

The
Medical
Research
Council
Report of the
Committee on Tuberculosis in
War-time

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MEDICAL RESEARCH
COUNCIL

REPORT OF THE
COMMITTEE ON TUBERCULOSIS IN
WAR-TIME



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COMMITTEE ON TUBERCULOSIS IN WAR-TIME

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Terms of Reference of the Committee.—To assist in promoting an investigation of the extent and causes of the war-time increase in the incidence of tuberculosis, particularly among young women, and also to advise the Council regarding possible preventive measures.

PREFACE

The Committee on Tuberculosis in War-time was appointed by the Medical Research Council, at the request of the Ministry of Health, in the autumn of 1941. It had already become evident that in the present war—as in that of 1914–18—there had been a reversal of the favourable pre-war trend of mortality from tuberculosis; and, on the analogy of the earlier experience, it seemed likely that the death-rates from this disease would continue to increase unless steps could be taken to deal with the determining factors and to limit the spread of infection. In 1939 and 1940 the increased mortality appeared to be mainly in young women, and the Committee's terms of reference, given on page ii, specifically refer to this aspect of the problem. The Committee's survey of the position up to the early part of 1942, however, shows that all age-groups have been involved to some extent in the increased mortality from tuberculosis, and that those affected include not only young women but also children and the older male age-groups. Details of this survey are given in the following report. The causes of the increase are analysed by the Committee in the light of existing knowledge, and various measures of a public health and administrative nature are recommended for dealing with it.

The present report differs from those usually published in the Council's series in that, apart from statistical analyses of existing data, it describes no new researches, but consists rather of a critical review of available evidence, and gives the Committee's practical recommendations based upon it. A new programme of statistical, clinical and pathological researches in tuberculosis would necessarily take much longer to complete, and, in the Committee's view, sufficient evidence already exists to justify administrative action on the lines here indicated. Apart from its intrinsic importance, tuberculosis is a sensitive index of the public health, and any increase in its incidence and fatality—and the inauguration of measures for dealing with it—are matters of urgent public concern. The Committee has therefore prepared this report on the present situation, and the Council are glad to include it in their series.

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15th September, 1942.

REPORT OF THE COMMITTEE ON TUBERCULOSIS IN WAR-TIME

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1. Present Knowledge of the Types and Development of Tuberculosis

Tuberculosis in man is caused by either the human or the bovine type of tubercle bacillus. Bacilli of the human type are derived from the cough spray and expectoration of persons suffering from pulmonary tuberculosis, and reach the lung by way of the air passages. Bacilli of the bovine type are found in the milk of cows with tuberculosis of the udder, and gain access to the human body by the alimentary tract. The bacilli of either type, whether introduced as the result of inhalation or ingestion, may sooner or later be carried by the lymphatics or the blood stream to other parts of the body.

For statistical purposes it is convenient to refer to "respiratory" or "pulmonary" tuberculosis when the disease predominantly affects the lungs, and to "non-respiratory" or "non-pulmonary" tuberculosis when it predominantly affects other organs, such as the glands, bones and joints, the meninges, or the genito-urinary system. It must be understood, however, that lesions in one organ may be accompanied or followed by lesions in others.

Although either type of tubercle bacillus may give rise to disease in any part of the body, and the type in any particular case can be determined only by careful bacteriological examination, certain generalisations are permissible. In England and Wales, for instance, it may be stated that 98 to 99 per cent. of all cases of pulmonary tuberculosis and about 70 per cent. of all cases of non-pulmonary tuberculosis are due to the human type of bacillus. The bovine type gives rise almost entirely to non-pulmonary tuberculosis, and plays a far greater part in infancy and childhood than in adolescence or adult life. At all ages about 6 per cent. of deaths are due to infection with bacilli of the bovine type. In Scotland the proportion of bovine infections is higher in all forms of tuberculosis than in England and Wales, and about 5 per cent. of cases of pulmonary tuberculosis are caused by the bovine type of bacillus.

Owing to the frequency of air- and milk-borne infections in Great Britain, most persons come into contact with the tubercle bacillus before they reach adult life, though this applies with greater force to town dwellers than to those who have spent their lives in rural districts. This primary infection may prove fatal, especially in infants, but more often the lesions produced are minimal and the child recovers after an illness which is usually too trivial for its real nature to be recognised. In a minority of children the primary infection is followed by chronic disease of the non-pulmonary form, affecting such organs as the glands or bones and joints. What factors decide the course of the primary infection is not known with certainty, but it is probable that the natural resistance of each individual and the environmental conditions at the time of infection play important roles.

It follows from what has just been stated that most persons reaching early adult life have successfully overcome their primary infection. They are, nevertheless, liable to develop pulmonary tuberculosis, either because their resistance is overcome by fresh infection from outside, or because organisms which have lain dormant in apparently healed foci reawaken into activity, this also being presumably a result of lowered bodily resistance. The relative importance of these two mechanisms in the development of tuberculosis in adult life is not known.

It should be stated that in this report "tuberculosis" refers to tuberculous disease. The term "tuberculous infection" merely means that at some time or other in the past tubercle bacilli have been introduced into the body tissues.

