PRELIMINARY TUBERCULOSIS SURVEY IN A MENTAL HOSPITAL.

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[Received November 8, 1945.]

THE problem of tuberculosis amongst mental hospital patients is of importance from both the psychiatric and public health point of view. Most of the active methods of psychiatric treatment must be abandoned or discontinued when physical illness intervenes. The problem is even more far-reaching from the standpoint of public health. Wingfield, Trail, Banks and McDougall (1942) have estimated that there is probably a reservoir of 250,000 infectious cases recognized and unrecognized in England, Scotland and Wales, and several authors have pointed out that mental hospitals contribute a disproportionate number to this reservoir. Modern methods of mental hospital administration with parole and leave privileges applied to the maximum number of patients lend importance to the public health aspect, not only the patients themselves and hospital staff being menaced, but also patients' visitors and relatives and other contacts outside hospital. The incidence of tuberculosis in mental hospitals has been variously estimated at 5 to 10 times and the mortality in peace-time 8 or 9 times that of the general population. These figures are sufficient to justify all efforts to bring the problem under control.

Since the beginning of this century the seriousness of this matter has been recognized. In 1900 Harrington in America recommended separate provision for tuberculous patients in state hospitals for the insane. In 1909 Mott investigated the tuberculosis situation in all London asylums. He pointed out the difficulties of diagnosis, and estimated that 2 per cent. of the patients were suffering from active tuberculosis. In 1926 Klopp conducted an extensive survey in 44 states of America which revealed how unsatisfactory was the situation. A questionnaire was issued to 106 hospitals containing 188,339 patients; 5,951 or 3·1 per cent. of these patients were known to have tuberculosis, and for 4,512 of these special building capacity was available; 16 out of 106 hospitals made no provision whatever, 59 possessed specially constructed detached pavilions or buildings for isolation, 55 were taking chest X-rays of all suspected cases, but only one hospital secured chest X-rays of all new admissions. He estimated that 5 per cent. of the total beds available would be required for the treatment of tuberculosis.

The difficulties of clinical investigation and diagnosis were so great that little extensive work was done until the advent of improved technical equipment. Green and Woodall in 1931 surveyed the Fernald State School by tuberculin testing and X-raying 1,681 positive reactors. They found that 1·5 per cent. had definitely active and 3·6 per cent. significant pulmonary

tubercular lesions. In 1933 McGhie and Brink reviewed 1,209 patients and 278 staff in London Hospital (Ontario); 1,107 patients positive to tuberculin were X-rayed, 7·3 per cent. showed significant lesions, 3·7 per cent. were considered active and a total of 4·95 per cent. required isolation. Bogen, Tietz and Grace in 1934 carried out a tuberculin survey at Longview State Hospital, and reported that of 2,275 patients, 3·0 per cent. were clinically tuberculous. In 1936 Burns reported the results of Mantoux testing 11,517 patients and 2,430 staff in state hospitals, asylums and schools for feeble-minded and epileptics in Minnesota, and of X-raying the 82 per cent. positive reactors. 9·2 per cent. of the total group showed evidence of parenchymal infiltration, whilst 11·2 per cent. of positive reactors showed evidence of pulmonary disease. Harrison and Schein in 1937 surveyed by X-ray 2,186 ambulatory patients in Marcy State Hospital, and found that 3·6 per cent. of these showed evidence of pulmonary tuberculosis, although none had previously been suspected. Of the positive cases 46 per cent. had reached a moderate or severe stage of infiltration, and 66 per cent. had been at least 5 years in hospital before attention was called to the presence of the disease. They pointed out the serious implication of the high proportion of moderately advanced and severe cases from the point of view of infection, and concluded that routine fluoroscopy of patient populations is necessary for diagnosis and control. In 1940 Wicks surveyed 13,257 patients and 2,542 staff in mental hospitals in Ontario, and described 6·7 per cent. significant lesions requiring treatment and isolation amongst patients, and 7·0 per cent. parenchymatous infiltration definitely or probably arrested. These figures are exclusive of patients already under treatment. He suggested a comprehensive plan for control and treatment. Blalock, Funkhouser and Flanagan in 1940 surveyed 1,263 patients in Southwestern State Hospital by X-ray, using paper films. The incidence of pulmonary tuberculosis in some stage, other than healed primary disease, was 10 per cent.; 4·9 per cent. of their total patients were deemed to have active disease. They discussed treatment and methods of control. In 1941 Plunkett and Tiffany discussed a tuberculosis control programme for institutions in New York State Department of Hygiene, and pointed out that the cost of providing an X-ray service to all has been the principal deterrent in establishing a uniform tuberculosis control programme. Their plan fell into two main subdivisions: (1) to determine the extent of the problem, and (2) to take the necessary steps for control. Deegan, Culp and Beck in 1942 published a paper on the epidemiology of tuberculosis following the survey of 3,407 adult patients and 749 staff by X-ray in Willard State Hospital. According to their classification 2·2 per cent. were considered active, 4·6 per cent. inactive, 3·2 per cent. healed and 10·3 per cent. showed evidence of calcification—a total of 20·3 per cent. presenting X-ray evidence of infection. Study of 587 subsequent admissions showed 17 cases of parenchymal infiltration, 7 active, 2 inactive and 8 apparently healed. A second patient survey conducted in 1940 on 2,141 patients, who previously presented no evidence of tuberculosis, revealed 16, or 0·66 per cent. new cases. Blalock and Funkhouser in 1943 published a follow-up survey of 1,156 consecutive admissions on 14 in. × 17 in. celluloid plates, and concluded that although

