the magnitude of these correlations, especially if infection rates in the older age groups were included, co-efficients of correlation were calculated separately between infection rates in each of the four age groups 0-4, 0-9, 0-14 and all ages at various levels of tuberculin reactions and X-ray. and bacillary

FIG. 3. HISTOGBAMS SHOWING THE DISTRIBUTION OF TUBERCULIN REACTIONS BY AGE AND SEX AMONG PERSONS WITHOUT PREVIOUS BCG SCAR

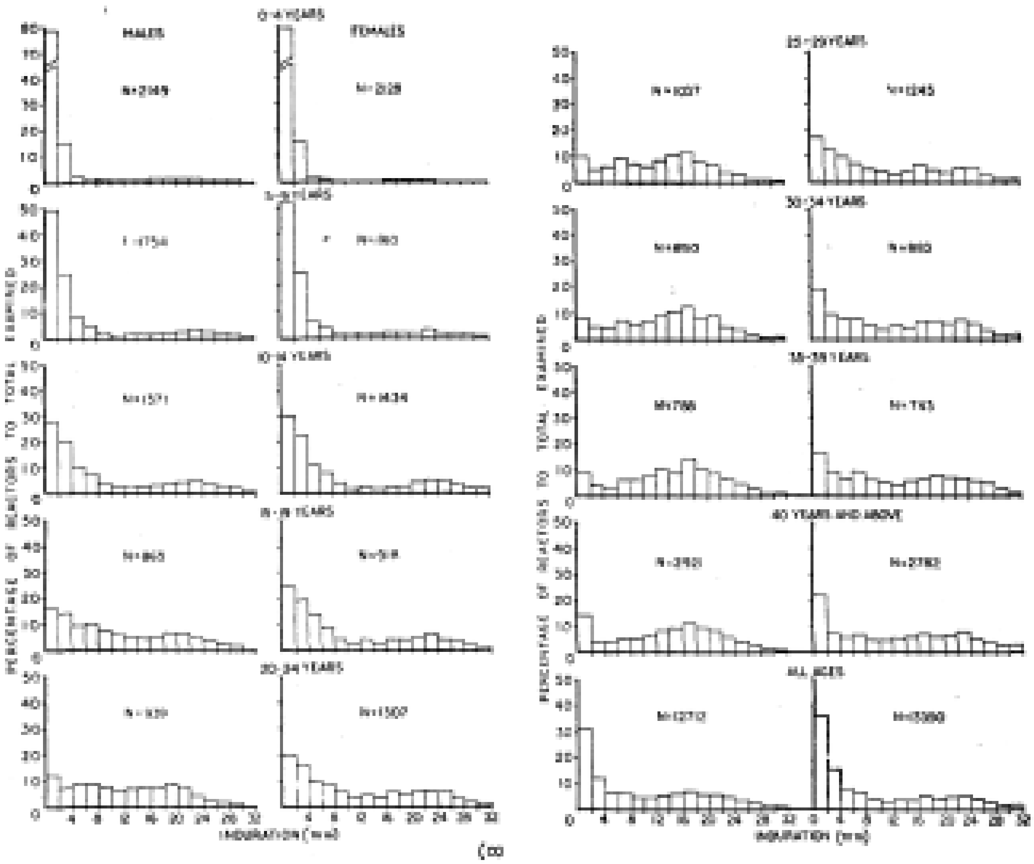
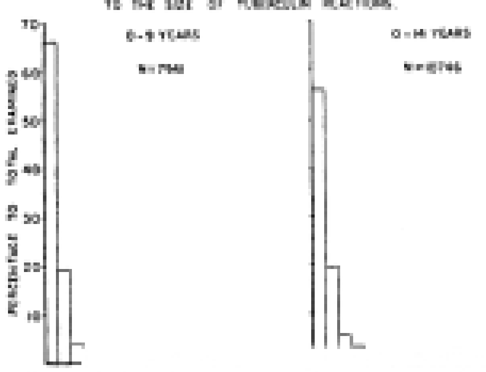
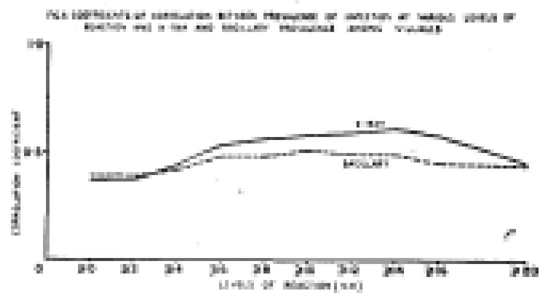


FIG. 4. DISTRIBUTION OF PERSONS WITH NO BCG SCAR ACCORDING TO THE SIZE OF TUBERCULIN REACTIONS.



INDURATION (mm)

case rates as found in age groups 10 years and above. Infection in the younger age groups could be expected to be a better index of the present or recent pool of infection in the com munity. But infection rates in lower age groups did not give a higher co-efficient of correlation with X-ray and bacillary case rates. The co-efficients of correlation were highest for infection rates in all age groups. These co-efficients of correlation in respect of infec tion rates for all ages for the 62 villages are shown in Fig. 5. The co-efficients of correla tion are not significantly different at any level, and therefore do not seem to be very helpful in defining a line of demarcation between positive and negative reactions. However, for calculating infection rates in the community an induration of 10 mm. has been chosen as the reasonable minimum tor a positive reaction on the basis of the histograms, the co-efficients of correlation and, it must be admitted, some-what arbitrarily.



4.3 Infection rates

With this definition of a positive reaction for the infected, 38.3 per cent of the population examined were found infected, the figures for the two sexes separately being 42.8 per cent males and 33.9 per cent females (Table 6). For persons 10 years and above (not shown in the table) infection rate for males is 58.5 per cent and for females 45.2 per cent. Table 6 also shows the number and percentage of persons infected in other specified age groups for each sex. The percentage of infected persons rises with age reaching a maximum at about 40 years. Thereafter this percentage is rather steady. For age group 10-19 years and above, infection rates are consistently higher among males than among females, the difference being most marked between 20 and 60 years of age, the peak being at 30-39 years. Difference in the infection rates in the two sexes has also been reported by Benjamin (1951).

4.4 Infection in village and town groups

Table 7 gives the number and percentage of infected persons in the 62 villages and the four town groups. The number of persons test-read in the four town blocks is only 1603 and may not be adequate for drawing a definite conclusion. For this reason the four town groups have been excluded from some of the tables.

Distribution of 62 villages by prevalence of infection is given in Table 8. In one of the rural groups, the defacto population was 5.

TABLE 6

Sex and age specific prevalence of infection

Age group	No. Test Read			No. infected (Reactors > 10 mm.)		
	Male	Female	Total	Male	Female	Total
0-4	2,149	2,128	4,277	60 (2.8)	55 (2.6)	115 (2.7)
5-9	1.754	1.910	3.664	235 (13.4)	267 (14.0)	502 (13.7)
10-19	2.234	2.352	4.586	794 (35.5)	700 (29.8)	1.494 (32.6)
20-29	1.976	2.552	4.528	1.166 (59.0)	1.109 (43.5)	2.275 (50.2)
30-39	1.678	1.626	3.304	1.199 (71.5)	861 (53.0)	2.060 (62.3)
40-49	1.196	1.218	2.414	845 (70.7)	695 (57.1)	1.540 (63.8)
50-59	945	905	1.850	671 (71.0)	493 (54.5)	1.164 (62.9)
60 +	780	659	1.439	475 (60.9)	349 (53.0)	824 (57.3)
Over-all	12,712	13,350	26,062	5,445 (42.8)	4,529 (33.9)	9,974 (38.3)

(Figures in brackets represent per cent infected)

TABLE 7

Sex specific prevalence of infection in rural and semi-urban groups

	Male		Female		Total		
	Tested and Read	Reactors >10mm	Tested and Read	Reactors >10mm	Tested and Read	Reactors >10mm	Preval-ence
Rural ...	11,942	5,074	12,521	4,196	24,463	9,270	37.9
Semi-Urban ...	773	371	830	333	1,603	704	43.9
Total ...	12,715	5,445	13,351	4,529	26,066	9,974	38.3

TABLE 8

Distribution of the villages by prevalence of infection

Infection Rate	Number of villages according to defacto population size				Total
	<250	250-499	500-749	750+	
0-4	1	...	...	...	1
5-9	...	...	...	...	...
10-14	...	...	...	...	...
15-19	...	...	...	...	1
20-24	~2	2	1	[illegible]	6
25-29	7	4	3	2	16
30-34	3	5	3	1	12
35-39	3	3	3	...	9
40-44	3	1	1	1	6
45-49	...	3	...	3	6
50-54	1	...	...	1	2
55-59	...	...	...	1	1
60-64	1	...	...	1	2
Total...	21	19	11	11	62

Of these four were tested and one found positive. In 37 of the remaining 61 villages, percentage of positive reactors varied from 25 to 39.

4.5 Complications of tuberculin reactions

Oedema, necrosis, vesicles or bullae were recorded, if present, for each tuberculin reaction that was read. Sometimes more than one complication was present. The distribution of these complications in 4 age groups in the two sexes is given in Table 9. The incidence of bullous reactions is not high. These include the few vesicular reactions. The incidence of complications appears to be higher in the females for all age groups except 0-4. Necrosis was not recorded in any reaction.

4.6 Sex reversal of proportion of 'large reactors'

Age specific curves taking 2,4, 6, 8,10,12,14, 16, 18, 20 and 24 millimetre induration as the minimum levels for 'positive' reactions were drawn for the two sexes. It was seen that although the percentage of reactors at all levels below 14 mm. was greater among males than among females, the percentage of reactors at levels 20 mm. and above was higher among females for all age groups above 15 years. This has been illustrated in Fig. 6 by age specific curves for reactors with indurations equal to or larger than 6, 14 and 20 mm. for the two sexes separately. The percentage of reactors, at the 18 mm. level was more 'or less equal in the two sexes (Fig. 7). This greater frequency of bigger tuberculin reactions in the female has also been noticed in another study carried out by the NTI (I960).* The significance of this phenomenon of 'Sex-reversal of proportion of large reactors' which does not seem to have

TABLE 9

Distribution of complications of tuberculin test with 1 TU RT 23 by age and sex

Age Group	Males					Females					Overall rate per 1,000
	Oedema	Bulla	Both	Total	Rate per 1,000	Oedema	Bulla	Both	Total	Rate per 1,000	
0-4 ...	15	2	9	26	12.1	9	3	11	23	10.8	11.4
5-9 ...	65	2	12	79	45.0	86	3	29	118	56.5	51.0
10-20 ...	181	5	20	206	92.2	206	4	27	237	100.7	96.6
>20 ...	242	13	22	277	42.1	394	15	69	478	68.7	55.8
Overall ...	503	22	63	588	46.2	695	25	136	856	64.1	55.4

* Dodballapur Training Survey (I960) —Unpublished data.

FIG.6. GRAPH SHOWING THE PERCENTAGE OF REACTORS ([illegible]) TO THE TOTAL EXAMINED IN EACH AGE GROUP

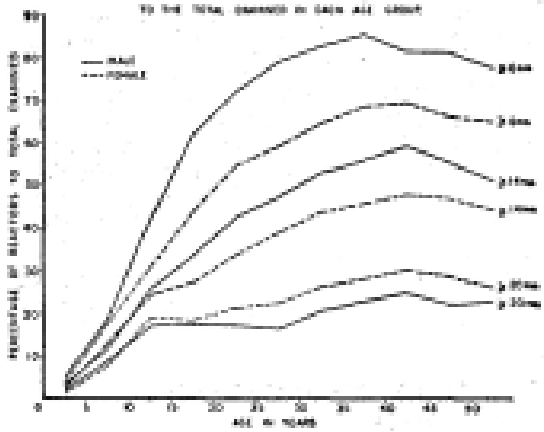


FIG.7. GRAPH SHOWING THE PERCENTAGE OF REACTORS ([illegible]) TO THE TOTAL EXAMINED IN EACH AGE GROUP

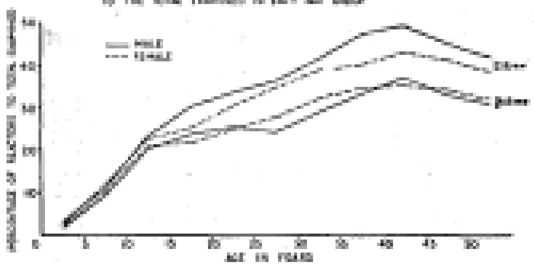


FIG.8. DISTRIBUTION OF RAOIQLOGICAU-Y ACTIVE AND BACHLARV CASES BY SIZE OF TUBERCULIN INDURATION

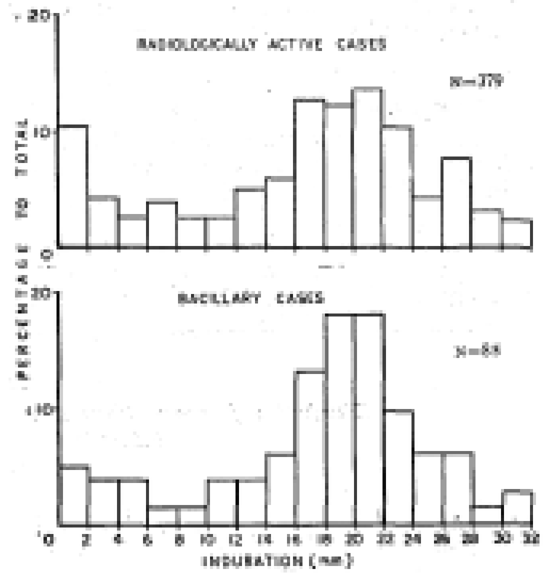
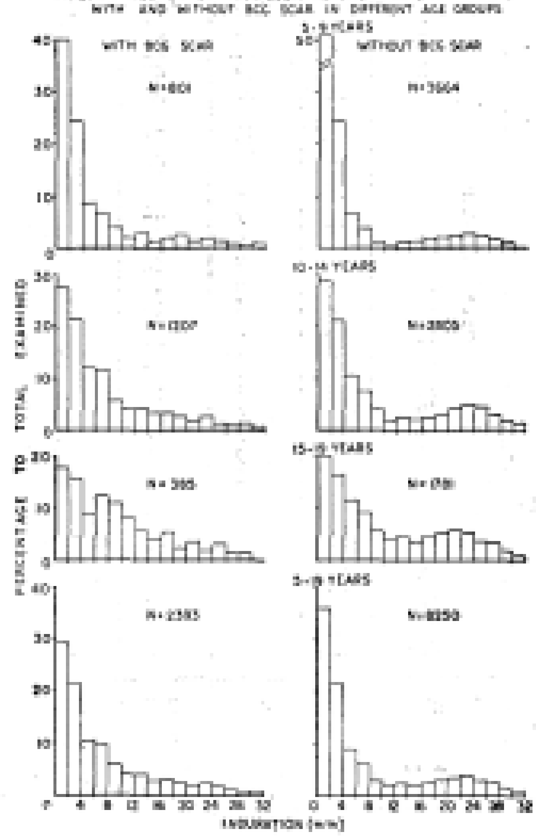


FIG.9 DISTRIBUTION OF TUBERCULIN REACTIONS AMONG PERSONS WITH AND WITHOUT BCG SCAR IN DIFFERENT AGE GROUPS



been noticed before, is not clear. But this observation appears to be in line with the earlier observation of higher incidence of complications of tuberculin reaction in the female although the total number of reactors among them is lower.