2. General Trend of Tuberculosis Deaths, 1939-41

Tuberculosis mortality was gradually declining up to the beginning of the war. Thus, in England and Wales there were 36,632 deaths from tuberculosis in 1928 and 26,176 in 1938 with corresponding death-rates of 91 and 60 per 100,000 persons. There were still, however, in 1938 some 230,000 cases of active or recently active tuberculosis under supervision at the tuberculosis dispensaries of England, Wales and Scotland; moreover, 65,000 new cases and 30,000 deaths were notified in that year. Over half of the new cases and of the deaths were in persons under 45 years of age; indeed, at ages 15-24 tuberculosis caused more deaths than any other single disease and about one-half of the total deaths due to all diseases. Clearly, any arrest of the favourable pre-war trend in tuberculosis must be regarded with concern. Not only did such an arrest follow the outbreak of this war, but there has been a reversal in trend, with an increase in deaths from tuberculosis.

(a) *Features of present increase.*—From Table I (p. 31) it will be seen that in England and Wales the total deaths from tuberculosis in 1940 exceeded those in 1939 by 2,528; both non-respiratory and respiratory forms of the disease were responsible for the increase. There was only a moderate further addition (516) to the total deaths in 1941, the rise in this year being mainly in the non-

respiratory forms. Similarly, in Scotland the total deaths from tuberculosis in 1940 were 477 more than in 1939; in 1941 there was a further but smaller addition of 171 deaths, the non-respiratory forms showing increasing prominence.

Comparing 1941 with the average of the immediate pre-war years 1938 and 1939 (Table I), for respiratory tuberculosis the increase is about 10 per cent. for England and Wales and about 18 per cent. for Scotland; for non-respiratory tuberculosis the increases are about 21 per cent. and 28 per cent. respectively; for all forms of tuberculosis together in England, Wales and Scotland the increase is 13 per cent., or 3,780 actual deaths. It will be seen that the deterioration since the beginning of the war has been greater in Scotland than in England and Wales, in regard both to respiratory and non-respiratory tuberculosis.

Although the figures in the second year (1941) of the war showed only moderate further additions to the total deaths from tuberculosis, there has been a notable change in the age-incidence as well as in the forms of the disease.

From Table II (A) it will be seen that in 1940 the increase in respiratory tuberculosis in England and Wales affected mainly children, older men and younger women. In 1941 the mortalities of these adult age-groups did not materially worsen though they continued to be unfavourable, judged by recent peace-time standards, but there was a substantial further relative increase in the deaths of children.* Comparing 1941 with 1938-39, for respiratory tuberculosis the net percentage increase in deaths has been greatest among children (under 15), older men (over 35) and young adults—particularly young women (20-25); while, for non-respiratory tuberculosis, the percentage increase appears to have been greatest among children (under 15) and young adults (15-20 and 20-25) of both sexes. It should, however, be noted that, in the case of respiratory tuberculosis, the actual numbers of additional deaths amongst all children have been much smaller than amongst all adults, so that too much stress must not be laid upon this increase; with non-respiratory tuberculosis the reverse has been true.

In Scotland, too (Table II (B)), the increase in deaths from respiratory tuberculosis in 1941 was greater among children than among adults, though in the latter the excess mortality shown in 1940 was maintained and, in the case of young adult females, it was somewhat increased. Comparing 1941 with 1938-39, the increases, for both respiratory and non-respiratory tuberculosis, affected much the same age-groups as in England and Wales, but, particularly in young adults (15-24), they were proportionately greater.

The outstanding feature of non-respiratory tuberculosis has been the increased incidence of tuberculous meningitis. The preponderance of meningitis is shown by the following comparisons of 1941 with 1938-39 for England and Wales:

	<i>Males</i>	<i>Females</i>
All forms	+ 12 per cent.	+ 12 per cent.
Respiratory	+ 11 per cent.	+ 9 per cent.
Meningitis	+ 34 per cent.	+ 38 per cent.
Other sites	+ 8 per cent.	+ 12 per cent.

and for Scotland:

	<i>Males</i>	<i>Females</i>
All forms	+ 15 per cent.	+ 25 per cent.
Respiratory	+ 13 per cent.	+ 23 per cent.
Meningitis	+ 37 per cent.	+ 60 per cent.
Other sites	+ 9 per cent.	+ 11 per cent.

* The proportionate increase from 1939 to 1941 in total tuberculosis mortality of children under 5 in England and Wales was around 50 per cent. in rural and urban areas alike, though in one or two large cities it was considerably higher. For children aged 5-14 the proportionate increase in deaths from the respiratory form was greater in town than country, whereas the reverse was true of the non-respiratory forms.

The increase in tuberculous meningitis in England and Wales has so far affected all age-groups up to 45; children up to 10 years show a relative increase in mortality of 50 per cent. Expressed in actual number of deaths under 10 years of age, there were, in 1941, 155 more from the respiratory form of tuberculosis, 471 more from meningitis and 146 more from the disease in other sites, making a total excess of 772 child deaths from tuberculosis over those during 1939. Young adult males and females aged 15-24 also show a large relative increase (50 per cent.) in meningitis mortality, but the actual number of excess deaths in this age-group is less than that for the children*.