incidence of tuberculosis is high among the mentally ill who have been in hospital for a long time, the incidence is approximately as high at the time when these patients are first admitted to hospital.

In this country there have been fewer reports of comprehensive surveys; Berrington and Greenwood in 1942 used the erythrocyte sedimentation rate as an indicator and X-rayed all above 14 mm. 348 X-ray films were taken, and they concluded that 8 per cent. of 1,100 patients showed X-ray appearances of active pulmonary tuberculosis. Snell, McMahon and Heaf reviewed 2,271 patients in Leavesden, 2,035 by mass radiography. Only 0·8 per cent. of the hospital population could not be included in the survey. They described 6 per cent. significant pulmonary lesions, and deemed 2 per cent. to 2·5 per cent. of these active. They pointed out that deformities were common and co-operation difficult. Investigation of patients with suspicious miniature films was thorough. The great majority of their patients were mental defectives, and the incidence amongst the numerically largest class, the imbeciles, was equal to that amongst the psychotics. A further survey by mass miniature radiography was published in the M.R.C. Memorandum Special Report Series No. 251. 1,564 patients, 89 per cent. of the total resident patient population of a L.C.C. Mental Hospital, were X-rayed. Newly discovered "significant" tuberculous lesions were present in 3·5 per cent. of the total X-rayed. Of these "treatment," or active cases, amounted to 1·3 per cent.; other cases under treatment raise the number of active cases in the hospital to approximately 2·8 per cent. The authors discuss the relation of phthisis to mental disease and to length of hospitalization. They point out the difficulty raised by uncertain psychiatric nomenclature, and conclude that only the mental defective group of patients had a noticeably higher-than-average incidence. They also note a rapid increase in the incidence of tuberculosis where hospitalization has been prolonged, suggesting that "the mental patients had not imported their tuberculosis but had contracted it within the hospital, presumably through contact with infective cases or through deterioration of resistance."

The methods of approach to the diagnosis of tuberculosis in this hospital have been unsatisfactory since the outbreak of war, when our X-ray plant was requisitioned. During the last 6 years patients requiring radiological examination have been conveyed to the local municipal hospital either by ambulance or by taxi—a costly and cumbersome procedure, which kept radiological examinations to a minimum. The choice of patients for radiography was made as follows: All patients who were clinically suspicious on admission or on annual physical examination, patients who showed weight loss at quarterly weighings and those who had questionable lung involvement during other illness, were kept under observation and examined radiologically if this was considered advisable. Patients under observation were put on morning and evening pulse and temperature charts and were weighed weekly. Sputum, if available, was examined by direct smear, and if negative by culture. Erythrocyte sedimentation rate and blood-counts were done. The Westergren method of sedimentation test was used. A fall of 5 per cent. in one hour or 10 per cent. in two hours was considered abnormal. Extensive use was made of

intradermal testing, using Tuberculin P.P.D. (Parke, Davis & Co.). The test was carried out with doses of two strengths—First Test Strength and Second Test Strength. Individuals who did not react to First Test Strength were re-injected 48 hours later with Second Test Strength dose. First Strength Test Dose contains 0·00002 mgm. of the Purified Protein Derivative, which corresponds to 0·1 c.c. of a standard Koch's "Old Tuberculin" or Tuberculin O.T. in the dilution of 1 : 25,000 (0·004 mgm. O.T.) to 1 : 50,000 (0·002 mgm. O.T.). Readings were taken after 24 and 48 hours. If no reaction occurred with First Test, 0·1 c.c. of Second Strength Test dose was injected intradermally. This dose contains 0·005 mgm. of P.P.D., which is 250 times the First Test Strength dose. The reaction in most instances has reached its maximum in 48 hours. The positive reactions were classified arbitrarily as follows:

1 + reaction consists of an area of swelling measuring from 5 to 10 mm. in diameter.