4.7 Tuberculin reactions among patients

Figure 8 shows the tuberculin reactions among X-ray and bacillary cases. There were in all 392 X-ray cases of whom tuberculin reactions were available in 379. There were 86 bacillary cases in all, among whom tuberculin reactions were available in 85. Of the X-ray cases 291 or 77 per cent were positive tuberculin reactors. Of the bacillary cases 73 or 86 per cent were tuberculin reactors. Similar findings with 1.0 mgm. of standard old tuberculin were reported by Gass and his co-workers (McDougall, 1949) 'Among subjects regarding whom on the basis of an X-ray picture 4 independent specialists agreed that there were definite tuberculosis lesions, 24.7

per cent showed completely negative tuberculin reactions'. Limitations of an index for infection rates have to be kept in mind.

4.8 Retests of persons with BCG scars

Of the total 28,994 tested and read, 2,916 or 10 per cent showed BCG scars, definite or doubtful. Distributions of tuberculin reactions for these by millimetres size in 11 age groups separately for males and females are given in Table 10 and 11. A Mass BCG Vaccination Campaign had been carried out during 1952 in one of the taluks (Kunigal) and during 1954-55 in rest of the district. 30 per cent of the children in the age group 10-14 years and 18 per cent in each of the two age groups 5-9 and 15-19 years showed such scars. In the age group 0-4 hardly any (0.75 per cent) showed such scars. In Fig. 9, distributions of tuberculin reactions in the 3 age groups 5-9, 10-14 and 15-19 are compared for those with no evidence of previous vaccination and those with evidence of previous vaccination. The 3 age groups do not show an adequate level of post-vaccination allergy. From tables 10 and 11 it can be calculated that for both sexes among the vaccinated 61.4 per cent of the persons in age group 5-19 years show in-

TABLE 10

Distribution of persons with previous BCG scars by each millimetre of tuberculin induration among various age groups

MALES

Size of tuberculin induration / Age group	0–4	5–9	10–14	15–19	20–24	25–29	30–34	35–39	40–44	45–49	50*	Total
0	11	140	175	35	8	12	3	5	1	1	3	392
1	...	34	34	7	1	...	...	...	...	...	...	76
2	5	61	82	20	4	1	1	...	...	1	...	175
3	...	49	67	14	9	6	3	1	...	...	...	149
4	...	31	53	11	2	1	2	1	...	...	...	101
5	...	11	28	10	1	2	...	1	...	...	2	55
6	1	18	57	14	4	2	3	2	...	...	...	101
7	...	12	35	17	3	5	4	4	1	...	...	81
8	...	10	28	14	3	1	3	...	...	...	1	60
9	...	4	21	16	4	2	1	...	...	1	...	49
10	...	6	12	13	2	1	2	4	...	...	1	41
11	...	3	16	10	2	3	2	1	1	...	...	38
12	...	7	18	13	3	2	1	1	3	1	...	49
13	...	6	15	6	2	3	1	2	...	1	1	37
14	...	1	13	5	3	5	1	...	1	1	...	30
15	...	3	12	9	5	1	1	...	2	...	...	33
16	...	4	11	6	3	1	2	1	...	1	2	31
17	...	5	17	5	1	...	2	...	...	...	1	31
18	...	6	15	4	4	2	1	1	1	1	...	35
19	...	4	6	...	3	3	...	1	...	...	...	17
20	...	3	4	7	2	2	...	1	...	...	1	20
21	...	2	7	3	1	1	...	1	2	1	...	18
22	...	2	9	3	2	...	...	...	1	...	...	17
23	...	5	7	2	2	...	1	...	...	...	...	17
24	...	3	6	1	1	2	...	...	...	...	1	14
25	...	1	3	2	...	...	1	...	...	...	...	7
26	...	2	2	1	...	...	...	...	...	...	1	6
27	...	1	5	1	1	...	...	...	...	1	...	9
28	...	...	2	...	...	...	...	...	...	...	...	2
29	...	1	4	3	...	...	...	1	...	...	...	9
30*	...	3	3	...	...	1	...	...	..	...	...	7
Total ...	17	438	767	250	76	59	35	28	13	10	14	1,707

* 16 persons for whom the presence or absence of a BCG scar was not stated have been excluded o m Ta bles4, 5, 10 and 11.

duration of 5 mm. or lower and 23.9 per cent 'O' mm induration. The post-vaccination allergy as elicited by 1 TU RT 23 with tween is by no means high. Either the vaccine was weak or the allergy produced had waned, or perhaps 1 TU RT 23 is not a good dose for eliciting post-vaccination allergy or being somewhat softer, post-vaccination reactions are possibily more difficult to read.

4.9 Incidence of infection

From the age specific infection rates among those with no evidence of previous vaccination, an attempt has been made to estimate, on the basis of certain assumptions, the annual incidence of infection (see Appendix IV). For the several age groups upto 35 years, the incidence of infection is shown in Table 12 and Fig. 10 (left half). The annual incidence of infection rises upto 15 years of age. After this age differences in incidence rates among the remaining age groups are not marked. There is a decline in the incidence rates in later years. The right half of figure 10 shows the incidence of infection when figures have been adjusted for the BCG vaccinated people among the population (Appendix IV). After this adjustment the incidence of infection seems to rise

TABLE 11

Distribution of persons with previous BCG scars by each millimetre of tuberculin induration

among various age groups

FEMALES

Age group	0-4	5-9	10-14	15-19	20-24	25-29	30-34	35-39	40-44	45-49	50*	Total
Size of tuberculin induration												
0	6	116	89	25	14	9	6	4	4	3	7	283
1	...	25	30	3	5	1	...	1	...	...	...	65
2	1	47	57	12	8	7	1	1	...	...	...	134
3	1	40	51	14	7	4	3	1	...	1	...	122
4	2	15	37	5	4	5	3	...	...	1	...	72
5	1	14	27	9	2	3	...	1	...	...	...	57
6	...	9	22	6	5	6	4	1	4	1	...	58
7	1	15	19	10	6	1	3	...	...	1	1	57
8	...	10	10	6	2	1	1	1	1	...	...	32
9	...	7	10	6	2	2	...	2	...	1	...	30
10	...	3	11	3	3	1	1	2	...	...	...	24
11	1	4	9	5	3	1	2	...	...	...	...	25
12	...	3	8	1	3	1	2	2	2	...	...	22
13	...	7	5	1	1	2	3	1	...	...	...	20
14	1	3	4	...	3	...	...	...	...	...	...	11
15	...	4	9	1	1	3	...	...	...	...	...	18
16	...	4	4	8	1	1	2	...	...	1	...	21
17	1	3	5	1	1	...	...	2	...	...	...	13
18	...	4	5	3	1	2	...	...	1	...	...	16
19	...	6	4	1	2	2	...	1	1	...	1	18
20	...	4	3	3	...	...	...	1	1	...	1	13
21	...	2	3	...	2	2	2	...	2	1	...	14
22	...	5	7	...	...	...	...	1	...	1	...	14
23	...	3	4	1	4	1	1	...	1	...	...	15
24	...	4	1	6	1	...	1	1	...	1	...	15
25	...	2	2	2	2	...	3	...	...	...	...	11
26	...	1	2	1	...	...	...	...	...	...	...	4
27	...	1	1	1	...	...	1	...	...	...	...	4
28	...	...	2	...	...	...	...	...	...	...	...	2
29	...	1	3	1	1	...	1	...	...	...	...	7
30*	...	4	4	1	...	...	1	1	...	...	1	12
Total ...	15	366	448	136	84	55.	41	24	17	12	11	1,209

*** 16 persons for whom the presence or absence of a BCG scar was not stated have been excluded from Tables 4, 5, 10 and 11.**

TABLE 12

Estimates of incidence of infection (> *10 mm) in the unvaccinated and general population (See Appendix IV)*

Age group	Prevalence among unvaccinated	Incidence rate of infection among Unvaccinated population by the method of			Incidence of infection among general population by the method of		
		Log	Approx.	Least squares	Log	Approx.	Least squares
1	2	3	4	5	6	7	8
0-4	2.7	1.09	1.08	2.18	1.09	1.08	2.11
5-9	13.7	2.38	2.26	2.78	2.29	2.16	2.69
10-14	28.9	3.81	3.52	2.81	2.69	2.49	2.72
15-19	38.3	2.80	2.64	2.79	2.65	2.58	2.70
20-24	47.1	3.04	2.85	2.69	4.39	4.02	2.61
25-29	53.4	2.51	2.38	2.48	2.51	2.38	2.43
30-34	60.7	3.35	3.13	2.12	3.35	3.13	2.11
35 +	62.4	0.89	0.87	1.60	0.89	0.87	2.65

upto age group 20-24. Thereafter there is a decline in the incidence of infection. The; reason (s) for this decline in incidence rates is (are) not understood. It is not due to the number of uninfected persons who are still at risk being insufficient after 20-24 years. Could it be due to waning of allergy perhaps due to desensitization by repeated small infections with specific or non-specific agents or perhaps due to some other factor which may be specific to these higher age groups? Further investigations may be necessary to explain this decline.

5. Results of X-ray examination

5.1 General considerations

The aim of X-ray examination in surveys is to find out an estimate of the prevalence of disease. Difficulties in X-ray interpretation are well known. To reduce the extent of under-reading it is considered necessary to have two independent readers. Many of the cases missed by one reader are picked up by the other under this procedure, but at the same time the number of over-readings increases. A correlation of the readings of the

FIG.10. ESTIMATED ANNUAL INCIDENCE OF INFECTION BY VARIOUS AGE GROUPS POR THE UNVACDNATEO AND GENERAL POPULATION ADJUSTED FOR 'REVIOSLY VACCINATED BY THE LOGORITHMIC. APPROXIMATION AND LEAST SQUARE METHOD

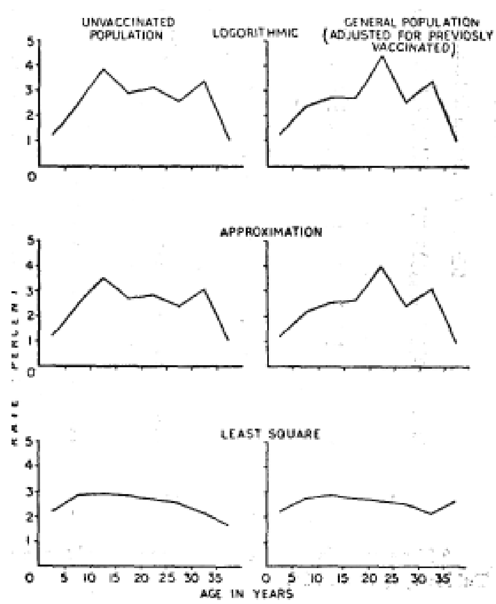


TABLE 13

Correlation between the radiological findings of the two readers

MALES

Reader II

		Normal	Unsatis-factory films	Calcifica-tion only	A	B	C	D	Total
Reader I	Normal	8,835	15	195	77	301	32	...	9,455
	Unsatisfactory films	45	148	...	2	...	1	...	196
	Calcification only	203		259	6	44	3	...	515
	A	41		3	38	24	18	6	130
	B	119	...	11	24	65	26	1	246
	C	16	...	1	13	38	86	28	182
	D	...	...	...	1	...	11	69	81
	Total ...	9,259	163	469	161	472	177	104	10,805

TABLE 14

Correlation between the radiological findings by the two readers

FEMALES

Reader II

		Normal	Unsatis-factory films	Calcifica-tion only	A	B	C	D	Total
Reader I	Normal	8,504	21	194	170	214	30	1	9,134
	Unsatisfactory films	49	140	*2*	1	2	1	...	195
	Calcification only	101		275	14	25	3		418
	A	*92*	...	8	80	20	11	4	215
	B	66	...	5	23	35	19	...	148
	C	11	...	...	15	14	36	11	87
	D	...	...	...	...	1	4	14	19
	Total	8,823	161	484	303	311	104	30	10,216

two readers in the present material according to classification shown in Appendix III is presented in Table 13 and Table 14 for males and females separately. Percentage agreement between the two readers for each category of X-ray reading has been calculated by taking the total read by at least one of the two readers as the denominator and the total read by both readers as the numerator. Thus in Table 13 (for males) and category of reading D we find that Reader I read 81 films as D and Reader II read 104 as D while both of them read only 69 as D, thus showing an agreement in 59 per cent amongst the total 116 cases read as D in males by either reader. The percentages-of agreement for some categories of X-ray cases are as follows:

	Males %	Females %	For both %
'D'	59	40	55
' C ' or ' D '	55	37	49
'C'	32	23	29

In general, there is greater agreement between the readers in respect of the films of males. The greatest agreement is seen in the category of reading D, viz., 59 per cent for males and 40 per cent for females. The agreement for the category C or D is only slightly lower, but the coverage of bacillary cases is considerably higher as shown by the following results.

(There were in all 84 bacillary cases among those x-rayed).