(b) *Comparison with the last war.*—The total deaths from tuberculosis in England and Wales in 1939 were much smaller than in 1914 (Table III). In the interval between those years the tuberculosis services had developed, so that one might have expected a more favourable position *vis-à-vis* tuberculosis at the commencement of this war. This makes more significant the comparative increases in the tuberculosis mortality, viz. 11 per cent. for males and 13 per cent. for females from 1939 to 1941, as against 5 per cent. for males and 7 per cent. for females from 1914 to 1916. In other words, the retrogression has in this war been twice as severe.

The age-incidence in the two wars has also differed over the corresponding periods. Thus (Table III), comparing 1916 with 1914, the increase was largely in middle childhood and early adult life, whereas, comparing 1941 with 1939, it has extended into early childhood and later adult life. There is a strong contrast between the present large increase in tuberculosis deaths in children under 5 and the slight net decline in this age-group between 1914 and 1916; this is largely due to the increase in meningitis deaths being considerably greater in the present war than in the last.

It is important also to stress a similarity between the trends in the two wars. In 1916, as in 1941, there was (Table III) no further material addition to the substantial rise in respiratory tuberculosis deaths which had occurred in the previous year. But, the curve which had flattened in 1916 again turned upwards in 1917; this is a warning against any complacency at the present time.

From these statistics it is therefore apparent that the adverse trend in respiratory tuberculosis mortality began immediately after the outbreak of war in 1939, progressed in 1940, but in 1941 showed no significant further increase except in the female population in Scotland. On the other hand, the adverse trend of deaths from other forms of tuberculosis did not begin until 1940, and in 1941 the trend showed increasing deterioration. Moreover, as the increase in non-pulmonary deaths is shown to be due to meningeal forms, it may be said that since the outbreak of war there has been not only an increase in the number of deaths but also that latterly the infection has assumed the more acute and fatal forms of the disease. Taking all forms of tuberculosis into consideration, the available figures have demonstrated that children, young adults (especially females) and the older male age-groups have suffered most. In comparison with the last war, children are an added group on this occasion.

The problem presents itself as to how far persons in various occupations, e.g. factory workers, office workers, etc., have been differentially affected in the rise of tuberculosis mortality. At first sight a simple problem, its solution is fraught with difficulties, for whereas it is comparatively easy to ascertain in a given area the occupational and industrial distribution of the new cases reported since the war, there are no data available to indicate the numbers of persons in these different employments, owing to the extensive changes in occupations throughout the country since National Registration in 1939.

* These figures are not shown in the Tables.

3. Factors which may be Responsible for the War-time Increase in Tuberculosis Mortality

The decline in tuberculosis mortality in this country during the past 80 years has been closely associated with a rise in the standard of living, including improvements in housing, nutrition, industrial conditions and personal hygiene.

In the lapse that occurred during the war of 1914-18 defective nutrition, especially shortage of first-class proteins,* and increased industrialisation, often under unfavourable hygienic conditions,† were among the factors held responsible.

In the present war it is not yet possible to assess accurately the part played by various factors in the increased mortality from tuberculosis. The Committee has set in train investigations which, it is hoped, will assist in this task. It is, however, worth while examining the environmental changes to which the population has been subjected, in order to reach some conclusions on which recommendations for preventing further deterioration in the position may be based.

Modern war tends to intensify the various social and environmental factors that are generally considered to affect the level of tuberculosis in a community. These factors include overcrowding, nutritional deficiencies, the nature of industrial employment, and the greater prevalence of sources of tuberculous infection. They are believed to produce their effect either by favouring opportunities for infection with tubercle bacilli (as has been repeatedly shown by comparing the incidences of tuberculosis among home-contacts and non-contacts), or by lowering the ability of the body to check the growth of bacilli, whether derived from apparently healed foci or freshly introduced into the body.

It has been pointed out in the previous section that the increase in tuberculosis mortality in this war differs from that in the last, (a) in extending into early childhood and later adult life, and (b) in comprising a much higher proportion of deaths from non-pulmonary forms of the disease, particularly meningitis. The chief environmental changes that are peculiar to this war are—(1) the evacuation of many tuberculosis hospitals and sanatoria in September, 1939, to make room for expected air-raid casualties, with the consequent return to their homes of numerous patients in an infective state; (2) the institution of black-out conditions, which, by diminishing ventilation, increase cross-infection and possibly lower general resistance; (3) overcrowding in the homes, due to destruction of residential property by enemy action and the added effects of billeting; (4) evacuation of the population, which may have led to billeting in homes containing infective tuberculous persons, and, conversely, to the introduction of tuberculous persons into healthy homes; (5) evacuation of town populations to the country, with the result that many children previously supplied with pasteurised milk have had to change over to a raw milk supply. The first four factors would favour pulmonary infection with the human type, the fifth non-pulmonary infection with the bovine type. All ages of the population are being submitted to an increased risk of the disease, and it is not, therefore, surprising to find that changes in tuberculosis mortality have occurred in this war which were not evident in the last.