2 + reaction consists of an area of swelling measuring from 10 to 20 mm. in diameter.

3 + reaction consists of an area of swelling exceeding 20 mm. in diameter.

4 + reaction consists of an area of swelling and definite necrosis.

A doubtful reaction is one characterized by a trace of swelling measuring 5 mm. or less in diameter.

A negative reaction is characterized by the absence of redness or swelling at the site of injection. (Parke, Davis & Company Leaflet B–0475.J–3.3.44–10M.)

This haphazard method of selection produced results which were slow and uncertain. At the end of 1944 it was found possible to arrange for mass miniature radiography of our staff and patients. The unit in Bristol at that time was a fixed unit, and so it was necessary to convey our patients by bus. Two bus-loads of 30 patients attended each session assigned to us, and by the co-operation of the staff of the miniature radiography department with our nurses, it was possible to deal with 94·8 per cent. of the male patients and 95·6 per cent. of the females. At the time of the survey there were 1,240 patients in the hospital, 540 males and 700 females. 1,181 were radiologically examined by miniature film (512 male, 669 female); 20 males had been X-rayed within the previous 3 months and were not repeated and the remaining 8 were subsequently examined radiologically, so that 100 per cent. of the males are included in the survey. Of the females 7 had had chest X-ray within the preceding 3 months and were not included. The remaining 24 were mainly bedridden, contracted and feeble patients, whose average age was 70 years. Thus 96·6 per cent. of the females were examined radiologically. Of our 1,240 patients, only 24 or 1·9 per cent. were not so examined, and none of these showed any clinical signs or symptoms of pulmonary tuberculosis. As is to be expected, the number of patients whose positioning was poor, resulting in doubtful films, was large, 172 (77 male, 95 female) being reported "uncooperative," "probably right" or otherwise than "normal." These were subjected to the same routine examination as those who were recalled, and if there was any doubt as to their chest condition they too were sent for large

film. 84 patients were recalled (51 male, 33 female). We selected a further 29 patients (14 male, 15 female), so that 113 patients in all were examined on large film. The examination of these patients prior to large film consisted of physical examination, ward observation and routine laboratory investigation. Pulse and temperature charts were kept and patients weighed weekly. Erythrocyte sedimentation rate was done, and sputum examined by direct smear and by culture. As a result of these investigations patients were classified either as "normal" or as "requiring further observation." The latter group contained all the active and doubtful lesions, which were re-X-rayed in 3 months and again in 6 months before assessing cases of doubtful activity. In the following figures those patients X-rayed prior or subsequent to mass radiography have been included in the category into which they would have fallen had they been discovered by miniature film. The survey thus covers the entire patient population less 1·9 per cent. bedridden and senile.

Cases showing evidence of tubercle all stages amounted to 73 (46 male, 27 female), or 5·9 per cent. of the total patient population. Of these, 1·4 per cent. were deemed active (13 male, 4 female) and 4·5 per cent. (33 male, 23 female) inactive. There were 3 cases of pleural effusion, all males. 10 cases were considered doubtful and later shown to be non-tubercular. 86·9 per cent. of the total population was considered entirely negative.