Category of X-ray reading	No. of cases	Bacillary cases	% Bacillary
D by both	83	42	50.6
D by either	151	54	35.8
C or D by both	259	60	23.2
C or D by either	525	71	13.5

One may use bacillary findings for choosing a suitable index of radiologically active disease. D by either or both does not give a satisfactory coverage of the bacillary cases. C or D by 'either' reader gives the greatest coverage of bacillary disease while C or D by 'both' reader yields a larger percentage of bacillary cases. These two latter indices could be used as a lower and an upper limit for the true prevalence of disease. If agreement between the two readers become closer, the difference between the lower and upper limits would be smaller. In the present study the agreement between the two readers for C or D cases was 49 per cent.

5.2 Umpire reading

Following Yerushalmy (1956) the 266 disagreed films i.e., read as C or D by only one of the two readers, were submitted to umpire reading. A list of the 266 films was prepared. The readings of the two readers were arranged. In two columns with the more 'serious' of the two readings in the right hand column. The umpire thus knew the readings of the two readers but not the identity of the reader for any reading. He recorded his readings in a separate column on the list. Tables 15 and 16 show correlation between the readings of the umpire and I and II readers respectively. Out of the 110 disagreed cases read by reader I only 31 (or 30 per cent) was confirmed. Out of 156 cases by reader II, 102 (or 65 per cent) were confirmed. It is seen that 133 (i.e., one half of the disagreed cases) were confirmed in the umpire reading. These included 10 out of the 11 bacillary cases among 266 disagreed films. Thus the coverage of bacillary cases was better when the method of umpire reading was used.

5.3 Choice of an index for prevalence of radiological disease

One may use any of the above indices or readings by any one reader as a means to denote disease in the community. In search for the 'best' index, correlations of the various indices with prevalence of infection and bacillary case rates were calculated. These along with bacillary findings and prevalence rate of X-ray cases according to each index are shown

TABLE 15

Correlation between the readings of reader I and those of umpire reader

READER I

UMPIRE	Normal	Unsatis-factory films	Calcification only	A	T}	C	D	Total
Normal	10	…	…	…	...	13	…	23
Unsatisfactory films		…	…	...	...	1	…	1
		…	1	…	…	…	…	1
A	6	…	…	4	1	27	…	38
B	13	...	1	2	16	38	...	70
C	33	1	4	26	28	28	1	121
D	1	1	...	7	1	1	1	12
Total	63	2	6	39	46	108	2	266

TABLE 16

Correlation between the readings of reader II and those of umpire reader

READER II

UMPIRE	Normal	Unsatis-factory films	Calcification only	A	B	C	D	Total
Normal	13	...	...	...	...	10	...	23
Unsatisfactory films	1	...	...	...	...	...	...	1
Calcification only	...	...	...	...	...	1	...	1
A	5	...	...	18	4	9	2	38
B	5	...	2	5	26	30	2	70
C	2	1	...	4	22	92	...	121
D	...	...	...	2	...	2	8	12
Total	26	1	2	29	52	144	12	266

TABLE 17

Comparison of various indices of prevalence of X-ray eases

Category of X-ray Cases	No. of cases in given X-ray category	Baoillary cases in given X-ray category		% of reactors to 1 TU (> 10 mm)	% of total bacillary cases missed	"Correlation co-efficient with prevalence of		Prevalence rate %
		No.	%			reac-tors	Bacil-lary cases	
C or D by I Reader	369.	63	17.1	73.2	25.0	0.59	0.41	1.76
C or D by II Reader	‘ 415	68	16.4	78.4	19.0	0.61	0.38	1.97
C or D agreed by both readers ...	259	60	23.2	80.6	28.6	0.63	0.49	1.23
C or D by either reader ...	525	71	13.5	73.6	15.5	0.58	0.32	2.50
C or D agreed by both readers + C or D by umpire ...	392	70	17.8	77.0	16.7	0.58	0.41	1.86

Sputum positive cases among the X-rayed = 84 (excluding two bacillary cases not X-rayed).

* Correlation co-efficient calculated on the basis of 62 villages only.

in Table 17. C or D cases by 'both' readers gives the highest co-efficient of correlation (though not significantly different) with bacillary cases (0.49) and with tuberculin reactors (0.63). But this index as shown earlier misses 24 i.e., 29 per cent out of the total 84 bacillary cases and may not thus be the best representative of X-ray disease in the survey area.

Among the 62 villages, as shown later in Table 24, as many as 30 did not have a single bacillary case. Co-efficients of correlation

TABLE 18

Co-efficients of correlation (c.c.) of disease prevalence, according to different categories of diagnosis, with prevalence of (1) bacillary cases and (2) infected, among different types of villages

Category of diagnosis	Type of village				
	All villages		Villages with Bacillary case		Villages without Bacillary case
	c.c. with Bac. cases	c.c. with infected	c.c. with Bac. cases	c.c. with infected	c.c. with infected
C or D by Reader I	0.41	0.59	0.61	0.70	0.46
C or D by Reader II	0.38	0.61	0.54	0.67	0.56
C or D agreed by both readers	0.49	0.63	0.67	0.66	0.53
C or D by either reader	0.32	0.58	0.51	0.71	0.50
C or D agreed by both readers + C or D by umpire	0.41	0.58	0.65	0.65	0.52
Bacillary cases		0.51		0.42	

calculated separately for the villages with and without bacillary cases are shown in Table 18. Co-efficients of correlation for both infection and bacillary disease with various categories of X-ray cases are invariably higher (though not significantly different) for villages with bacillary cases.

A consideration of all the data presented above does not make the choice of a suitable index (of the 'best' index) for X-ray disease in the community easier or definite. There may not be much to choose between different indices, but keeping in view the bacillary cases covered, agreement with the umpire and various co-efficients of correlation, two indices appeared suitable, namely, C or D by both plus those confirmed by the umpire from the disagreed films between the two readers and C or D by reader II only. Co-efficients of correlation for these two indices with infection rates in the total population at four different levels for a positive tuberculin test were as follows:

	at 8 mm	at 10mm	at 12mm	at 14mm
C or D by both plus those confirmed by the umpire ...	0.56	0.58	0.59	0.61
C or D by II reader only ...	0.56	0.61	0.63	0.63

The differences are not significant and choice between indices remains indefinite. On general considerations it may net be desirable to prefer the readings of a single reader because the results would not be easily comparable. It was, therefore, decided to prefer a 'method' rather than an individual reading and C or D by both plus those confirmed by the umpire was selected as the suitable index to represent amount of radiologically active disease in the area surveyed. -This had also given a better coverage for bacillary cases, i.e., 70 or 83 per cent out of the total 84 bacillary cases "discovered among those X-rayed. Unless otherwise stated this index only has been used as indicative of Radiologically Active Disease in this paper.

5.4 Prevalence rates for radiologically active disease

According to this index prevalence of radiologically active tuberculosis for all persons X-rayed by age and sex groups is shown in Table 19. The overall prevalence rate is 1.9 per cent, respective figures for males and females being 2.5 per cent and 1.2 per cent. About 66 per cent of the total X-ray disease was in the age group 40 years and above. Prevalence rates are higher among males than among females for all age groups except 10-19 years. This greater prevalence among males is especially well marked after the age of 30 years and increases with rise in age. The higher prevalence of disease in the female in the age group 10-19 years was also seen in the NTSS.

Table 20 shows the distribution of villages by X-ray disease rate and size of village. Eight villages with a population of over 900

TABLE 19

Sex and age prevalence of radiologically active disease

Age group	No. X-rayed			Radiologically active disease					
	Male	Female	Total	Male		Female		Total	
				No.	%	No.	%	No.	%
10-19	3,402	2,991	6,393	9	0.3	17	0.6	26	0.4
20-29	2,304	2,708	5,012	18	0.8	17	0.6	35	0.7
30-39	1,892	1,716	3,608	53	2.8	18	1.0	71	2.0
40-49	1,347	1,261	2,608	46	3.4	26	2.1	72	2.8
50-59	1,019	948	1,967	67	6.6	26	2.7	93	4.7
60+	1 841	592	1,433	78	9.3	17	2.9	95	6.6
Overall	10,805	10,216	21,021	271	2.5	121	1.2	392	1.9

TABLE 20

Distribution of villages by radiologically active disease

X-ray rate per 100 X-rayed	Number of villages according to defacto population size				Total
	<250	250-499	500-749	750+	
0	7	1	..	...	8
0- (excl. ‘ 0 ‘)	2	6	2	2	12
1-	4	5	7	4	20
2-	2	5	2	3	12
3-	2	2	...	2	6
4-	3	...	...	...	3
5-	...	...	...	...	...
6-	...	...	...	...	...
7-	1	...	...	...	1
Total	21	19	11	11	62

did not show a single X-ray active case. Half of the villages showed a prevalence rate from 1 to 3 per cent. One village with a population of 152 X-rayed had 7 X-ray cases, 4 of which were bacteriologically positive.

5.5 Other radiological findings

In addition to reading X-ray pathology as active, other findings on the X-ray films as in Appendix III were also recorded, and are presented in Table 21 by each reader and by the umpire for the C or D cases read by each of them. Bacillary cases have been shown in brackets. Reader I read in all 74 cavitary cases, definite or doubtful, among the 369 active cases read by him. Reader II read 56 cavitary cases among the 415 active cases read by him. Of the 74 cavitary cases read by reader I, 32 were bacillary. Of the 56 cavitary cases read by reader II, also 32 were positive bacteriologically. Reader I read in the total, 3 active cases due to pleurisy with effusion and 1 due to hilar adenitis. Reader II read 13 cases in each of the two categories. None of the cases in either of these two categories by either reader was positive on sputum examination. Readings of the umpire for the 133 C or D cases from among the disagreed cases by the two readers are also shown.

6. Results of bacteriological examination

6.1 Bacillary cases

Table 22 shows the number and percentage of bacillary cases in the several age and sex groups as found by examination of a single ‘spot’ sample of sputum. The percentage of bacillary cases especially among the males rises with age as has been seen for radiologically active cages and infected persons. The percentage of bacillary cases also is higher among

TABLE 21

Pathology and aetiology of C and D cases of each reader separately

(See Appendix III)

Reader	Aetiology	Pathology					Total
		A	b	c	d	e	
First	C	1	4	260 (19)	...	1	269
	D	1 45 (24)	24 (8)	30 (12)	3 1	...	100
Second	C	...	...	259 (16)	10	12	281
	D	34 (22)	22 (10)	74 (20)	3	1	134
Umpire	C	...	6	109 (7)	3	3	121
	D	4 (2)	2	3 (1)	2	1	12

Figures in brackets show bacillary cases

TABLE 22

Age and sex specific prevalences of bacillary cases in the defacto population examined

Age group	No. X-rayed			No. of sputa positive by either method		
	Male	Female	. Total	Male	Female	Total
10-19	3,402	2,991	6,393	2 (0.06)	4 (0.13)	6 (0.09)
20-29	2.304	2.708	5.012	9 (0.39)	6 (0.22)	15 (0.30)
30-39	1.892	1.716	3.608	15 (0.79)	7 (0.41)	22 (0.61)
40-49	1.347	1.261	2.608	12 (0.89)	3 (0.24)	15 (0.58)
50-59	1.019	948	1.967	12 (1.18)	2 (0.21)	14 (0.71)
60+	841	592	1.433	10 (1.19)	4 (0.68)	14 (0.98)
Overall	10.805	10.216	21.021	60 (0.56)	26 (0.25)	86 (0.41)

Figures in brackets represent percentages

males in all age groups except 10-19 years, The bacillary cases found in the different age groups are however small. 0.41 per cent of the total X-rayed population (0.56 per cent males and 0.25 per cent females) have been found to excrete tubercle bacilli. It can be calculated from the table that 50 per cent of the bacillary cases were found in age group 40 years and above. The X-ray findings of the two readers for the bacillary cases have been correlated in Table 23. One bacillary case, was read normal by both readers. Sputum examination had

TABLE 23

Correlation between the radiological findings of the two readers among bacillary cases

Reader II

Reader I	Normal	Unsatisfactory films	Calcification only	A	B	C	D	Not X-rayed	Total
Normal ...	1	...	...	2	4	2	...	...	9
Unsatisfactory films ...	...	1	...	...	...	1	...	...	2
Calcification only ...	...	...	...	...	...	...	...	...	...
A ...	...	...	...	1	1	1	2	...	5
B ...	1	...	1	...	1	2	...	...	5
C ...	...	...	...	2	1	8	8	...	19
D ...	...	...	...	...	...	2	42	...	44
Not X-rayed ...	...	...	...	...	...	...	...	2	2
Total ...	2	1	1	5	7	16	52	2	86

been requested by one of the readers with the remark that there was 'hair shadow' on the right apex. 4 further cases had been read as normal or non-tubercular pathology by both the readers. One reader had read in all as many as 9 bacillary cases as normal radiologically.

Distribution of the 86 bacillary cases as found positive by different techniques was:

Positive by direct smear	59
Positive by culture	66
Positive by culture and direct smear	39
Positive by direct smear, culture contaminated	4

It may be seen that 27 or 46 per cent bacillary cases were added by culture to those positive by direct smear.

Distribution of villages by bacillary case rates is given in Table 24. It will be seen that in as many as 30 villages, comprising 5,367 persons X-rayed, not a single bacillary case was found. These 30 villages represent about 25 per cent of the population X-rayed. On the other hand one village with an X-rayed population of 152 showed as many as 4 bacillary cases.

Number and percentage of bacillary cases among the X-ray cases in different age groups is presented in Table 25 separately for males and females. Except in the age group 10-19, the percentage of bacillary cases with advance of age among the X-ray cases drops steadily. This greater frequency of abacillary lesions with advance in age could be due to either

TABLE 24

Distribution of villages by the bacillary case rates according to the size of population

Bact. prevalence rate	Number villages of according to defacto population size < 250	250-499	500-749	750+	Total
0	16	9	4	1	30
1	...	...	...	2	2
2	...	...	2	1	3
3	...	5	1	1	7
4	...	2	1	1	4
5	...	...	1	1	2
6	1		...	1	2
7	...	1	...	2	3
8	...	...	...	1	2
9	...	...	...	...	1
10	...	...	...	...	...
11	...	1	...	...	1
12	...	...	...	...	...
13	...	1	...	...	1
14	1	...	...	...	1
15	...	...	...	...	...
16	...	...	...	...	...
17	1	...	...	...	1
18	...	...	...	...	..
19	...	...		...	...
20+	2	...	...	...	2
Total	21	19	11	11	62

accumulation of old abacillary lesions with advance in age or due to new lesions in older age groups being more often abacillary, or judgement regarding activity of a lesion being

TABLE 25

Number and percentage of bacillary cases among X-ray cases in different sex and age groups

Age group	X-ray cases		Bacillary cases		Percentage	
	Male	Female	Male	Female	Male	Female
10-19	9	17	2	3	22.2	17.6
20-29	18	17	8	4	44.4	23.5
30-39	53	18	14	5	26.4	27.8
40-49	46	26	11	2	23.9	7.7
50-59	67	26	11	1	16.4	3.8
60+	78	17	8	1	10.3	5.9
Overall	271	121	54	16	19.9	13.2

probably less reliable from a single picture in older people.