Apart from the differences, which have just been described, there are certain features common to both wars. Chief among these is the great increase in industrialisation. The effect of such a change is by no means easy to analyse, but some of the factors may be briefly considered. (1) The average number of employees working in factories is increased, thus augmenting the number of

* K. Faber: Tuberculosis and Nutrition. *Act. tuberc. scand.*, 1938, 12, 287.

† M. Greenwood and A. E. Tebb: An Inquiry into the Prevalence and Aetiology of Tuberculosis among Industrial Workers, with Special Reference to Female Munition Workers. *Spec. Rep. Ser. Med. Res. Comm.*, Lond., No. 22, 1919.

those exposed to tubercle bacilli and widening the range of infectivity of any tuberculous person working in the factory. (2) Owing to the demand for more labour, persons who are suffering from tuberculosis, and who in peace-time would have had little chance of obtaining employment, are being drawn into industry, and are multiplying the foci of infection. (3) Large numbers of persons who, before the war, were relatively isolated are entering factories where they meet, for the first time, conditions that are peculiar to herd life; not only are they more exposed to-infection, but, instead of being housed and fed at home, they fend, and often indifferently, for themselves; and the same is true of persons who migrate from country to town for employment in war industries, some of whom have not previously been exposed to tuberculous infection. The study of both natural and experimental epidemics has shown the ill-effects which such a disturbance of equilibrium may bring about. (4) The general resistance of workers in all callings is likely to be lowered by an inadequate amount of rest and recreation, resulting from hours of labour necessarily increased in order to meet the needs of war, for fatigue has always been held to be one of the most important predisposing factors in tuberculosis. Other industrial conditions liable to reduce resistance are deficient ventilation and often inadequate lighting, due to black-out conditions; difficulties of transport which add to the length of the worker's day; and the harassment to women in the feeding and care of their families. In addition to these, must be mentioned air-raids, shelter life, and the duties of home-guards, fire-watchers and other civil defence occupations, all of which tend to encroach on the hours of sleep, and render the nightly period of recuperation more difficult to secure.

Although nutrition is an essential factor in the maintenance of health and resistance to disease, its relation to the increase of tuberculosis during the present war is difficult to assess. The Ministry of Food, availing itself of new knowledge which has accrued since the last war, has paid great attention to the nation's food requirements and particularly to the importance of protective foods. The introduction of British Restaurants and factory canteens is making a notable contribution to the maintenance of the nation's level of nutrition. With adults as with schoolchildren, it is the communal mid-day meal which offers the best opportunity of ensuring the inclusion of protective foods. The number of these establishments is, however, still too small,* and a large number of the smaller factories and offices have no canteens. Moreover, experience shows that the mere provision of factory canteens is not enough; personal supervision and persuasion are essential to their effective use.

The results of expert inquiries in Great Britain and other countries, and by the League of Nations, have given milk a dominant position in our dietary, owing to its being so nearly a complete food. In general terms, the Advisory Committee on Nutrition, appointed by the Ministry of Health, expressed the view (1937) that the desirable amount of milk for children is 1-2 pints a day, for expectant and nursing mothers about 2 pints a day, and for other adult members of the community half a pint a day. On the basis of these figures, it may be estimated that the average quantity of milk per head of the population in Great Britain needed for satisfactory nutrition is not less than three-quarters of a pint a day. During 1941 the average consumption of liquid milk was 0.53 pint per day, which, though rather greater than the figure of 0.43 pint for 1939, was nevertheless well below the desirable level. In peace-time this inadequate consumption of milk was in some measure balanced by the ready availability of eggs, cheese, meat, fish, vegetables and fruit, but, with the restriction of these commodities in war, milk becomes of greater importance, especially in winter.

The nutritional needs of children have been met by priority supplies of milk and other protective foods. These, and the increasing provision of balanced

* There is now a steady increase in the number of British Restaurants, and their amenities are being improved.

school meals, would seem to be securing their objective, for the health of the child population is, generally speaking, up to its peace-time level. On the other hand, in view of the deficiencies mentioned above, the adult population must be considered as having been inadequately supplied with milk during the winter months.

It is probable that the various factors discussed above do not apply in the same degree to all the age-groups among which an increase in tuberculosis mortality has been observed, and it is permissible to indicate where special emphasis may be laid.

Thus, referring to children first, due weight must undoubtedly be given to infection of the milk supply. That the latter, however, is not the only factor is suggested by reports (1) that there has been among children throughout the country an increase in respiratory tuberculosis, a form of the disease which is mainly attributable to human sources of infection, and (2) that there has been a considerable increase in tuberculous meningitis among children in London, where the great bulk of the milk receives effective heat-treatment. From this indirect evidence it would appear that infection with the human type of bacillus is playing an important part in the increased mortality from tuberculosis. Consequently, in assigning responsibility to this increase, attention must be focused not only on the milk supply but also on contact infection in the home.