TABLE I.—*Results of Chest X-Ray Survey of Patients in Bristol Mental Hospital.*

	Males.		Females.		Total.	
	No.	%.	No.	%.	No.	%.
Total number in hospital during survey	540	—	700	—	1,240	—
,, ,, sent for miniature radiography	512	94·8	669	95·6	1,181	95.2
,, ,, who had large film three months before miniature film	20	3·7	7	1·0	27	2·2
,, ,, who had large film subsequently	8	1·4	—	—	8	0·65
,, ,, examined radiologically	540	100·0	676	96·6	1,216	98·1
,, ,, not examined radiologically	—	—	24	3·4	24	1·9
,, ,, with evidence of tubercle all stages	46	8·5	27	3·9	73	5·9
Active	13	2·4	4	0·6	17	1·4
1. Minimal lesions	1	0·2	—	—	1	0·08
2. Moderately advanced lesions	2	0·4	—	—	2	0·16
3. Far advanced lesions	10	1·9	4	0·6	14	1·1
Inactive	33	6·1	23	3·3	56	4·5
1. Minimal lesions	24	4·4	17	2·4	41	3·3
2. Moderately advanced lesions	9	1·7	6	0·9	15	1·2
3. Far advanced lesions	—	—	—	—	—	—
Doubtful lesions subsequently shown non-tuberculous	10	1·9	8	1·2	18	1·5
Pleural effusion	3	0·6	—	—	3	0·24
Non-tubercular lesions	21	3·9	25	3·6	46	3·7
Entirely negative	460	85·2	616	88·0	1,076	86·9

Since the survey 6 of the active male cases and 2 of the active females have died of pulmonary tuberculosis. One male considered normal during the survey has since died of miliary tuberculosis. The incidence amongst female

TABLE II.

Reference.	Place.	Number.	Method.	Active.	Inactive.	Total.
McGhie and Brink (1934)	Canada	1,209	Tuberculin testing and X-ray	3·7%	3·5%	7·3%
Bogen, Tietz and Grace (1934)	America	2,275	Ditto	3·0%	—	—
Burns (1936)	,,	3,572	,,	2·1% + sputum	Parenchymal tuberculosis 12·6	—
Burns (1936)	,,	11,517	,,	1·9% + sputum	—	9·2%
Harrison and Schein (1937)	,,	2,186	Fluoroscopy and X-ray	3·6%	—	—
Blalock, Funkhouser and Flanagan (1940)	,,	1,263	X-ray paper films	4·2%	6·2%	10·4%
Wicks (1940)	Canada	13,257	Numerous methods	1·3%	5·4%	All required isolation 6·7%
Deegan, Culp and Beck (1942)	America	3,407	X ray 14 in. × 17 in.	2·2%	Inactive, healed 4·6 + 3·2 = 7·8	—
Berrington and Greenwood (1942)	England	1,100	Erythrocyte sedimentation rate and X-ray	8·0%	—	—
Blalock and Funkhouser (1943)	America	1,156	X-ray 14 in. × 17 in.	3·8%	7·4%	11·2%
Snell, MacMahon and Heaf (1943)	England	2,271	Miniature radiography	2%–2·5%	3·5%–4%	6·0%
M.R.C. Memo Special Report Series No. 251 (1945).	,,	1,565	Ditto	1·5 + 1·3 = 2·8%	2·2%	5·0%
Bristol Mental Hospital	,,	1,181	,,	1·4%	4·5%	5·9%

TABLE IIA.

	Number X-rayed.	Not X-rayed.	Active lesions.	Inactive lesions.	Total.
Mott (1909)	—	—	2·0%	—	..
Snell, McMahon and Heaf (1943)	2,271	0·8%	2%–2·5%	3·5%–4%	6·0%
Clark *et al.* (1945), M.R.C. Special Report No. 251	1,564	11·0%	2·8%	2·2%	5·0%
Bristol Mental Hospital	1,216	1·9%	1·4%	4·5%	5·9%

TABLE III.

	Number X-rayed.			Significant lesions.			% of total in category.			Active lesions.			% of total in category.		
	M.	F.	Total.	M.	F.	Total.	M.	F.	Total.	M.	F.	Total.	M.	F.	Total.
Under 1 year	54	79	133	2	3	5	3·7	3·8	3·8	2	2	4	3·7	2·5	3·0
1–5 years	126	128	254	17	11	28	13·5	8·6	11·0	3	1	4	2·4	0·8	1·6
Over 5 years	360	493	853	40	21	61	11·1	4·3	7·2	8	1	9	2·2	0·2	1·1
Total	540	700	1,240	59	35	94	10·9	5·0	7·6	13	4	17	2·4	0·6	1·4

TABLE IV.