6.2 Contamination rates

The maximum distance from the field to the NTI was over a hundred miles and from the NTI to the UMTS Laboratory, 75 miles. It took one to thirteen days for the sputum samples to be delivered at UMTS. Among the 2333 samples of sputa cultured, both tubes were contaminated in 395 (i.e., 17 per cent of the samples) and one tube was contaminated in another 536 samples (23 per cent). Among the contaminated, 616 cultures were repeated from the material left over from the first cultures and preserved in a refrigerator. A total of 2 from both tube contaminations and 12 from one tube contaminations were found positive in these repeat cultures.

The unusually high contamination rate of 40 per cent was considered to merit further study. The influence of the following characteristics on contamination was analysed.

(i) X-ray category of the examinee
(*ii*) Age of the examinee
(iii) The interval between collection of the sputum sample and its inoculation in the culture medium
(iv) Seasonal variation as shown by a study of weekly fluctuations in contaminations

None of these factors could be held responsible for the high contamination rate.

6.3 Absentees for examination

Sputum could not be collected from 108 persons out of 2,441 persons eligible (Table 3). These included 13 X-ray cases read as C or D by both the readers.

The number of bacillary cases found in this study should be taken as a minimum, because the collection of a single 'spot' sample of sputum and the presumption that all the absentees at sputum examination had negative sputa and the high contamination rate, all-tend to reduce the number of bacillary cases detected.

7. Other results

7.1 Standardised rates

In order to make figures comparable, it is usual to compute standardised rates which take into account differences in the sex and age composition of the population examined and the actual population. The age and sex distribution of the population in the district as in 1960 being not known, this standardisation is not feasible. Since the absentee rates have been found to vary in the different age and sex groups, it was considered desirable to make due allowance for this and calculate standardised rates assuming that the prevalence rate among the absentees was the same as among those examined in each age and sex group. These standardised rates worked out to be 38.3 per cent for infection, 1.86 for X-ray cases and 0.41 per cent for bacillary cases, the latter two for ages 10 years and above only. These standardised rates are not different from the prevalence rates for the population examined due to high coverages obtained during the survey.

7.2 Estimates for the district

The population of Tumkur district excluding the headquarter' town of Tumkur was estimated to be 12.2 lakhs during November, 1960, the middle point of the Baseline Survey period. Appendix V gives details of findings for each group in the survey.

Standard error and co-efficient of variation for three prevalence rates are given in Table 26 (Appendix VI). It may be seen that a co-efficient of variation of 5 per cent for infection rate, 8 per cent for radiologically active disease

TABLE 26

Estimates of prevalence for various epidemiological characteristics in Tumkur District

Category	Prevalence rate %	Standard error %	Co-efficient of variation %	95% confidence limits of prevalence	
				Lower %	Upper %
Infection ≥ 10 mm	38.3	1.8	4.8	34.6	41.9
X-ray (by both plus umpire)	1.86	0.15	8.10	1.56	2.16
Bacillary	0.41	0.05	11.5	.31	.51

Note: Prevalence of infection relates to persons test read, and for the other two categories to persons X-rayed.

rate and 12 per cent for the bacillary case rate has been achieved. In the NTSS (Page 92) the co-efficient of variation for X-ray disease rate in villages varied from 5.7 per cent to 10.2 per cent in various zones.

With a confidence of 19 in 20 it can be asserted that the number of radiological cases aged 10 years and above in the said population lies between 11.8 thousand and 18.8 thousand, and is likely to be round about 16.2 thousand.

Similarly with a confidence of 19 in 20 it may be asserted that the number of bacteriological cases aged 10 years and over in the above population may lie anywhere between 28 hundred and 44 hundred and is likely to be about 36 hundred.

7.3 Variation within the district

The villages surveyed were a random sample from the entire district. Therefore, estimates for smaller units like the taluks are not valid. But the differences between the southern-half consisting of 6 taluks (Tumkur, Chiknayakanahalli, Tiptur, Gubbi, Kunigal and Turuvekere) and the northern-half consisting of 4 taluks (Pavagada, Sira, Madhugiri and Koratagere) have been strikingly large. The findings in the two halves are presented in Table 27. It will be seen that although the population in the two halves is nearly the same, the prevalence of infection in the northern-half is 46 per cent compared with 30 per cent in the southern-half while the prevalence of active disease is 2.3 per cent in the north and 1.4 per cent in the south. The bacillary rates are 0.58 per cent and 0.24 per cent respectively. The reason or reasons for these differences are not known, but these have not been found due to any differences in the coverages by age and sex or due to size of village in the two zones.

A further difference observed may also be recorded. Although only 25 out of 86 bacillary cases are in the southern-half, the sex ratio of these cases in this half *is* different from that in the northern-half. In the southern-half there are 11 male and 14 female bacillary cases, while in the northern-half there are 49 male and 12 female cases. Among X-ray cases in the northern-half this preponderence in the number of males is not seen. The prevalence rates in the 10 taluks range from 1.6 per cent to 3.7 per cent. Results of significance tests for the differences mentioned above have not been presented in this paper, because even though such tests showed significant differences these are not necessarily valid as the sample has not been stratified by taluks.

TABLE 27

Prevalence of infection and diseased in the Southern and Northern Zones

	No. of groups (incl. towns)	Defacto popln.	No. tested and read	Infected		No. X-rayed	Radiologically act. cases		Bacillary cases	
				No.	%		No.	%	No.	%
Southern Zone ...	40	15,911	12,895	3,907	30.3	10,514	150	1.43	25	0.24
Northern Zone ...	26	16,056	13,171	60,67	46.1	10,507	242	2.30	61	0.58

TABLE 28

Prevalence of infection, X-ray and bacillary cases, by size of village

Size of village (defacto population)	No. of villages	Test-read	Infected > 10 mm	X-rayed	Radiologically active cases	Bac. cases
<250	21	2,300	775 (33.70)	1,792	34 (1.90)	8 (0.45)
250-499	19	6.081	2.045 (33.63)	4.722	76 (1.61)	15 (0.32)
500-749	11	5.398	1.752 (32.46)	4.329	62 (1.43)	14 (0.32)
>750	11	10.684	4.698 (43.97)	8.892	185 (2.08)	40 (0.45)
Overall	62	24,463	9,270 (37.89)	19,735	357 (1.81)	77 (0.39)

Figures in brackets represent percentages

7.4 Variations with size of village

In Table 28 the prevalence rates for infection and radiological and bacillary disease have been given for villages of different size. The total X-rayed was only 1792 in the 'smallest' villages and the high radiological and bacillary disease rates may not necessarily be reliable for such villages. Thus all the three prevalence rates appear to be highest for 'large' villages with population of 750 or more. For reasons given in the preceding paragraph the results of significance tests for the differences observed are not given.

7.5 Accessible and inaccessible villages

The difference in the prevalence rate in the accessible and in the inaccessible villages is of considerable importance. NTSS was confined to accessible villages only and all surveys in developing countries will of necessity have to be confined only to accessible villages. NTSS (Page 75) also states, 'preliminary results indicate that there is no significant difference regarding the tuberculosis prevalence in the 'accessible' and 'inaccessible' rural areas now surveyed'. 46 out of the 62 villages of the present survey were considered accessible. Findings in the two sets of villages are presented in Table 29. The percentage of tuberculin reactors and radiologically active cases is higher in the inaccessible villages while percentage of bacillary cases is higher in the accessible villages. However, the differences for X-ray and bacillary cases are not statistically significant but the sample was not stratified for this characteristic.

8. Some remarks

The Baseline Survey in Tumkur district confirms, in general, the findings of NTSS that there is a considerable amount of tuberculosis in the villages. There is an appreciable variation in the prevalence rates of infection, radiological and bacteriological cases among different taluks, among villages of different sizes and in the northern and southern halves of the district. As the sample surveyed was drawn from the entire district, these differences may not necessarily be valid. All the same if such differences are there these can seriously interfere with the assessment of different control programmes applied to different parts of the district. If the original sample had been stratified for the taluks or for the size of villages, differences found would have been more reliable. The conclusion may be drawn that stratification according to the factors mentioned should be considered necessary in drawing a sample for a survey, especially so, if the results are to be used for assessment of different control programmes in different areas of the district. At any rate there can be no serious disadvantage in stratification.

Co-efficients of correlation between infection and various categories of disease on the one hand and between X-ray and bacillary disease on the other, have been shown earlier. The

TABLE 29

Prevalence of Infection, radiological and bacillary cases in accessible, inaccessible and urban areas covered by the Survey

Areas	Defacto population	No. tested and read	No. of reactors > 10 mm		No. X-rayed	Radiologically act. cases		Sputum + ve by either method	
			No.	%		No.	%	No.	%
1 ‘	2	>	4	5	6	7	8	9	10
Accessible (46 villages)	22,671	18,731	6,961	37.2	15,125	266	1.76	63	0.42
Inaccessible (16 villages)	7,142	5,732	2,309	40.3	4,606	91	1.98	14	0.30
Urban (4 blocks) ...	2,149	1,603	704	43.9	1,290	35	2.71	9	0.70
Total (66 groups) ...	31,962	26,066	9,974	38.3	21,021	392	1.86	86	0.41

value of some of these co-efficients is not as high as to be useful in utilising the comparatively simple tuberculin test for judging the amount of radiological and bacillary disease in a group or a community. It is possible that some of these values have not been high enough due to the relative crudeness of the methods that are available for surveys. Limitations due to reader error in tuberculin tests and X-ray readings are well known. Limitations of a single spot sample of sputum for juding the number of bacillary cases have been reported earlier Raj Narain (1962). There are many other limitations of the methods available for surveys which may account for the low values of the many co-efficients of correlation in this report. The value of these co-efficients of correlation will be judged better, it is hoped, by further surveys.

Some methods for defining more accurately a positive reaction and an index for X-ray disease have been used. The results may not appear commensurate with the labour put in. However, a basis for further work has been, it is hoped, defined. Another survey with a sampling ratio of 20 per cent with more intensive sputum examination is nearing completion. Correlation of the findings by the different techniques used may help in judging their value better and may make their application more precise.

Summary

A Tuberculosis Prevalence Survey was carried out in Tumkur District, Mysore State, India, to provide basic information regarding age-sex specific prevalence rates for infection, radiologically active disease and bacillary cases. The survey was confined to 66 groups—62 rural and 4 semi-urban selected at random. Coverages were about 92 to 95 per cent. The results of the survey showed (and confirmed) the limitations of these examinations in providing clear indices for prevalence. Attempt has been made to find the best possibe indices for prevalence of infection, radiologically active disease and bacillary cases by correlating the findings of one with the other two and making use of all types of data available. A clear cut choice of the best possible indices was still not available, but a basis for further work has been defined. Some interesting variations in prevalence, which have been observed in this survey, indicated the desirability of stratified samples for such surveys.

The main findings of the survey, in the defacto population examined are:

1. 38.3 per cent were infected; 42.8 per cent among males and 33.9 per cent among females.
2. The percentage of infected persons rises with age, reaching a maximum at about 40 years.
3. For age group 10-19 years and above, infection rates are consistently higher among males than among females.
4. Complications to tuberculin test were observed in about 5 per cent of the tests read and consisted mostly of oedema; incidence of complications was significantly more among females.
5. Large reactions of 20 mm. or more were observed among a larger proportion of females than males.
6. Incidence of infection rises with age at first, but drops in later years.
7. 1.9 per cent had radiologically active disease; 2.5 per cent among males and 1.2 per cent among females.
8. 66.3 per cent of the radiologically active cases were persons aged 40 years or more.
9. Prevalence rate for radiologically active disease increases steadily with age; the increase being particularly marked among males.
10. 0.41 per cent were bacillary cases among persons of age 10 or more; 0.56 per cent among males and 0.25 per cent among females.
11. Prevalence of bacillary cases steadily increases with age among males.
12. 50 per cent of the bacillary cases were persons aged 40 years or more.

Acknowledgements

The authors are grateful to the field teams for their hard and painstaking work.

To Miss J. McLary for training the technicians, and for conduct of the survey in general. To Dr P. Chandrasekhar who from September 1960 onwards was Medical Officer-in-charge of field teams. To the teams and team leaders Shri G. Dwarakanath and Shri N. Suryanarayana Rao. To the statistical unit and secretarial staff for their help and co-operation. To Dr J. O'Rourke WHO Medical Officer for acting as the umpire reader for the disagreed films.

To the Union Mission Tuberculosis Sanatorium, Arogyavaram, South India, for carrying out all bacteriological examinations.

The authors are also grateful to members of the Technical Co-ordinating Committee of the National Tuberculosis Institute for their helpful suggestions and criticism, especially to Dr N. L. Bordia, Dr M. Plot, Mr S. Andersen and Mr S. S. Nair who joined the NTI as Senior Statistical Officer in August 1962.

REFERENCES

1. Benjamin, P. V. (1951); *Proceedings of the Eighth Tuberculosis Workers Conference,* 1951, Tuberculosis Association of India, New Delhi—P. 43.
2. Indian Council of Medical Research, New Delhi (1959): *Tuberculosis in India, a sample survey* (1955-58).
3. McDougal, J. B. (1949): *Tuberculosis (A Global Study in Special Pathology),* Baltimore, The Williams and Wilkins Company—*P.* 261.
4. Raj Narain and Subramanian, M. (1962); *Proceedings of Eighteenth Tuberculosis Workers Conference,* Bangalore.
5. Yerushalmy, J. (1956): *International Tuberculosis Year Book, 26,* No. 1-2.