Young adults, especially young women, constitute a group particularly susceptible to environmental factors, so far as tuberculosis is concerned.* To explain the increase in respiratory tuberculosis among them, consideration should be given to the question of their adequate nutrition, the conditions of their employment, and, in particular, the fatigue resulting from the relatively long hours which they are now working. Relevant also is the increase of tuberculous meningitis among young adults, which points to the introduction into industry of previously non-infected persons under conditions that tend to lower resistance. Finally, it should be noted that young adult females who are directed into the Services will have controlled environment and medical supervision, whereas the living conditions of those directed into industry are usually not controlled nor is comparable medical supervision exercised. In addition, the women going into the Services have a preliminary medical board which will filter out a number of tuberculous persons, who will presumably be liable thereafter to pass into industrial employment.

The increase in respiratory tuberculosis among middle-aged men is more difficult to explain, and the Committee is not prepared at this stage to lay stress upon any particular factor.

Summarising this section, we may say that environmental changes have occurred during the present war which, in the opinion of this Committee, have led to an increase in the risk of infection and to a decrease in the resisting powers of the individual, varying in extent and degree in different sections of the community; these factors, if unchecked, would seem likely to bring about a further rise in the mortality from tuberculosis.

4. Measures for Preventing Further Deterioration in the Trend of Tuberculosis Mortality

(I) TO REDUCE THE SPREAD OF BOVINE INFECTION FROM MILK: PROVISION OF SAFE MILK SUPPLY

The report of the Cattle Diseases Committee of the Economic Advisory Council in 1934 made it clear that tuberculous infection among cattle is widespread in Great Britain. According to information available before the present war, an average of about 40 per cent. of cattle throughout the country react to the tuberculin test, showing that they have come in contact

* P. D'Arcy Hart & G. Payling Wright: *Tuberculosis and Social Conditions in England*. Nat. Ass. Prev. Tub., London, 1939.

with the tubercle bacillus; about 40 per cent. of cattle slaughtered in abattoirs are found to have naked-eye lesions of tuberculosis; and about 0.5 per cent. of milch cows are suffering from tuberculosis of the udder and are excreting virulent tubercle bacilli in their milk.

Examination of milk from individual herds showed that an average of rather over 6 per cent. of all farms were sending out milk containing tubercle bacilli. The inference that practically all bulked milk, representing the mixed milk of twenty or more herds, must be infected, has been shown by different observers to be correct.

The gravity of this position was realized by the Ministry of Agriculture when, in 1937, it introduced the Tuberculosis (Attested Herds) Scheme to encourage milk producers to eradicate tuberculous infection from their herds. Assisted by the Government and with financial remuneration from the Milk Marketing Board, many of the more enterprising owners of milking herds took advantage of this scheme, with the result that in 1939 about 3 per cent. of the dairy farmers in the country had had their herds attested. Unfortunately, it was found impossible to proceed with the scheme during the war, except in a very modified form, and little or no further progress in the eradication of tuberculous infection from cattle can be expected till more normal conditions are restored.

It must, therefore, be realised that a considerable proportion of our milk supply is, and will continue to be, infected with tubercle bacilli. The danger of such milk, particularly for children, has been pointed out by numerous representative medical organisations, and the Cattle Diseases Committee has estimated that in 1931 about 2,000 human deaths in England and Wales were due to this cause.

Since the eradication of tuberculosis from cattle, with the consequent production of a tubercle-free milk, is impossible under present conditions, the only alternative method of preventing tuberculosis of bovine origin in the human population is to subject the milk to a degree of heat-treatment sufficient to destroy the tubercle bacilli contained in it. Of the various forms of heat-treatment, that known as "pasteurisation" is the most convenient and satisfactory for dealing with large quantities of milk. Whether carried out by the "holder" method or by the "high temperature short time" process, it destroys tubercle bacilli without causing any material change in the nutritive qualities of the milk. If all milk for human consumption were pasteurised in licensed plants under adequate supervision, it is no exaggeration to say that tuberculosis of bovine origin would be eliminated*.

Before the war, information, which the Ministry of Health has kindly allowed us to quote, showed that pasteurisation was practised to a very varying extent in different parts of the country. On the one hand, London pasteurised as much as 93 per cent. of its milk, and on the other, a few County Boroughs pasteurised not more than 10 per cent. Generally speaking, about 40 to 50 per cent. of the milk distributed in the aggregate of County Boroughs was pasteurised, and about 15 per cent. more was heat-treated in some other way. In the smaller towns very much less was pasteurized, and in rural areas practically none. It follows that one result of the war-time evacuation policy has been to transfer considerable numbers of children from London and other large towns, where a substantial proportion of the milk supply is pasteurised or otherwise heat-treated, to small urban and country districts where practically all of it is supplied raw. The full effects of this change in milk supply cannot yet be assessed, but they may be grave.