	Number X-rayed.			Significant lesions.			% of total.			Active lesions.			% of total.		
	M.	F.	Total.	M.	F.	Total.	M.	F.	Total.	M.	F.	Total.	M.	F.	Total.
Schizophrenic reaction type	270	334	604	29	16	45	10·7	4·8	7·4	7	2	9	2·6	0·6	1·5
Affective reaction type	110	185	295	16	9	25	14·5	5·0	8·5	2	1	3	1·8	0·5	1·0
Organic reaction type	59	83	142	5	3	8	8·5	3·6	5·6	1	0	1	1·7	—	0·7
Mental defectives	51	66	117	5	4	9	9·8	6·1	7·7	1	1	2	2·0	1·5	1·7
Miscellaneous	50	32	82	4	3	7	8·0	9·4	8·5	2	0	2	4·0	—	2·4
Total	540	700	1,240	59	35	94	10·9	5·0	7·6	13	4	17	2·4	0·6	1·4

TABLE V.

Staff.	Males.				Females.		Total.	
	No.	%.	Previously diagnosed.	Total.	No.	%.	No.	%.
Miniature radiography	91	100	3	94	79	100	173	100
Recalled for large film	3	3·3	—	—	2	2·5	5	2·9
Evidence of tuberculosis, all stages	3	3·3	3	6 (6·4%)	2	2·5	8	4·6
Active	1	1·1	—	1 (1·1%)	—	—	1	0·58
Minimal	1	1·1	—	1 (1·1%)	—	—	1	0·58
Moderate	—	—	—	—	—	—	—	—
Severe	—	—	—	—	—	—	—	—
Inactive	2	2·2	3	5 (5·3%)	2	2·5	7	4·0
Minimal	1	1·1	1	2 (2·2%)	1	1·3	3	1·7
Moderate	—	—	2	2 (2·2%)	—	—	2	1·2
Severe	1	1·1	—	1 (1·1%)	1	1·3	2	1·2
Entirely negative	88	—	—	88 (93·5%)	77	97·5	165	95·4

patients is much lower than amongst males—a fact noted in all the papers quoted except that of Bogen, Tiets and Grace.

Discussion.

From reports of hospitals where adequate investigations have been carried out and from mortality figures, it is certain that the incidence of tuberculosis in mental hospitals is many times higher than in the general population. This larger incidence in mental hospital patients makes its recognition, control and treatment an important section of any scheme for general tuberculosis control. Although the mortality from tuberculosis in this hospital is high, the wartime increase described in the M.R.C. Report of the Committee on Tuberculosis in Wartime has not been observed here. The average tuberculosis mortality during the three years preceding the war was 11·6 per cent. of the total deaths, whereas for the first five war years the average was 10 per cent. of the total deaths. Only in 1943, when the total death-rate was the lowest on record, did the proportion of tuberculosis deaths exceed the average figure for the three previous years. Overcrowding, blackout and wartime dietary have therefore caused no increase, either absolute or relative, in our total tuberculosis deaths or in our tuberculosis mortality rate. The number of new cases notified during the war years has remained approximately at the pre-war level. The results of this survey would therefore not seem to have been influenced by wartime conditions, and may be taken as a fair representation of the average position in the hospital.

Direct comparison of our results with those of other surveys is impossible owing to lack of uniformity in methods of investigation and of classification. Such comparisons as have been made are therefore approximate. With expansion of mass miniature radiography services, it is likely that much work will be done on tuberculosis in mental hospitals in the near future. It would, therefore, be advisable that a scheme should be devised whereby results and conclusions could be directly compared. Methods of investigation and classification will be more satisfactory if simple and comprehensive. Criteria of activity such as we have adopted appear satisfactory, and a simple classification into three grades of severity of radiological pulmonary involvement, although inadequate from a strictly scientific viewpoint, will serve usefully for administration and treatment, and will further allow fairly accurate comparisons with conclusions of other hospitals.

This arbitrary division into " grades of severity " will serve a useful purpose only when its limitations are recognized. For example, " inactive disease with far-advanced lesions," if not a contradiction in terms, is, at least, unlikely. But the absence of any uniformity in reports in the literature both in regard to criteria of activity and in assessment of the extent of the disease leads to endless confusing subdivisions.

Diagnosis.—The common practice in mental hospitals, as amongst the general population, of delaying diagnosis until symptoms have appeared is unsatisfactory. There are seldom symptoms and few of the classical signs until two to three years after radiological shadows are visible in the lungs (Fellows, H. H., 1934). Much later will these symptoms and signs become

apparent in indifferent and unco-operative psychotic patients. The ordinary methods of physical diagnosis apply in mental hospitals. Stethoscopic examination of the lungs is useless in a substantial proportion of cases, but it cannot on this account be dispensed with. Sputum examination, also, must often be omitted in mental hospital practice. We have been able to demonstrate tubercle bacilli in only 3 cases by direct examination of sputum, and have cultured them from the sputum of another case negative on direct examination. This might largely be overcome by concentration, direct examination and culture of stomach contents, but we have not considered this advisable because of laboratory staff shortages. This factor has also hindered the carrying out of other laboratory tests not of a positive value, e.g., blood-counts, culture of faeces, D'Amato's test. In other respects the clinical observation of mental hospital patients is essentially the same as in sanatorium practice. Pulse, temperature and weight recordings are equally useful, and we have found the erythrocyte sedimentation rate of value in assessing the activity and in following progress (Bower and Schein, 1935).