APPENDIX I

Composition of a field team

1. Team Leader
2. Two census takers
3. One tuberculin tester
4. One card controller
5. One X-ray technician
6. One tuberculin test reader
7. One laboratory technician
8. Two scouts
9. Two drivers for X-ray units Two drivers for
10. staff cars of testing and reading teams.

Drivers help in positioning persons for X-ray examination, for scouting and in various other ways

APPENDIX II

Definitions of some terms used

(a) Household

A household is defined as a group, whose members live together and have their main meals prepared in the same kitchen.

If the group consists of persons who live and sleep under the same roof but take meals in different places, they are still to be regarded as forming a household.

Ex. (i) Students or others occupying a house or a room in common and messing elsewhere should be registered at their common residence.

(ii) Servant who sleeps in his own household in the village but takes his meals in the master's house will be registered in his own household.

(b) *Homeless persons*

Persons who have slept in the village the previous night but who do not belong to any household in the village are treated as homeless persons eligible for registration.

(c) Permanent residents (P.R.)

Permanent residents of the village are those who belong to households in the village as also homeless persons who live in the village. In the case of homeless persons, the answers given by them as to whether they belong to the village or not, may be taken as the basis of the classification.

(d) Temporarily present (T.P.)

A person is classified as temporarily present if he does not belong to the village but has slept in the village the previous night.

A person who has stayed in the village for more than one year shall be regarded not as a TP but as permanent resident of the village.

Similarly, a person who has been staying in the village for a period of less than one year and does not intend to leave the village within a year from now, shall be regarded not as a TP but as a permanent resident.

(e) Temporarily absent (T.A.)

A person is classified as temporarily absent if he belongs to the village, but was absent from the village the previous night. If the person was absent from the village for more than one year, he should be regarded as a permanent absentee and shall not be registered. If the person is absent for less than a year and has no intention of returning to the village within one year from now, he should be regarded as a permanent absentee and shall not be registered.

APPENDIX III

READING OF X-RAY FILMS

All readings of X-ray films will be recorded on a separate form. Each form will clearly indicate the Group Number, Group Name, Film Roll No., Date of X-ray exposure, the date of X-ray reading and the name of the reader. This is done to ensure complete independence of the two readings. Individual cards are not available to the readers at the time of reading.

X-ray code

The X-ray code is based mainly on the code followed in NTSS. In all cases where pathology is present readings are recorded under the following four headings.

I. *Extent of disease*

Each lung (R= right; L=left) is considered to consist of three zones:

1. Upper zone—area of the lung above a horizontal line drawn along the lower margin of the anterior end of the 2nd rib.
2. Middle zone—area of lung lying between the upper and lower zones.
3. Lower zone—area of the lung below a horizontal line drawn along the lower margin of the anterior end of the 4th rib. The zones involved are recorded as R^ R_2, R_3, etc.

II. *The physical appearance of the lesion*

Only one of the following is recorded in all cases where a pathology is present.

(a) Infiltrate with cavity
(b) Infiltrate with doubtful cavity
(c) Infiltrate without cavity
(d) Pleural effusion
(e) Hilar Adenitis. Only dense shadows with distinct contours in the hilar regions are to be considered abnormal. Particular care should be taken *not* to react on confluenting vascular and bronchial shadows which are normally present in the hilar region.
(*f*) Pulmonary scar—Fibrotic strands or bands in the lung fields.

(g) Pleural scar—Thickening of pleura or obliteration of the castophrenic angle.

(h) Pneumothorax or Pneumoperitoneum.

(*i*) Cardio-vascular pathology—marked alterations of the shape and size of heart or large blood vessels.

(*j*) Thorocoplasty or Rib Resection.

(k) Other pathology of the chest—any pathology of the chest which cannot be listed from a—j.

If more than one of the lesions listed above are found, only the main lesion from the point of view of tuberculosis is recorded.

III. *Presence of calcification*

Calcifications wherever present are recorded independent of any other pathology. End-on blood vessels and foreign bodies are, as far as possible, excluded.

IV. *Impressions regarding aetiology*

For all abnormalities (except for calcifications only) the reader gives a judgment regarding the aetiology of the lesion. The probability of finding tubercle bacilli in the sputum of the examinee serves as a guide. In making this judgment the nature of the lesion is taken into account (presence of cavity, location of lesion, etc.) and also the extent (size of areas involved; uni-or bilateral distribution). The radiological appearance of the lesion is also taken into account. If the reader, in recording a lesion, feels some doubt whether an abnormality really exists or not, the degree of doubt and the probability of isolating tubercle bacilli guide the ultimate judgment. The following aetiological classification is used:

A. Probably non-tuberculous

All lesions which are considered of non-tuberculous origin. The probability of finding tubercle bacilli judged to be near 0.

B. Probably tuberculous but inactive

All scars and other healed lesions except calcifications; some doubtful shadows, if they are recorded at all may be classified as inactive. Probability of finding tubercle bacilli is judged to be small.

C. Probably tuberculous, possibly active Lesions appearing to be of tuberculous nature but without a definite cavity and not extensive. Tubercle bacilli may be detected even with a single collection of sputum.

D. Probably tuberculous and active

The lesion appears to be of tuberculous nature, may be extensive, may be bilateral, or a definite cavity is present. The probability of finding tubercle bacilli by a single collection is judged to be high.

The last two categories namely C and D are grouped together as Radiologically Active Tuberculosis.

(For choice of index of disease used in this paper, see text).

APPENDIX IV

Statistical note on the calculation of incidence rates

The incidence rates of infection can be estimated from the prevalence rates of infection in various age groups with certain assumptions viz:

1. Mantoux reaction of over 9 mm. is synonymous with infection with Myco. Bact. Tuberculosis and hence the infection rates calculated on this basis reflect the true position.
2. The onset of infection within each age group is similar in the two sexes.
3. Mortality rate is the same for both infected and uninfected.
4. The phase in the epidemiology of tuberculosis through which the community has passed has no influence on the annual attack rate.
5. The incidence of infection is uniform within the several age groups specified. With these assumptions age specific annual incidence rates can be worked out directly for those without BCG scars. But in order to estimate the incidence of natural infection in a community some adjustment has to be made to account for the exclusion of those with BCG scars. A method of making this adjustment, using the incidence rates among those without BCG scar, is also given in this appendix.

Estimation of annual incidence among those without BCG scar:

The following three methods may be adopted:

(1) *Logarithm method*

Let P_t be the proportion of infected in the age ' t'

Let P_t+i be the proportion of infected in the age 't + i'

Let r_t be the annual infection rate in the age group ' t' to ' t + i'

Then non-infected people in the age t + i

= (non-infected in the age t) — (infected in the interval t, t + i)

$$\therefore (1-p_{t+i}) = (1-p_t)(1-r_t)^i$$

$$\therefore (1-r_t)^i = \frac{(1-p_{t+i})}{(1-p_t)}$$

$$r_t \equiv 1-\text{antilog}\left\{\frac{1}{i}\log\frac{1-p_{t+i}}{1-p_t}\right\}$$

(2) *Approximation (Binomial) method*

The annual incidence of infection being of the order of 2 percent , if i is also small we have

$$(1-r_t)^i = 1-ir_t \quad (0 \leq r_t \leq 1) \text{ approximately}$$

$$\therefore 1-ir_t = (1-p_{t+i})/(1-p_t)$$

$$\therefore ir_t = \frac{P_{t+i}-P_t}{1-p_t} \text{ or}$$

$$r_t = \frac{1}{i}\left\{\frac{P_{t+i}-p_t}{1-p_t}\right\} = \frac{1}{i}\frac{\Delta i\,P_t}{1-p_t}$$

Where Δ is the symbol of differencing and i the interval of differencing.

$$\left.\begin{array}{l}\text{Incidence of}\\ \text{infection at age t}\end{array}\right\} = \frac{\text{(Newly infected in the interval)}}{\text{Interval x Uninfected at the beginning of the interval}}$$

(3) *Least square method*

This method uses the best mathematical fit to the age specific infection curve.

Let $y = ax^2 + bx + c$ be the curve of best fit to the data relating to the age specific prevalence rates of infection where y is the prevalence of infection in the specified age x.

Since it may be reasonably supposed that all are uninfected at birth, the pevalence of infection at birth (i.e. at age zero) should be zero and the constant term in the above equation vanishes. Thus the equation to be fitted reduces to the type

$$y = ax^2 + bx$$

Using the method of least square, we note that

$\mu = \Sigma (ax^2 + bx (-) y)^2$ should be minimum;

i.e. $\frac{d\mu}{da} = 0$ and $\frac{d\mu}{db} = 0$ with appropriate conditions on the value of the second derivatives

Let $X = \frac{x}{5}$ $\quad \therefore x = 5X$

Then $\mu = \Sigma (25 a X^2 + 5b X-y)^2$ should be minimum

i.e. $\mu = \Sigma (AX^2 + BX-y)^2$ should be minimum where $A = 25a$ and $B = 5b$.

Then $\frac{d\mu}{dA} = 2\Sigma (AX^2 + BX - y) X^2 = 0$

i.e. $\Sigma (AX^2 + BX - y) X^2 = 0$

$A \Sigma X^4 + B \Sigma X^3 = \Sigma X^2y \ldots (1)$

Similarly, $\frac{d\mu}{dB} = 2\Sigma (AX^2 + BX - y) X = 0$

i.e. $\Sigma (AX^2 + BX - y) X = 0$

$A \Sigma X^3 + B \Sigma X^2 = \Sigma XY \ldots (2)$

The normal equations then are given by (1) and (2).

By solving these equations we can find out the constants A and B and hence the equation of best fit.

By substituting x= 1, 2, . . $_t$. n in the equation of best fit we estimate the values of y (i.e. P_t) at different ages.

By using the formula

$$\sqrt{t} = \frac{1}{i}\frac{P_{t+i} - P_t}{1-p_t}$$

the incidence of infection at each age is calculated.

Adjustment for exclusion of those with BCG Scar:

Most of the villages in the survey were covered by Mass BCG Campaign during 1954-55. Some of those who were vaccinated at that time would have become naturally infected but for vaccination. Thus the prevalence of natural infection in the community would have been different from that observed among those without BCG scars. The prevalence rates for natural infection have, therefore, to be estimated for the population including persons with BCG or doubtful scar before incidence rates (for natural infection) could be derived from them. For this purpose, we assume that the annual infection rate among the BCG or doubtful scar group is the same as among those without any scar.

By applying the above rates to the number tested and read among those with BCG scar (after making due allowance for the fact that they were vaccinated in 1954-55) the number among them that would have been found infected at the time of the survey has been estimated. The prevalence rate was then re-calculated by including this to the number actually found to be infected among those without BCG scar. From these prevalence rates, incidence rates were worked out by the three alternate methods explained earlier. But this value is a tentative value because the estimated number of persons that would have become infected in the BCG vaccinated but for the vaccination are calculated on the basis of an incidence rate which is only approximate. In order to arrive at a stable figure this process should be repeated 3 or 4 times till we get at a rate that does not undergo further revision, i.e., becomes stable. This may be taken as the true incidence rate.

APPENDIX V

Details of findings for each group in the survey

Group No	Total registered	Total Test read	Infection rate > 10 mm	Total X-rayed	Radiologically active disease		Bacillary cases	
					No.	Rate	No.	Rate
1	2	3	4	5	6	7	8	9
501	456	387	49.9	303	10	3.3	4	1.32
502	966	799	47.2	630	13	2.1	3	0.48
503	273	251	48.2	176	3	1.7	2	1.14
504	220	185	61.1	152	7	4.6	4	2.63
505	103	97	30.9	69	2	2.9	1	1.45
506	874	738	47.8	581	19	3.3	5	0.86
507	377	295	34.2	200	2	1.0	...	...
508	1,427	1,196	41.6	961	15	1.6	6	0.62
509	93	75	37.3	64	...	...	...	...
510	351	331	36.6	239	2	0.8	...	...
511	3,021	2,276	51.0	1,906	53	2.8	6	0.31
512*	560	423	51.8	345	12	3.5	4	1.16
513	897	723	61.0	637	24	3.8	5	0.78
514	480	409	40.8	338	9	2.7	1	0.3
515	1,056	888	55.5	714	16	2.2	5	0.7
516	769	593	26.3	488	4	0.8	1	0.2
517	266	217	35.9	160	4	2.5	...	...
518	347	314	19.4	218	2	0.9	...	...
519	242	186	28.5	147	1	0.7	...	...
520	306	272	32.4	212	5	2.4	...	...
521	113	85	35.3	73	3	4.1	...	...
522	347	265	21.9	220	1	0.5	1	...
523	140	129	41.1	87	3	3.4	...	...
524	630	553	35.1	453	5	1.1	...	...
525	491	402	46.0	328	4	1.2	1	0.3
526	428	401	32.7	295	9	3.1	1	0.34
527	568	509	41.8	373	6	1.6	2	0.54
528	1,803	1,479	45.4	1,279	23	1.8	7	0.55
529	467	401	29.4	271	2	0.7	...	...
530	625	563	35.9	440	12	2.7	4	0.91
531	49	39	25.6	32	...	...	...	...
532*	512	404	41.8	285	4	1.4	1	0.35
533	501	410	25.1	352	4	1.1	...	...
534	897	665	22.0	606	3	0.5	...	...
535	447	383	25.6	320	3	0.9	1	0.31
536	836	677	34.4	543	8	1.5	1	0.18
537	510	432	34.3	339	9	2.7	3	0.88
538*	540	407	56.6	318	9	2.8	2	0.63
539	23	200	27.0	177	...	...	...	...
540	516	437	33.2	350	4	1.1	1	0.29
541	117	99	29.3	81	...	...	...	...
542	321	252	34.5	228	3	1.3	1	0.44
543	145	118	28.0	90-	1	1.1	...	...
544	442	341	32.0	284	6	2.1	...	...
545	84	59	40.7	48	1	2.1	1	2.08
546	205	182	20.3	112	2	1.8	...	...
547	227	194	22.2	157	2	1.3	1	0.64
548	102	83	50.6	69	5	7.2	...	...
549	336	282	37.6	196	2	1.0	...	...
550	506	430	26.7	312	4	1.3	...	...
551*	537	369	38.9	342	10	2.9	2	6.58

* Town blocks

Group No.	Total registered	Total Test read	Infection rate > 10mm	Total X-rayed	Radiologically active disease		Bacillary cases	
					No.	Rate	No.	Rate
1	2	3	4	5	6	7	8	9
552	59	51	33.3	45	2	4.4	...	...
553	740	650	33.1	498	8	1.6	1	0.2
554	713	596	36.1	499	6	1.2	2	0.4
555	183	148	43.9	110	1	0.9	...	...
556	17	17	29.4	13	...	...	...	...
557	132	106	33.0	93	...	...	...	...
558	5	4	...	...	...	...	...	...
559	592	471	22.7	385	3	0.8	...	...
560	446	332	21.4	289	2	0.7	1	0.35
561	181	150	36.6	115	2	1.7	...	...
562	271	194	27.8	171	...	...	...	...
563	506	347	27.4	328	1	0.3	1	0.3
564	429	352	27.8	274	7	2.6	2	0.73
565	821	650	26.0	547	7	1.3	1	0.18
566	102	93	36.6	58	2	3.4	1	1.72

APPENDIX VI

Statistical note on the calculation of the co-efficient of variation for the various prevalences

The villages or town blocks were selected randomly in the manner described in the test and the entire population of the selected villages and the town blocks were included in the survey. It may, therefore, be noted that the sampling plan was that of cluster sampling, each cluster being a village or a town block and not a random sample of persons constituting the rural population of the district. The parameter to be estimated in the population is the prevalence rate, which may be denoted by p. If the number examined and the number of cases in any village of the district be denoted by x_i and y_i respectively then

$P = \sum y_i / S X$; where the summation extends over all the villages of the district.