Our recommendation is, therefore, to urge as great an extension of pasteurisation as possible. The way in which this should be carried out, and the

* See G. S. Wilson: *The Pasteurisation of Milk*. London, 1942.

means by which pasteurised milk could be made available in towns that receive at present mainly a raw supply, are not for us to propose. We would, however, suggest that when transport and other difficulties make it impossible for pasteurised milk to be delivered to the home, the housewife should be instructed by suitable propaganda (e.g. at ante-natal clinics, maternity and child welfare clinics, the cinema, etc.) to boil it.

To ensure that pasteurisation is adequately carried out, it is important for skilled workers to be available in the processing depots. Many of these have already been called up for service with the Forces and their places have been taken by men with less experience. If this continues the position may become serious. We therefore suggest that specially skilled workers in pasteurisation depots should be placed on the list of reserved occupations, and that workers in this category who have already been called up should be returned to their posts.

A special problem is presented by schoolchildren in country and small urban districts where, owing to transport or other difficulties, pasteurised milk cannot be supplied. Boiling of milk in the schools throws a heavy burden on the teachers and, unless local voluntary help is available, is not likely to be carried out. The only alternative solution is to supply such schools with full-cream dried milk, which can be readily made up with hot water and which, when flavoured with chocolate, makes a pleasant drink of high nutritive value. Whether sufficient dried milk for this purpose is available we are not in a position to say, but we are seriously disturbed at the not infrequent practice at the present time, of giving children raw, potentially infected milk as a priority food.

We would also stress the desirability of increasing the production of milk, especially during the winter months. At the same time, all practicable measures should be taken, by controlling udder disease in the cows and by promoting the use of hygienic methods of production, to ensure that the milk is of a reasonable standard of cleanliness and is not wasted by premature souring.

(II) TO PREVENT THE SPREAD OF INFECTION FROM UNSUSPECTED CASES OF PULMONARY TUBERCULOSIS, AND TO IMPROVE THE OUTLOOK FOR THOSE SUFFERING FROM THE DISEASE: MASS RADIOGRAPHY

(a) *Present Position*

Of the factors which decide the fate of a person with pulmonary tuberculosis, one of great practical importance is the extent of the disease at the time of diagnosis. At present, diagnosis is often made lamentably late, and, taking all cases together, the fatality rate is consequently high.

Lateness of diagnosis is illustrated by the fact that of 35,000 pulmonary tuberculosis patients discharged from, or dying in, hospitals and sanatoria in England and Wales during 1938, as many as 65 per cent. had been classified at the time of admission as intermediate or advanced cases. The high fatality rate of pulmonary tuberculosis under ordinary conditions is indicated by the results of a recent inquiry by Dr. B. C. Thompson* in an industrial area. It was found that, among all patients with tubercle bacilli in the sputum, the chances of survival to one year from the time of diagnosis were 1 in 2½, to five years were only 1 in 4, and to ten years only 1 in 8; the calculation was based on the experience of 406 patients, representing all sputum-positive persons over the age of 10 placed on a local tuberculosis dispensary register between 1928 and 1938. Larger figures showing the medical prospects of patients with pulmonary tuberculosis in this country have been mainly based on discharges from sanatoria, and so may be expected to give somewhat more favourable results. But, taking the most recent L.C.C. figures available, out of 3,446 adult

* *Tubercle, Lond.*, 1942, 23, 139.

patients with pulmonary tuberculosis discharged from the Council's tuberculosis hospitals and sanatoria in 1933, only 43 per cent. were alive five years later.

When pulmonary tuberculosis is diagnosed in the earlier stages, the outlook for the patient is fortunately different, for, with adequate treatment, the progress of the disease can more often be arrested and the person restored eventually to normal life and full work. With earlier diagnosis the rule, rather than the exception which it is at present, there is every hope that the fatality rate of persons suffering from pulmonary tuberculosis, taking all cases together, would be greatly lowered.

The present unsatisfactory results would, no doubt, be improved if the public were more fully aware of the importance of seeking medical advice when symptoms first appear, and if there were closer co-operation between the general practitioner and the tuberculosis officer. But, we are up against a fundamental difficulty, namely, that in the earliest stages of pulmonary tuberculosis symptoms are often absent or insignificant, so that the person may be unaware of his illness until the disease is moderately or even far advanced. A radiograph of the chest would reveal the condition, but this is usually taken only when a doctor is consulted by the patient on account of symptoms. In order to discover the disease before symptoms develop, the initiative of the X-ray examination should pass from the patient to the doctor. This can be effected only by mass radiography.

(b) *Mass Radiography*

X-rays have been used to assist in the diagnosis of tuberculosis of the lungs for at least a quarter of a century, and, latterly, apparatus has been so improved that the earliest visible signs of this disease can be recognised with precision. The routine X-ray examination of selected groups of supposedly healthy persons is termed mass radiography, and fresh impetus has been given to this type of examination during the last few years by the development of a new technique. Unlike the ordinary method of taking X-ray photographs (direct radiography), in which the image is directly received upon a large-sized X-ray film, this technique involves the use of a camera with which the natural-sized X-ray image on the fluorescent screen is reproduced on a much reduced scale on a photographic film. The method is conveniently termed indirect or miniature radiography. Its chief virtue lies in its speed; it makes possible the examination of a large number of people in a short space of time and at moderate cost, by an apparatus which may be transportable.* It may represent a turnover of, say, 3,000 examinations a week, compared with perhaps 500 by the direct method. The results, however, are less detailed, so that every miniature film showing a variation from normal should be followed by a full-size direct radiograph.