There is no doubt, however, that the diagnosis and control of tuberculosis ultimately becomes a radiological problem in mental hospitals. Plunkett and Tiffany have pointed out the cost of such a service has long been prohibitive, but transportable mass miniature radiography apparatus has provided a satisfactory answer. A primary survey is necessary to determine the extent of the problem and further yearly review of the patient population and staff. Unless all new patients are X-rayed, or all Mantoux positive admissions, these steps alone will prove insufficient. Many mental hospitals are either temporarily or permanently lacking in X-ray apparatus, and until such a lack is supplied the problem cannot be tackled satisfactorily. Following a " weeding-out " by mass radiography, routine examinations and laboratory investigations should be carried out prior to a large film being taken, and the final assessment of cases not ruled out by large film should be made in collaboration with a tuberculosis specialist. Further desirable steps in control will be discussed later.

Treatment.—Observation cases : Whilst under observation cases of doubtful activity were transferred to infirmary wards. On being deemed inactive they are redistributed according to their mental category, and they will again be radiologically checked at the end of a year.

Active cases : On the female side there has always been ample verandah space off the infirmary ward to cope with tuberculous female patients. On the male side some structural alterations were necessary. An open verandah contiguous to the male infirmary was converted so as to add 11 further beds to the verandah accommodation already available. This provided 15 sanatorium beds. A further 4 side rooms off the infirmary are reserved for cases of tubercle, and may be used for noisy or resistive patients and for those who require constant supervision. Patients are treated as far as possible along orthodox sanatorium lines, of which diet, rest and fresh air are the mainstays. We have not carried out artificial pneumothorax although we do not consider mental disease to be any contra-indication to this method of treatment, and we intend to initiate it when conditions permit (Blalock and Funkhouser, 1943).

Laundry, eating and drinking utensils are kept separate from those of other patients. Soiled clothes are conveyed separately to the laundry and undergo steam sterilization before being mixed with the general laundry. Distinctive crockery and cutlery is provided so that any mixing with ordinary ward crockery is impossible.

The determination of progress and estimation of when the disease is arrested is difficult. Serial X-rays and erythrocyte sedimentation rate are the main sources of reliable information, although a negative sputum in some cases may be of value.

The question of providing central sanatorium accommodation, where mentally ill tuberculous patients could be transferred from other hospitals, has often been discussed. Leonidoff (1938) has argued against such a proposition; others have been in favour of it (Klopp, 1927; Wicks, 1940). The difficulties in the way of accomplishing this are so great that we do not consider that a discussion of its relative merits is warranted. Sanatorium accommodation is so restricted for the general population that it is impossible to conceive an elaborate scheme being undertaken for mental hospital patients. When small numbers of patients are involved, a method of segregation of the active infective cases and of observation of the inactive cases, such as we have indicated, must serve as an alternative.

Comparison with other surveys.—In other surveys the total number of significant lesions reported, active and inactive, has varied between 5 per cent. and 11 per cent. as compared with our figure of 5·9 per cent. In two similar surveys carried out in England by mass radiography the incidence of significant tuberculous lesions has been 6 per cent. and 5 per cent.—figures closely approximating to our own. However, the number of active cases which we have found, 1·4 per cent. of all patients, is considerably less than in any other survey. Burns (1936) used the finding of tubercle bacilli in the sputum as a criterion of activity and described 1·9 per cent. of 11,517 patients as active, but such a criterion is not generally applicable in mental hospital practice. Our criteria have been strict, involving a lengthy period of observation after preliminary X-ray and examination by a tuberculosis specialist, coupled with laboratory and clinical investigation and radiological check-up in three and six months. This low incidence of 1·4 per cent. is difficult to explain, all the factors incriminated elsewhere being equally applicable to this hospital.