Let x and $\wp x^2$ be the mean and the variance of x_i y and $\wp Y^2$ the mean and the variance of y_i and let $\wp xy$ be the covariance between X_i and y_i over all the villages in the district.

The estimate of the population parameter P is given by $\hat{P}$ where

$$\hat{P} = \Sigma y_a / \Sigma x_a$$

where y a is the number of radiologically active cases diagnosed among x_a persons x-rayed in cluster a' the summation in each case running over all the n clusters (n=66). For simplicity, the town blocks have been treated as villages randomly selected, as the result is unlikely to be affected appreciably by this procedure. It is known that this estimate is biased but the bias is small and can be ignored.

The variance of this estimate is given by the formula

$$V(\hat{P}) = \frac{p^2}{n}(C_{xx} - 2C_{xy} + C_{yy})$$

where C_{XX} is the square of the co-efficient of variation of x in the population, i.e. $C_{xx} = \frac{\wp x^2}{x^2}$

similarly $C_{yy} = \frac{6 y^2}{\bar{y}^2}$ and $C^2_{xy} = \frac{6\ xy}{\bar{x}\ \bar{y}}$

Since the variances and the means are not known, they have to be estimated. An estimate of the variance of P is furnished by the formula.

$$V(\hat{P}) = \frac{\Sigma y_i^2 - 2P\ \Sigma x_i\ y_i + P^2 \Sigma x_i^2}{n(n-1)\ \bar{x}^2}$$

These procedures applied to the data of the survey furnished the following results.

Category	Estimated prevalence	Standard error	Co-efficient of variation
	%	%	%
Infection	38.3	1.84	4.8
X-ray cases	1.9	0.15	8.1
Bacillary cases	0.4	0.05	11.5

Of the total number of 392 X-ray cases among 21,021 X-rayed, 35 belong to the town blocks wherein 1290 were examined. These figures make it appear that the prevalence rate in the towns is higher than in the villages, but this inference is not to be regarded as valid since the total number of persons X-rayed in the towns is 1290 and this figure is rather inadequate for drawing any general conclusions.

INTERMITTENT TREATMENT OF PULMONARY TUBERCULOSIS

A concurrent comparison of twice-weekly isoniazid plus streptomycin and daily isoniazid plus PAS in Domiciliary Treatment*

From the Tuberculosis Chemotherapy Centre, Madras†

Domiciliary chemotherapy of tuberculosis has become accepted practice in developing countries, but the best method of administering the drugs is still in question. Self-medication for long periods may result in irregularities, and although fully supervised daily chemotherapy has been used to avoid these, it imposes a considerable strain on clinic and patients, and is hardly practicable in developing countries (see review by Fox, 1962). If, instead, supervised therapy could be given intermittently—e.g., twice a week—the method could become more generally applicable.

A rational basis for intermittent chemotherapy was suggested by previous studies at this Centre. In a comparison of 3 regimens of isoniazid alone with a regimen of isoniazid plus *p*-amino-salicylic acid (PAS) (Tuberculosis Chemotherapy Centre, 1960) it had been found that a daily dosage of isoniazid (7.8—9.6 mg/kg. body-weight) was more effective when given in 1 dose than when given in 2 doses. There was evidence that this was because a high peak concentration of isoniazid in the serum played a more important role in the response to treatment than the maintenance of a continuous inhibitory level of the drug (Gangadharam *et al.,* 1961). It was therefore reasonable to study regimens in which the interval between suitably high doses of isoniazid was extended. It seemed unlikely that efficacy would be seriously diminished by a limited degree of intermittency, in view of our observation that patients who showed irregularity (on the evidence of urine tests) in taking isoniazid in a large dosage every day responded to treatment as well as those who were completely regular. (Tuberculosis Chemotherapy Centre, 1963a, 1963b).

There is relevant experimental evidence that a high dosage of streptomycin or isoniazid given at intervals of 5 or 7 days is effective in suppressing the development of tuberculosis in the guinea-pig (Corper and Cohn, 1947; Palmer *et al.,* 1956). There is similar evidence, in tuberculosis of the mouse, of the effectiveness of isoniazid every 7 days (Bloch, 1961), and of isoniazid plus streptomycin every 3 days (Grumbach *et al,* 1952).

In view of our finding and the experimental evidence, we decided to test the effectiveness of a combination of the 2 most potent standard antituberculosis drugs—namely, isoniazid and streptomycin—given twice weekly under supervision, the minimum interval considered to offer substantial practical advantages over a daily regimen. Isoniazid was to be given, in high dosage and streptomycin was to be administered in doses of 1 g., which, in view of the light weight of our patients, is a higher dosage than is usual.

The investigation

In June 1961, we started a controlled comparison of this supervised intermittent regimen with our standard unsupervised daily regimen of isoniazid plus PAS. The findings are of sufficient importance to merit this preliminary communication, which gives bacteriological results at 6 and 9 months. (Detailed findings at 1 year will be published later in the *Bulletin of the World Health Organisation.)*

* Published in the *Lancet,* London (1963, i, 1078) and reprinted by permission of the editor.

†The Centre is under the joint auspices of the Indian Council of Medical Research, the Madras State Government, the World Health Organization and the Medical Research Council of Great Britain. The research of the Centre is guided by a Project Committee consisting of representatives of the above agencies and the Director of the Centre. The British Medical Research Council (acting through their Tuberculosis Research Unit) are responsible for advising the World Health Organization on the research. This preliminary communication has been prepared by the senior scientific staff of the Centre.

Chemotherapeutic regimens

The 2 chemotherapeutic regimens studied were:

SHTW.—Streptomycin sulphate by intramuscular injection in a dose of 1 g. irrespective of the patient's weight, plus isoniazid in a single oral dose of 650 mg. for a patient weighing 100 Ib. (45.4kg.); the 2 drugs were given together twice weekly (at intervals of 3 and 4 days). Each dose of streptomycin was, on average, 27.0 mg/kg initial body weight (range 18.2 to 53.7 mg). The dosage of isoniazidwas increased for heavier and reduced for lighter patients (Tuberculosis Chemotherapy Centre, 1963a), the average being 13.9 mg/kg. body-weight initially (range 12.5 to 16.1 mg).

PH.—Isoniazid 200 mg. daily plus PAS (sodium salt) 10 g. daily in 8 cachets (4 in the morning, 4 in the evening) for a patient weighing 100 Ib. or more. The dosage was reduced for lighter patients (Tuberculosis Chemotherapy Centre, 1959). The average daily initial dosage of isoniazid was 4.4. mg/kg. body-weight initially (range 3.7 to 6.3 mg), and that of PAS was 220 mg/kg. (range 180 to 320 mg).

Management of the patients

The patients in the SHTW series attended the Centre's clinic twice a week and received an injection of streptomycin; a dose of isoniazid was given at the same time under the direct supervision of the clinic staff. The PH patients attended the clinic once a week for a supply of cachets, which were to be taken at home. In other respects the management of the patients in both series followed the same lines as in a previous investigation at this Centre (Tuberculosis Chemotherapy Centre, 1960). All the patients were to be treated as out-patients for 12 months.

Among other procedures, specimens of sputum were examined bacteriologically before treatment and monthly thereafter. These specimens were cultured on Lowenstein-Jensen medium according to the procedure described previously (Tuberculosis Chemotherapy Centre, 1960). For the purpose of this communication, progress has been assessed only by the culture results of 2 'collection' (overnight) and 1 supervised 'spot' specimen of sputum obtained at 6 and at 9 months.

Definition of suitable cases

The patients were drawn from the same area in Madras City as before (Tuberculosis Chemotherapy Centre, 1960, 1963a, 1963b). They all conformed to the same criteria as in the earlier studies. In particular, all had bacteriologically confirmed pulmonary tuberculosis on admission, were aged 12 years or more, and as far as was known had either received no previous antituberculosis chemotherapy or had received it for not more than 2 weeks.

Patients admitted to study

In all, 165 patients were allocated by a random procedure either to the intermittent regimen (83 SHTW patients) or to the daily regimen (82 PH patients). Fifteen patients have been excluded from the analysis because they had been excreting resistant organisms on admission to the investigation; 7 (3 SHTW, 4 PH) had organisms resistant to isoniazid, 5 (1 SHTW, 4 PH) had organisms resistant to streptomycin and 3 (all PH) organisms resistant to both drugs. There remain 150 patients (79 SHTW, 71 PH) for analysis.

Condition on admission

The age, sex and weight distributions of the patients (not tabulated here) were similar for the 2 series on admission. Table I shows their pretreatment radiographic and bacteriological condition. The radiographic findings were reported from single full-plate radiographs by an independent assessor (Dr J. Frimodt-Moller) who was unaware of the treatment series of any patient. He graded cavitation as extensive in 24 per cent of the 79 patients in the SHTW series and in 15 per cent of the 71 in the PH series; 5 per cent and 6 per cent, respectively, had no cavitation. With regard to total extent of disease, 28 per cent of patients in the SHTW series and 31 per cent in the PH series had extensive or gross disease; 48 per cent and 52 per cent, respectively, had 4 or more lung zones involved in disease. The distributions of the bacterial content of the first (or only) collection specimen of sputum were also similar. Thus, 10 per cent of both series were negative on direct smear examination; the proportion with 2-plus or 3-plus positive smears were 67 per cent for the SHTW and 72 per cent for the PH series, respectively.

RESULTS

Deaths

Three patients died of pulmonary tuberculosis, 2 (1 SHTW, 1 PH) in the first week and the third (SHTW) in the sixth month. This patient's sputum was culture-negative at 3 and 4 months, but she had a serious radiographic deterioration in the fifth month (no culture results were available at 5 months). One other patient (PH) died suddenly from a non-tuberculous cause (believed to be pulmonary embolism) in the eighth month; the sputum had been culture-negative from 1 month. Permission for necropsy was refused for all 4 patients.

Premature termination of originally prescribed chemotherapy

Three patients (all PH) had their original regimen terminated for drug toxicity, 1 in the first, 1 in the fifth and 1 in the ninth month. Six patients (5 SHTW, 1 PH) became uncooperative and stopped the treatment, 2 (SHTW) in the third month, 1 (SHTW) in the seventh and the other 3 in the eighth month; in 3 of the SHTW patients streptomycin toxicity may have been a contributory factor.

The patient who died from a non-tuberculous cause in the eighth month has been included in the analysis at 6 months, and the 9 whose originally prescribed chemotherapy was terminated prematurely have been included up to the time of the termination. The patients who died of tuberculosis have been retained in the analysis.

Bacteriological findings

The results of culture examination of the sputum specimens at 6 and 9 months are shown in Table II. (Apart from the above exclusions, results are not available for 1 patient [PH] at 6 months and 3 [2 SHTW 1 PH] at 9 months.) The average number of culture results per patient was 2.7 in each series at -6 months and 2.8 in each series at 9 months. At 6 months all the cultures were negative in 84 per cent of 77 SHTW patients compared with 85 per cent of 68 PH patients; at 9 months the corresponding figures were 93 per cent of 72 and 89 per cent of 65, respectively.

Drug toxicity

Two patients in the SHTW series had toxic symptoms attributed to isoniazid. One patient had convulsions a few hours after the administration of chemotherapy on 2 occasions in the first 2 months of treatment; these did not recur after pyridoxine in a dosage of 6 mg twice weekly was added to the chemotherapy. The other patient first complained of symptoms attributable to peripheral neuropathy in the second month; pyridoxine in a dosage of 6 mg. twice weekly was given with the chemotherapy with subsequent improvement in the clinical symptoms and signs. Complaints of giddiness were recorded in 24 of the 79 patients in this series (7 of 71 PH patients also complained of giddiness), once in 15 of them and on 2 or more occasions in 9. In 5 of the latter it was necessary to reduce the high dosage of streptomycin to approximately 15 mg/kg, bodyweight for each dose; 4 of the 5 remained under treatment to the end of the period.

Three patients in the PH series developed hypersensitivity reactions to PAS in the early weeks of treatment; as noted above, it became necessary to change to a different chemotherapeutic combination. Desensitisation was attempted and was initially successful in 2 patients; however, both again developed reactions which could not be controlled. All 3 patients received prednisone.

DISCUSSION

In the treatment of pulmonary tuberculosis with combined chemotherapy, it is standard practice to give the 2 or more drugs in 1 or more doses daily; regimens consisting of 1 drug (isoniazid or PAS) given daily and another (usually streptomycin) given on 2 or 3 days a week are no longer regarded as adequate by most authorities.