Two main forms of apparatus for mass miniature radiography are now coming into use. One of these gives individual films measuring 5 by 4 inches; this type has been recently introduced in the U.S.A., and the Ministry of Health has taken steps to import a small number of sets. The alternative form gives a 35 mm. cine-film, and the Committee's Technical Sub-Committee, after careful study, has unanimously approved a specification for the Medical Research Council, which has also been accepted by the Army Medical Service. The essentials of this form of apparatus, and the principles to be applied in its use, appear as an Appendix to this report. The apparatus is now in process of construction, and it is hoped that, by the end of 12 months, 50 sets will have become available.

* There are varying degrees of transportability, from an apparatus carried in a van and set down in a room at the place of work, to an apparatus fixed and operated in the van itself. The former type is likely to be most suitable in, e.g., a large factory, and the latter in rural communities where only small numbers are being examined in any one locality.

We are of opinion that the miniature method is suitable for the opportunities and circumstances of war-time, and, in the light of our reference, we have applied ourselves in the first instance to what is practicable under existing conditions. Owing to the limitation of apparatus likely to be available in this country, concentration at the present time should be upon those groups where, through the nature of the employment or the composition of the population at risk, a relatively high incidence of unsuspected tuberculosis is likely to be found. Furthermore, the use of the apparatus should be under the general direction of the Ministry of Health and the Department of Health for Scotland, co-operating with the Ministry of Labour and National Service.

Bearing in mind the main objects to be achieved as the result of mass radiography, this procedure may broadly be classified into three categories: (i) pre-employment mass radiography, (ii) employment mass radiography, and (iii) periodic mass radiography.

(i) *Pre-employment mass radiography*.—Mass radiography can be applied once to a selected group, composed of persons about to enter a new employment, in order to prevent the entry of persons with active pulmonary tuberculosis into an environment where they will provide new sources of infection for others. It will also prevent the entry into an environment where they may break down again of persons whose disease has recently been active. The most fertile field in these respects is the three Services, and entrants into industry and certain other occupations, which altogether embrace a large proportion of the young people of both sexes in this country. Among the entrants to industry we may instance young adults (aged 15–24), particularly women, entering the war industries, e.g. the Royal Ordnance Factories, from different employment or as their first job. Another class of persons specially suitable for this type of mass radiography, but possibly to a less degree under present conditions than those already mentioned, are new entrants to silicosis-producing industries, such as anthracite mining and potteries, because of the interconnection between this disease and tuberculosis. In keeping with this, it would be well if the employment examination under Section 99 of the Factories Act, 1937, of young persons entering the potteries could be extended to include an X-ray examination of the chest.

Undoubtedly pre-employment mass radiography* benefits the community within the environment and improves its productive efficiency. It must be emphasised, however, that the method does not ensure that, in those found to have active pulmonary tuberculosis, the disease will necessarily be slight in extent; some of the cases discovered will already be in an advanced stage. Moreover, those free of detectable trouble at that moment, and accepted into the community, may develop pulmonary tuberculosis at some later date; such persons will run the usual risks of late diagnosis and its consequences, unless they have been re-examined at regular intervals during employment (see below, periodic mass radiography.)

Examples of pre-employment mass radiography (without periodic re-examinations of those accepted) are the schemes for examination of recruits to the Canadian and United States Armies, and to the Australian Imperial Forces; of certain Royal Air Force personnel; and of applicants for employment in various industries, e.g. the Brazil fruit trade, and, in England, the Mitcham (Radio) Works Ltd. In the latter factory during the last five years, Dr. L. Banzky* has examined 12,000 applicants for employment by fluoroscopy, and has found active tuberculosis, confirmed by radiography, in 1 per cent. This incidence may be contrasted with the finding of only 0.27 per cent. active pulmonary tuberculosis in 20,000 examinations of Royal Air Force personnel in 1941–42, reported by Wing Commander R. R. Trail†, but it should

* *Industrial Welfare*, 1942, 2A, 19.

† *Lancet*, 1942, i, 609; ii, 413.

be emphasised that these were selected personnel who had already been submitted to clinical examination.

The Committee welcomes the information that systematic radiography of new British Army recruits is being developed as far as possible ; although this is to be done after entry to the Forces, and the existing methods for detecting tuberculosis before entry continue to apply, it represents a great advance on the use of the latter alone. Since the X-ray examinations will be made by the Service authorities at comparatively few centres, where there are suitably large concentrations of personnel, the scheme does not conflict with the view expressed by the Medical Advisory Committee to the Ministry of Labour in its recent report (Cmd. 6353, 1942), namely, that mass radiography of recruits before entering the Forces, as part of the examination by civilian medical boards, is impracticable owing to the large number of places (200 or more) where these boards operate.