Length of hospitalization in relation to tuberculosis.—It has almost become an established theorem that the incidence of tuberculosis in mental hospitals increases with the length of hospitalization. Recent work has thrown doubt on this. Blalock and Funkhouser (1943) investigated 1,156 consecutive admissions and found evidence of tuberculosis, all stages, in 11·2 per cent. of cases, compared with 10·4 per cent. incidence in a primary survey three years previously. Our figures would allow a similar view. Of active cases an incidence greater than average occurred in those hospitalized for under one year. In considering the inactive cases, it must be remembered that the greatest number of discharges from hospital falls into the " under one year " category, next in order into the " one to five year " category. Discharge of cases resident over five years is more infrequent. Also, patients whose physical condition is poor are

less likely to be discharged than those who are physically robust. Thus any increase in the incidence of inactive tuberculosis amongst patients over one year in hospital may be accounted for by their already having been infected on admission. We have two patients in the " one to five year " category at present under treatment for tuberculosis, who remain in hospital on a voluntary basis, but whose mental condition would permit them to be discharged to a sanatorium could accommodation be found for them. Any conclusion arrived at in a primary survey can, however, give no true idea of the incidence of tuberculosis amongst admissions. Only complete investigation of all new patients can decide this. Future work on consecutive admissions will help throw light on this aspect of the problem, but unfortunately due to lack of facilities we have been unable to follow this course.

Mental disease in relation to tuberculosis.—As evidence accumulates, the assertion of a predisposition to tuberculosis amongst schizophrenics becomes more doubtful (Kretchmer, 1921). In endeavouring to correlate tuberculosis and mental disease the difficulties of psychiatric nomenclature considerably complicate the picture. We have adopted the broadest possible grouping of mental diseases, as suggested in M.R.C. Report on Mass Miniature Radiography of Civilians, but have felt it necessary to add a further group under the heading of " Miscellaneous." Into this group fall epileptics, paranoiacs, psychoneurotics and others whom we consider could not properly be classified under the broad headings chosen. Although the numbers are too small to be statistically significant, the incidence of significant lesions in the schizophrenic reaction group is less than in the affective reaction group. Three of the 9 active tuberculous schizophrenics have been in hospital less than one year.

Staff.

The question of tuberculosis amongst mental hospital staff has received much attention. McGhie and Brink in 1933 X-rayed all the nurses and 39 selected members of the male staff in 11 provincial hospitals in Ontario. They discovered 12 positive cases amongst the male nurses, 8 of whom had active disease. Three active cases amongst the male staff were physicians. Heinbeck in 1936 published several papers indicating the high incidence of tuberculosis amongst nurses. He maintained that negative tuberculin reactors were more likely to contract the disease than positive reactors and advocated vaccination with B.C.G. Burns (1936) reported that of 2,430 employees in State Institutions in Minnesota 1,380 were Mantoux positive, of which 91, or 3·7 per cent., showed X-ray evidence of parenchymal infiltration, and 16 had a positive sputum. Hilleboe (1937) pointed out that there was ample opportunity for cross infection amongst patients in mental hospitals, and stressed that many employees working amongst undiscovered tuberculous cases in mental hospitals have contracted the disease. Myers, Trach, Diehl and Boynton in 1938 discussed the question of legal action against hospitals by staff, and concluded that for the protection of the hospital, tuberculin testing and chest X-ray of all new patients should be available. In 1940 Wicks investigated 2,542 nursing, domestic and artisan staff in Ontario Mental

Hospitals, and described 0·6 per cent. active cases amongst them, excluding those already diagnosed. 3·9 per cent. had arrested tuberculosis and were still at work. Deegan, Culp and Beck (1941) investigated 749 employees at Willard State Hospital, 393 males and 356 females, and discovered 12 cases of clinical tuberculosis (1·5 per cent.), 9 of which were minimal, 1 moderately advanced and 2 far advanced. A second X-ray two years later revealed that 3 nurses (2 student nurses and 1 attendant) had developed minimal lesions. These had previously been normal; all were asymptomatic, but had been in contact with known tuberculous cases. Snell, McMahon and Heaf (1943) examined 224 employees, 105 males and 119 females; 37 males and 5 females refused examination. No new cases were discovered amongst the female staff. Of the 3 males who required further investigation, 1 had been notified previously, 1 was inactive, and 1 resigned before further investigation could be carried out. The Medical Research Council Memorandum on Mass Miniature Radiography of Civilians (1945) reports on a group of 198 employees, representing 43 per cent. of the total staff. This low percentage was largely attributed to the absence of any active propaganda to obtain volunteers. Amongst the female staff 4 persons were discovered with significant tuberculous lesions, and 2 of these were recommended for sanatorium treatment. These figures represent an incidence amongst the female staff of 3·4 per cent. significant cases and 1·7 per cent. treatment cases.