There have been a few reports of studies in which the entire medication, whether with a single drug or a combination, was less frequent than once a day. Frimodt-Moller *et al.* (1953) compared isoniazid alone every fourth day with the same dosage given daily, and found similar radiographic responses in the 2 series at 12 weeks. Katz *et al.* (1954) and Chambers *et al.* (1955) treated a small group of patients with streptomycin 2 g. plus isoniazid 500 mg. both being given together by injection "twice weekly. They considered that the radiographic and bacteriological improvement was inferior to results achieved previously with daily isoniazid plus twice-weekly streptomycin. Tyrrell (1956) gave newly-diagnosed cases

TABLE I

Radiographic and bacteriological condition on admission to treatment

Condition on admission to treatment	SHTW		PH	
	No.	%	No.	%
Extent of cavitation:				
Nil … … … … … …	4	*5*	4	*6*
Slight … … … … …	26	*33*	26	*37*
Moderate … … … … …	30	*38*	30	*42*
Extensive … … … … …	19	*24*	11	*13*
Total extent of disease :				
Trivial or slight … … … …	6	*8*	1	*1*
Limited or moderate… … … …	51	*65*	48	*68*
Extensive or gross … … … …	22	*28*	22	*31*
Number of lung zones involved in disease :				
1, 2 or 3 … … … … …	41	*52*	34	*48*
4, 5 or 6 … … … … …	38	*48*	37	*52*
Bacterial content of sputum : (First or only "collection" specimen)				
Direct smear negative … … …	8	*10*	7	*10*
Direct smear positive				
1-plus (scanty) … … …	18	*23*	13	*18*
2-plus (moderate) … … …	41	*52*	44	*62*
3-plus (heavy) … … …	12	*15*	7	*10*
Total patients …	79	*100*	71	*100*

TABLE II

Presence of tubercle bacilli in multiple sputum specimens at six and nine months

Months after start of chemotherapy	Treatment series	Total patients (A)	Tuberculous death	Patients with at least one specimen positive on culture	Patients with all cultures negative	
					No.	% of A
6	SHTW	77	2	10	65	*84*
	PH	68	1	9	58	*85*
9	SHTW	72	2	3	67	*93*
	PH	65	1	6	58	*89*

streptomycin 1 g. and isoniazid 400 mg. on the same day twice weekly, half being treated in hospital and half as ambulatory out-patients. At 6 months, sputum conversion had occurred in 78 per cent of 45 in-patients and in 80 per cent of 46 out-patients; there was no comparative group on daily drug administration. Holmes *et al.* (1962) reported on 29 patients given a large dose of isoniazid once a week for periods of up to 3 months, but only 2 became culture-negative. Streptomycin plus isoniazid, the 2 drugs being given together every other day, has been used with success by Mackay-Dick and his colleagues (Mackay-Dick, 1954, 1959; Todd *et al.,* 1956; Bade *et al.,* 1959; and by Hutton *et al.* (1956), but in these series the intermittent regimen was used as continuation therapy after a period of 1 to 3 months of daily combined chemotherapy.

In our controlled study, streptomycin plus isoniazid, both drugs being given together twice a week in high dosage under supervision as a primary treatment (SHTW regimen), has proved to be therapeutically as effective as the standard oral 2-drug regimen of PAS plus isoniazid, prescribed for self-medication daily (PH regimen). Although results are at present complete only up to 9 months, there is no reason to think that the position will be different when all the results at 12 months are available.

Evidence of toxicity was seen in some patients in both series. In the SHTW series, it was necessary to reduce the dosage of streptomycin in 5 patients because of giddiness. In 19 other patients who reported giddiness, it was not considered necessary to reduce the dosage, and in most it is uncertain how far, if at all, their complaints were due to the streptomycin. Isoniazid caused convulsions in 1 patient and peripheral neuropathy in 1 other; both responded to 6 mg. of pyridoxine given twice weekly with their chemotherapy. Probably the isoniazid toxicity could have been prevented if this small dose of pyridoxine had been given from the start of treatment (Tuberculosis Chemotherapy Centre, 1963b). In the PH series 3 patients developed hypersensitivity to PAS and their original treatment had to be terminated.

Five of 79 patients on intermittent chemotherapy became unco-operative and stopped their treatment. The reasons are uncertain, though streptomycin toxicity may have been a factor in 3. A fuller assessment of the acceptability of the intermittent regimen should be possible when the findings for 1 year are available, but it will be difficult to make valid comparisons with the regimen for daily self-medication.

The encouraging therapeutic results of intermittent chemotherapy in this trial suggest that a change in orientation of drug administration for tuberculosis may become possible in the developing countries, from the present daily self-admini tration to twice-weekly fully supervised administration. The next steps for consideration include study of dosage and acceptability in greater detail and of a decrease in the frequency of administration to once weekly. Once-weekly regimens are now being investigated at this Centre; if this frequency should prove successful, it would offer further advantages, in convenience for the patients, in economy, in applicability to mass treatment, and possibly in decreased toxicity.

SUMMARY

One hundred and sixty-five patients were allocated by a random procedure to an intermittent chemotherapeutic regimen of streptomycin plus isoniazid given together under supervision twice weekly (SHTW regimen, 83 patients) and to a standard regimen of PAS plus isoniazid for daily self-administration (PH regimen, 82 patients). Fifteen patients (4 SHTW, 11 PH) have been excluded from the analysis because they had organisms resistant to streptomycin or isoniazid or both at the start of treatment.

This preliminary report gives the sputum-culture results at 6 and 9 months.

The pre-treatment status of the patients in the 2 series was similar in respect of a number of factors examined—namely, age, sex, weight, radiographic findings and bacterial content of the sputum.

Three patients (2 SHTW, 1 PH) died of pulmonary tuberculosis. At 6 months all the cultures were negative for 84 per cent of 77 SHTW patients compared with 85 per cent of 68 PH patients. The corresponding proportions at 9 months were 93 per cent and 89 per cent, respectively.

Two SHTW patients had isoniazid toxicity, treated with 6 mg of pyridoxine twice a week without interrupting the regimen; in 5 SHTW patients the dosage of streptomycin was reduced because of giddiness; and 3 PH patients

had their originally prescribed treatment terminated for PAS toxicity. Six unco-operative patients 5 SHTW, 1 PH) stopped treatment, This may have been partly due to streptomycin toxicity in 3 SHTW patients.

The encouraging results of twice-weekly supervised chemotherapy in this trial suggests that a change in orientation of drug administration for tuberculosis in developing countries may become possible.

REFERENCES

Bloch, H. (1961) *Amur. Rev. resp. Dis.,* 84, 824.

Chambers, J., Katz, S., McCormick, G., Gimble, A., Leonard, J., Schmidt, W., Shea, J. (1955) *in* Transactions of the XIVth Conference on the Chemotherapy of Tuberculosis; p. 107. Washington, D.C.

Corper, H. J., Cohn, M. L. (1947) *Science* 106, 446.

Bade, A. W. T., Harrison, G. K., Large, S. E., Mackay-Dick, J., Reid, L. McA., Riddell, R. W. (1959) *Thorax* 14, 104.

Fox, W. (1962) *in* Proceedings of the XVIth International Tuberculosis Conference 1961; p. 307, Amsterdam.

Frimodt-Moller, J., Jesudian, K. T., Muthiah, T. S., Barton, R. M. (1953) *Ind. J. Tub.,* 1, 23.

Gangadharam, P. R. J., Devadatta, S., Fox, W., Narayanan Nair, C., Selkon, J. B. (1961) *Bull. World Hlth. Org.,* 25, 793.

Grumbach, F., Rist, N., Riebel, J. (1952) *Ann. Inst. Pasteur* 83, 397.

Holmes, C. X., Martin, G. E., Fetterhoff, K. L, Kaiser, J. C. (1962) *Amer. Rev. resp. Dis.,* 86, 87.

Hutton, P. W., Lutalo, Y. K., Williams, A. W., Tonkin, I. M., Fox, W. (1956) *Tubercle, Land.,* 37,151.

Katz, *S.,* McCormick, G., DeLeon, A., Gruver, R., Stanton, J., Bakir, F., Marshall, E. (1954) in Transactions of the XIIIth Conference on the Chemotherapy of Tuberculosis; p. 355. Washington, D.C.

Mackay-Dick, J. (1954) *Lancet* ii, 44.

Mackay-Dick, J. (1959) *Brit. med. J.,* ii, 100.

Palmer, C. E., Ferebee, S. H., Hopwood, L. (1956) *Amer. Rev. Tuberc.,* 74, 917.

Todd, G., Teare, D., Gordon, W. I. (1956) *Lancet* ii, 1.

Tuberculosis Chemotherapy Centre (1959) *Bull. World Hlth. Org.,* 21, 51.

Tuberculosis Chemotherapy Centre (1960) *Bull, World Hlth. Org., 23,* 535.

Tuberculosis Chemotherapy Centre (1963a) *Bull. World Hlth. Org.* (in press).

Tuberculosis Chemotherapy Centre (1963b) *Bull. World Hlth. Org.* (in press).

Tyrrell, W. F. (1956) *Lancet* i, 821.

NEWS AND NOTES

Annual General Meeting

The twenty-fourth annual general meeting of the Tuberculosis Association of India was held on 9th May at the headquarters office. The conference of the Secretaries of State Association was also held on the same day.

Rajkumari Amrit Kaur, President of the Association, in her address to the general meeting urged the Indian doctors and specialists to devote more time to original research and help effectively in the prevention and control of tuberculosis in India.

Major-General C. K. Lakshmanan, Vice-Chairman of the Association presented the annual report on behalf of Dr M. S. Chadha, Chairman of the Association who was out of India. Shri S. Ratnam, Honorary Treasurer presented the audited accounts of the Association for the year 1962. The meeting adopted the report.

Over 100 visitors including Dr D. S. Raju, Union Deputy Minister for Health, attended the meeting by invitation.

The following persons were elected to the Central Committee of the Association for the year 1963-64:

Lt.-General S. P. Bhatia
Dr P. K. Sen
Lt.-General B. M. Rao
Dr R. N. Tandon
Dr (Mrs) M. B. Kagal
Dr R. M. Kasliwal
Mrs M. Clubwala Jadhav

Standing Technical Committee

The Standing Technical Committee of the Association which met in New Delhi on 10th May considered the subjects to be discussed at the next TB & Chest Diseases Workers' Conference to be held in New Delhi. The Committee resolved that the programme for the Conference may include a Panel Discussion on "Problems connected with the Home Treatment in Tuberculosis," a Symposium on "Hospital Admission Policy" and papers on BCG Vaccination, Domiciliary Drug Therapy, etc. The Committee further decided that papers may be invited on these and other subjects from all TB workers and the programme finalised at its next meeting to be held in October, 1963.

New TB Seal Design

Design for the TB Seal for the 14th Seal Sale Campaign has now been selected. Out of a large number of designs sent in for the competition by artists from different parts of India, the one submitted by Shri M. Krishnan of Madras was selected. The design depicts a lady wishing the patriot all success in the traditional manner by putting tilak on his forehead. The theme is reminiscent of the timeless spirit of sacrifice made by our women at the call of the country.

The prize amount of the Seal design is Rs 500. For the 14th TB Seal Sale Campaign, the poster and placard will carry the picture of the Seal.

Silver Jubilee Celebrations

The Tuberculosis Association of India will be completing its twentyfive years of service in February, 1964. It is contemplated to celebrate its Silver Jubilee in March-April, 1964, combining with it the annual general meeting, the Central Committee meeting, Secretaries' Conference and the meeting of the Technical Committee. The 19th TB Workers' Conference also will be held in Delhi at that time.

The Association will bring out a Silver Jubilee Souvenir which will serve as a handbook of anti-tuberculosis movement in India.

The sixth edition of the Directory of TB institutions in India will also be brought out at this time. State Associations and government agencies are requested to send in the latest information about institutions in their states for incorporation in the Directory not later than 31st July, 1963.

State Associations are also requested to send in a brief history of the anti-TB movement in their States latest by 30th June, 1963.

Donation of Film

The Canadian Tuberculosis Association has donated to this Association a film entitled, "The Quiet Betrayal." The film comes to this

Association as a goodwill gesture of the school children of Yellow-kniefe public school in the North West Territories of Canada who arranged a ticketed show of a Concert programme and collected funds for this film.

Silver Jubilee Research Award

The Medical Council of India has announced a Silver Jubilee Research Award Fund to commemorate its Silver Jubilee. The first award will be made in November/December, 1964. The award is open to all citizens in India and foreign nationals who have done research work in India in medical and allied Sciences.

The value of the award is Rs 15,000 and a Gold Medal of the value of Rs 1,000.

For details contact Secretary, Medical Council of India, Kotla Road, New Delhi.

Dr S. N. Bansali Charitable Trust Prize

The Bombay Obstetric and Gynaecological Society has invited two essays on "Any original work on human sterility" and "Perinatal Mortality" or "Vaginal Cytology" for the award of Dr S. N. Bansali Charitable Trust Prize for the year 1962 and for the award of Dr Herculano De Sa Silver Jubilee Prize for the year 1963.

The value of the prizes are Rs 500 and Rs 250 respectively. For full details write to the Secretary, Bombay Obstetric and Gynaecological Society, Purandere Griha, Chowpatty Sea Face, Bombay-7.

The Indian Journal of Tuberculosis

ABSTRACTS

Vol. X June, 1963 Abst. No. 3

Biopsy of the Bronchial Wall as an Aid in Diagnosis of Sarcoidosis

Of the 35 patients with sarcoidosis, bronchoscopic Biopsies in 22 showed non-Caseating, epitheloid Cellgranulomas in the sub mucosa.

Of the 9 patients who .had wheezing and Stridor, 7 revealed granulomas on Bronchoscopic Biopsy.

Random specimens from 26 patients with no significant bronchial symptom revealed silent Bronchial granulomatous involvement in 15 patients.

Specimens received from areas of Mucosal thickening showed granuloma in 15 of 18 patients and even specimen removed from normal appearing mucosa at random revealed granuloma in the depths of 7 of 17 patients.

Random Bronchoscopic Biopsy adds a new and simple technique for the tissue diagnosis of intra thoracic sarcoidosis.

(Oscar H. Friedman, Stanley M. Blangrund and Louis E. Siltzback; Journal of American Medical Association, Vol. 783, No. 8, February 23, 1963.)

The Incidence of Pulmonary Emphysema

In random necropsy studies of 138 patients, 49.3% were found to have emphysema.

In 6.5%, this was severe enough to cause death or disability.

The emphysema may be Centrilobular, Panacinar or the Alveolar duct type. The incidence of Centrilobular was slightly more common and involved the upper Zones (upper lobe and the superior segment of lower lobe more) more frequently. Panacinar and alveolar duct emphysema was evenly distributed and in severe cases it involved the lower zones of the lungs i.e., Basal Segment of the lower lobe and lower part of the Middle lobe or lingula.

Lungs with widespread emphysema showed mixture of both Centrilobular and Panacinar emphysema.

(William M. Thur Block; Am. Rev. Resp. Dis; Vol. 87, No. 2, Feb., 63.)

Diffuse Pulmonary Lesion. The Problem of Differential Diagnosis

By diffuse pulmonary lesions, we mean any condition capable of producing bilateral densities on the chest X-ray film, which are more or less symmetrical and involve extensive portions of both lungs.

For diagnosis, in addition to the roentgen film, History, Physical examination, Laboratory studies, Biopsy of lymph node or lung help in final diagnosis.

Regarding X-ray diagnosis, three points are of importance:

First: type of infiltration.
Second: Distribution.
Three: Presence of additional lesions.

The type of infiltration may be classified as (a) Streaks. The streaks may be fine, dense or massive, *(b)* Miliary, sub-miliary or larger nodules.

The pattern of distribution is of help in differential diagnosis. These may be situated in the upper part of the lungs, lower part of the lungs, Mid portions of the lungs or evenly distributed throughout the lung fields.

(Howard A. Buedner, Coleman B. Rabin, G. W. H. Schepers, David M. Spanni and Morton M. Ziskind; Dis. Chest, Vol. 43, No. 2, Feb., 63.)

The Medical and Surgical Treatment of Staphylococcal Pneumonia

The Incidence of Staphylococcal Pneumonia is higher in children. 60% of the cases in children are under the age of six months and it has a seasonal variation with a peak during winter and early spring. There is no such variation in adults.

Staphylococcal Pneumonia may be manifested in one of the two following characteristic fashions, the Juvenile and the Adult forms.

The Diagnosis is based first on recovery of the Staphylococcus aureus organisms and second on the characteristic roentgenographic picture.

The single most reliable clinical criterion in the diagnosis of Staphylococcal Pneumonia is the appearance of the X-ray film of the chest.

The roentgenographic picture is rapidly changing in presence of an unchanging clinical picture.

Acute Pneumonia with multiple cavities and Pneumatocele is almost certainly of Staphylococcal origin. Although empyema occurs in other acute pneumonia especially Pneumococcal, this complication raises the strong suspicion of Staphylococcal etiology particularly in children when empyema developes into a Pyopneumothorax, one must regard a Staphylococcal etiology as very probable.

In addition, a progressive clinical picture with severe Pneumonites which does not respond to sulphonalimides, standard doses of Penicilline or tetracycline Drugs is a supportive evidence of Staphylococcal pneumonia. Medical treatment rests on the selection of chemotherapeutic agents on the basis of invitro sensitivity of the organism.

Chloramphenicol is generally conceded to be the most effective because of low incidence of Staphylococcal resistance.

The points to be kept for antibiotic therapy are:

1. Never use a single antibiotic agent.
2. Sensitivity tests should be done.
3. The treatment should be carried for more long time as compared to for another organisms.

Surgical treatment includes drainage of Plural Effusion by continuous suction, reduction of pneumothorax and only rarely decortication for adhesive limitation of respiratory function.

Occurrence of the disease in the first three months of life short fulminating course of the disease with little or no prodrome of leukopenias all indicate good prognosis.

(Manard E. Pont and William C. Rountree. Dis. Chest Vol. 43, No. 2, Feb., 63.)

Further Developments in Human and Bovine Anti-tuberculosis Chemoprophylaxis with Isoniazid in Italy

Of the 16,402 subjects of both sexes, 65.5 per cent were treated with Isoniazid and 34.4% were controls.

In group treated with Isoniazid 51.6 percent and 40.3 per cent in the Control Group lived in tuberculous family surroundings or with strong contagion.

Initial tuberculin reaction was positive in 77% of cases.

In 2507 cases or 15.2% in whom Isoniazid was given were with suspected pre-allergic phase and in tuberculin negative subjects living in contact with tuberculous people (Primary Chemoprophylaxis).

Former tuberculous or plaisitic subjects were submitted to Chemoprophylaxis in order to avoid relapse. Psychiatric patients and silicotic miners were also included.

At the Chemoprophylaxis Centre in Latium and the Aosta Valley; of the 10272 people, 6567 were treated and 3705 were under control.

79.4% were tuberculin positive and 20.6 per cent tuberculin negative. Of both Categories, about two thirds were treated with Isoniazid and one third with a placebo.

Prolonged isoniazid treatment did not modify the pre-existing allergic state which remained uncharged in 57% of treated and 62% of Controls.

Conversion of tuberculin reaction to negative occurred in 12% of treated and 9% of the Controls.

13% of the treated and 25% of the Control, tuberculin negative became tuberculin positive.

In the treated group 12 or 0.18% developed tuberculous disease compared to 45 or 1.21% of the Control. Of the 3132 subjects treated in tuberculous surroundings, 10 or 0.31 per cent against 29 of 2.14% out of 1349 Control.

In healthy family surroundings 2 or 0.058 cases of tuberculosis were found in 3435 as compared to 16 or 0.68% of 2350 in Control. Of the 5198 tuberculin positive subjects treated with Isoniazid, 6 or 0.11% became ill against 27 or 0.91% in 2958 Controls.

In tuberculin negatives, 6 or 0.44% of 1369 subjects treated became ill as compared with

18 or 2.4% of 747 Controls, indicating that primary Chemoprophylaxis is valuable.

Isoniazid treatment had inhibitory influence on the primary adenopathies and on the pulmonary haematogenous forms of tuberculosis such as miliary tuberculosis, Pleurisy, Osteo articular tuberculosis while it was less effective in preventing post-primary pulmonary infiltrative forms.

Indications for Chemoprophylaxis with Isoniazid are:

(1) In Primitive areas and in countries with a high rate of tuberculosis which lack anti-tuberculosis organization.

(2) In similar but less serious situation when it is possible to carry out examination of the sputum, skin testing and Photofluorographic examination, selection of cases may be possible evolutive tuberculous forms to be treated with standard antibiotics, latent forms with isoniazid alone and tuberculin negative cases with vaccination.

(3) In countries where the incidence of tuberculosis is comparatively low with good dispensary and sanatorium organization, Chemoprophylaxis has selective indications which are as follows:

(a) For tuberculin negative children and adolescents exclusively when living with tuberculous people and in pre-allergic phase prior to removal from surroundings and to anti-tuberculosis vaccinations if they remain allergic.

If allergic charges take place, treatment with Isoniazid and other antibiotics should be pursued for at least six months.

(b) In all tuberculin positive children under five years of age, even when living in non-infectious surroundings and more particularly if tuberculin conversion is of recent origin in children over five years of age and in adolescents belonging to families with a tuberculous background especially if they are living with tuberculous individuals.

(c) In tuberculin positive subjects under 15 years of age living in any surroundings during anergizing grave illnesses and for 3 months after illness.

(d) In adults with recent tuberculin con version with tuberculin change as the only manifestation especially if they are living in contact with tuberculous people.

(e) In tuberculin negative as well as tuberculin Positive adults who may be exposed t° tuberculous infections due to laboratory accidents.

(f) Among allergic adults affected with Chronic diseases requiring prolonged treat ment with Corticosteroids.

(g) Among silicotics and siderotic miners,

(h) In formerly tuberculous subjects who happen to be in the following circumstances:

(1) Living in tubercle bacillus infected family or working at certain institutions.

(2) Diabetics (during at least 3 years after recovery).

(3) During Pregnancy and Puerprium.

(4) In subjects formerly suffering from pleurisy and periotonites.

(5) In formerly tuberculous subjects treated with artificial relaxation therapy or surgical measures without adequate Chemotherapy.

(Attilio Omodei Zorini; Dis. Chest, Vol. 43, No. 2, Feb., 63.)

Respiratory Function and Cardiac Dysponea

In 58 patients with acquired and congenital Heart disease, ventilation, lung volumes, gas mixing, diffusing capacity and mechanics of breathing were measured.

In patients with slight cardiac dysponea, the Forced Vital Capacity, total capacity was low along with prolonged 90 per cent desaturation time, a low compliance and high work of breathing both at rest and on hyperventilation.

In patients with moderate cardiac dysponea, there was hyperventilation at rest in addition to the above.

In patients with severe cardiac dysponea, in addition to the above had abnormalities of function, and had lower than the normal Functional Residual Capacity and Maximum Breathing Capacity, a decreased alveolar capillary permeability and an increased non-elastic resistance.

No test distinguished the patients with slight dysponea from those with moderate dysponea. The group with severe cardiac dysponea differed significantly from the slight and moderate dysponea groups in showing a lower total lung capacity and desaturation time, a lower compliance and higher non-elastic resistance.

(C. R. Woolf; Dis. Chest, Vol. 43, No. 2, Feb., 1963).

EXTRACTS

Doctor's Dilemma

Chronic cough and shortness of breath are often the "doctor's dilemma." These two symptoms have many causes. They may express many different underlying changes in the lungs, many alterations in the cardio-pulmonary relationships and many bizarre afflictions of mind or body. Trouble in the lungs may belong to the lungs or come from trouble with the heart. Conversely, the heart can fail from trouble with the lungs. Indeed, these two vital organs, the heart and the lungs, are so intimately dependent upon each other that it is almost axiomatic to say that what is good or bad for one is equally good or bad for the other.

(From N.T.A. Bulletin, February, 1963).

Cough and Shortness of Breath

What about cough? Some people do it to attract attention, some from habit, some from disease of the heart, but mostly it is nature's method of expelling strange humours from the lungs. Normally, the remarkably streamlined cleansing instruments in the bronchial tubes—wispay, microscopic hairs—sweep secretions and invisible foreign material beyond areas dangerous to the lungs. Smoking, poisonous fumes, pneumonias, and chronic bronchitis may irreparably destroy these delicate pulmonary brooms, thereby paving the way for a variety of chronic lungdiseases.

What about shortness of breath ? It may be a heart that has gone out of kilter, blood that has become unduly thin and anemic, blood pressure that has mounted skyward, kidneys that function poorly, a mechanical obstruction to the flow of air into and out of the lungs, a thickening of the millions of breathing membranes called the alveolar walls, or a conscious or unconscious refuge of the neurotic. Or it may be just a very pregnant lady.

(From N.T.A. Bulletin, February, 1963).

REVIEW

Respiratory Physiology — British Medical Bulletin—Published by the Medical Department—The British Council 65 Davies Street—London—W.I. Vol. 19—Number I—January 1963—P-Hugh-Jones and J. Morgan Campbells—XI+96 pages—36 figures—22J x 28J. cms—£l-10s.

This issue of the Bulletin is a Symposium on Respiratory, Physiology, to which contributions have been made by seventeen distinguished students of the subject. The papers are mostly the results of the contributors' own original research.

The study of the control and regulation of respiration is made difficult by the fact that Central neurone systems, reflex loops, widely scattered receptors, as well as chemical and mechanical factors are involved. As one author has pointed out, it *is* further complicated by the ambivalent nature of the respiratory act. On the one hand, breathing is a fundamental reflex which persists deep into unconsciousness: on the other hand, it is a movement under almost complete voluntary control. To illustrate the mechanism of the regulation of breathing, Dornhorst compares it to a machine consisting of the motor cortex, a computer and a servo-mechanism. From all the impulses and stimuli received by it, the computer works out the 'required ventilation' (vr). When the 'vr' reaches the servo-mechanism, the 'effector' in it, produces the 'achieved ventilation' (va). 'va' has a feed-back into the computer.

The 'Chemical stimulus to breathing' is described by another author. The question whether arterial partial pressures are the direct regulators of nervous activity, or whether the regulating devices operate at the venous, interstitial or intra-cellular levels, remains to be answered.

The 'Excitation mechanism of the carotid body', is dealt with by some authors. They hold that hypoxia is the essential factor in chemoreseptor activity, and that hypoxia may be caused by low arterial oxygen tension, anaemia, stagnation of blood, hystotoxic conditions etc. When oxygen supply to the carotid body becomes inadequate in any way, anaerobic metabolism causes the release of substances which, diffusing out of the cells, stimulate the pericellular chemosensory nerve-endings.

The 'Regulation of Respiration in Exercise' is described by one author and 'Exercise limitation in health and disease', by another. These papers bring out the fact that respiratory physiology is in reality cardio-respiratory physiology.

Investigation has also shown that the lining layer of the lung alveoli is of fundamental importance in the physiology and pathology of the lungs of new-born infants as well as of adults; as such, they are of interest not only to research workers, but also to clinicians. The nature of the 'lining complex' and the part it plays in preventing spontaneous collapse of the lung, are described.

Another paper describes 'The handling of particles by the human lung'. This should be of interest to clinicians and public health, as well as research workers, on account of its bearing on air-borne diseases.

The 'Distribution of gas and blood in the normal lung is also discussed. The method of investigation employed in the study is of special interest Radio-active gas is inhaled by the subject, and its' presence m small areas of the lung is recorded by scintillation counters placed in front and behind selected areas of the chest. The number or volume of the counts is a mesure of the degree of ventilation of the selected lung field, and the rate of removal when the breath is held, is taken as a measure of the blood flow in the lung field. Studies have been conducted in the erect and prone positions of the subject and in rest and after exercise. These studies have confirmed that gravity has a marked effect on the distribution of blood in the lungs, perfusion being more m the lower portions of the lung than the upper, and that exercise tends to reduce this difference. These results are further confirmed by lobar and segmental analysis of gas obtained by bronchospirometry.

One paper discusses the 'Distribution of gas and blood in the lungs in diseases' such as Bronchitis Emphesema, Cystic disease, Mitral Stenosis, Pullmonary Hypertension etc.

Other subjects dealt with in the Bulletin are-'Physics of blood flow in the lung'; 'The regulation of blood flow through the lungs'; 'Lymph flow in the lungs'; and the 'Kinetics of gas transport in blood'

The treatment of the subject is of the high standard that one would expect from the British Council In this publication there are papers which should be of interest to post-graduate teachers and clinicians However, its main appeal would be as a work of reference to research workers in search of new horizons reached by leading authorities in this specialized field—to those who are already initiated into the mysteries of fundamental research—rather than to those who are looking for a comprehensive introduction to the subject of Respiratory Physiology as a whole.

—T. J. JOSEPH