Daniels (1944), in an Interim Report of the Prophit Tuberculosis Survey, pointed out a variety of reasons to explain the high annual case-rate amongst nurses, particularly in Mantoux-negative entrants, but concluded that it was not possible to comment on the relative risk of nursing as an occupation. When more efficient methods of investigation of the general population are evolved, and more extensive investigations of nurses before and after their entry into the profession are carried out on a large scale, this comparison should be possible. The figures from most reviews are too small to be of much value individually, and only when a uniform and comprehensive scheme of investigation is in general use will the results be of statistical value.

In the Bristol Mental Hospital one year previous to miniature radiography one physician and two male nurses had had sanatorium treatment for pulmonary tuberculosis. Their number is added to those discovered at miniature radiography in assessing the incidence amongst the staff. Administrative, artisan and nursing staff were all informed of the facilities for miniature X-ray and advised to avail themselves of them. Without further propaganda 100 per cent. presented themselves for examination.

Of the males, 62 nurses and 29 administrative staff were X-rayed. Amongst the administrative staff no significant lesions were discovered. Three of the male nurses had significant lesions, and were subjected to a routine examination similar to that of the patients. One nurse had a minimal arrested lesion, one had an advanced arrested lesion, and one was found to have a minimal active lesion with a positive sputum. This latter was immediately admitted to a sanatorium. None of these men had stethoscopic signs of pulmonary tuberculosis. Of the females, 58 nurses and 21 laundry, domestic and administrative staff were examined. One sister had a minimal healed lesion, and one of the

domestic staff was discovered to have inactive advanced pulmonary tuberculosis for which she had previously been treated in a sanatorium. No active case of phthisis was discovered amongst the female staff, but since the survey one probationer nurse, negative on X-ray during the survey, has died of miliary tuberculosis.

The figures for tuberculous infection are higher amongst the male than amongst the female staff—a significant fact when the patient statistics are considered.

Plan for future diagnosis and control.—Wicks (1940) made recommendations which represent a satisfactory scheme for the early diagnosis and control of tuberculosis amongst mental hospital patients and staff. The following should have radiological examination of lungs:

1. All new patients as soon as possible after admission, preferably within one week.
2. All applicants for staff vacancies.
3. All employees who have not been X-rayed or have not had a negative tuberculin test.
4. All employees before resigning, proceeding on prolonged leave of absence or leaving for other purposes. Negative tuberculin reactors should be repeated before leaving.
5. All staff and patients with symptoms referable to the chest, or during any undiagnosed ill-health.
6. All patients for insulin, electrical convulsive or metrazol treatment.
7. At intervals of one year, all patients and all tuberculin positive staff. All who require further investigation to be repeated in six months.
8. No negative reactor should be allowed in contact with the disease or with patients isolated pending investigations. Negative reactors to be periodically checked.
9. Concise and complete lectures should be given to the nursing staff concerned with the management of the tuberculosis ward.

In order to carry out such recommendations with economy and satisfaction mass radiography services are necessary for primary survey and for yearly "combing," whilst an X-ray plant is necessary on the premises for early diagnosis and control of tuberculosis amongst newly admitted patients. With such systematic examination, an efficient system of segregation, and an enlightened nursing attitude, there is reason to hope that the high incidence of tuberculosis in mental hospitals may be reduced until it is as low as it is in the general population, and that the standard of treatment may be as high.

Summary.

A primary survey of 1,240 mental hospital patients is reported and analysed.

The incidence of significant tuberculous infection is roughly similar to other such surveys. The incidence of active disease is considerably lower.

It is not certain that the incidence of tuberculosis increases relative to the length of hospitalization.

Relation of tuberculosis to mental disease and length of hospitalization is briefly discussed.

Recommendations for a scheme of diagnosis and control are quoted.

For permission to publish this paper I am indebted to Dr. R. E. Hemphill, Medical Superintendent, Bristol Mental Hospital.

I wish to thank Dr. E. E. Mawson, Medical Director, Mass Radiography, and her staff for their invaluable and efficient co-operation, and Dr. A. J. P. Alexander, of Winsley Sanatorium, for his help and encouragement.

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