The Committee recommends the practice of pre-employment mass radiography as an important measure in tuberculosis control, particularly in connection with the occupations and industries indicated above. It is desirable that such X-ray examination should be identified wherever possible with a Health Centre in the factory or other place of employment. In recommending mass radiography the Committee wishes to stress that action on cases suspected of abnormality by its means should be taken only after thorough clinical and pathological investigation.

(ii) *Employment mass radiography.*—Although the detection of active tuberculosis among entrants to employment by the method proposed above is of great importance, it will not of itself safeguard industrial workers. The long continued studies of herd disease under experimental conditions, carried out under the auspices of the Medical Research Council, prove that admission of healthy non-immunes to a group within which an infectious disease smoulders is a danger not only to the entrants but also to the original members of the group. This rule applies to tuberculosis. We must remember that, under war-time conditions, young women from middle-class homes, or from villages without industrial establishments, enter factories, shops and offices, passing from the social milieu of small to that of large groups. They may provide the soil for new epidemiological growths. It is, therefore, eminently desirable that the group itself, not only entrants to it, should be studied. A single X-ray examination can but give an instantaneous picture ; repeated X-ray examinations at short intervals (*see below*) may not be practicable. But the epidemiological equilibrium in tuberculosis cannot be so unstable as in the acute infective diseases which have been the object of experimental research, and it is reasonable to believe that re-assessment even at fairly long intervals will be of definite value. The Committee therefore believes that such single examinations—suitably termed “employment mass radiography”—would be of great value if carried out in selected employee groups, e.g. in munition factories. It would be possible from knowledge of areas with a high incidence of tuberculosis and a concentration of war industries, to suggest where such mass X-ray examinations should take place. They would undoubtedly lead to the elimination of very important unsuspected sources of infection, particularly accentuated under war-time conditions (*see p. 24*), even if they were undertaken only once during the period of hostilities.

In undertaking schemes of “employment mass radiography”, it should be the aim to obtain consent from the overwhelming majority of the group. For example, in a factory selected for its large number of young adults, all workers, irrespective of age and sex, should be included, for it is sometimes among the older age-groups that unsuspected infectious cases are found. The older groups are particularly important because of the tendency for the disease in them to assume a very chronic form, associated with little disability, and often

masked by symptoms attributed to other conditions, for instance, chronic bronchitis. The statistics already given show an increase in tuberculosis among middle-aged and older men since the war.

(iii) *Periodic mass radiography*.—When mass radiography is applied at regular intervals (e.g. yearly or six-monthly) to the same group, usually consisting of persons working in the same environment, it is called periodic mass radiography. The object, in addition to eliminating from the group persons who are actual or potential expectorators of tubercle bacilli, is to discover new cases when the disease is in its early stages—even before symptoms are present—and when, with adequate care, the chances of recovery for the affected individuals are comparatively great.

While the "combing-out" of a number of unsuspected infectious cases at the first examination of such a scheme is valuable, false hopes must not be raised that the outlook for these particular individuals will differ from that for similar cases discovered in the ordinary way. It is only after a scheme has been in operation long enough for several examinations to have been made, that its full benefits will be experienced by the group. Three changes should thereby take place: (1) a decrease in the incidence-rate of new cases; (2) an increase in the proportion of early cases among all active cases discovered; (3) an increase in the proportion of patients who recover and return to work after medical supervision alone, or after active treatment of relatively short duration; and (4) as a result of these changes, an increase in the productive efficiency of the group, and a saving in its manpower.

Examples of schemes of periodic mass radiography that have been in operation long enough to prove their value are those for the employed staff of the Metropolitan Life Insurance Co., New York City, of the Eastman Kodak Co., U.S.A., and of Philips Works, Eindhoven, Holland; those for the staffs and students of numerous American universities and medical institutions; and, in Britain, those for the students at the medical schools of University College Hospital and at Cardiff, and for the nurses at certain hospitals. Some of these schemes are compulsory and others voluntary; most are combined with pre-employment mass radiography. Before the introduction of the Metropolitan Life Insurance Co. scheme of annual examinations in 1928, only one-third of the tuberculosis cases among employees were in an early stage. Soon after its introduction, the proportion rose to two-thirds, and it has recently been as high as three-quarters; by contrast, among cases diagnosed by the ordinary methods in New York City, only about 1 in 10 are early. During the same ten-year period of this scheme's existence, the incidence-rate of new cases among employees has gradually fallen, while, by contrast, among applicants for employment it has remained fairly constant. Finally, four-fifths of the Metropolitan employees diagnosed in the early stage and given prompt treatment under the scheme are able to return to work and to continue there.* These ex-patients, it may be added, provide the best propaganda agents for the scheme. In the Eastman Kodak Co., the incidence of tuberculosis has been reduced from 2.3 per 1,000 employees in 1921 to 0.2 per 1,000 in 1940,† while, as a result of the Philips (Eindhoven) scheme, it is claimed that in the past seven years there has been a notable reduction in sickness-absence due to tuberculosis, and ample repayment for the money expended.

The Committee regards routine periodic mass radiography as the best method of controlling pulmonary tuberculosis in any community or group of fairly constant composition, working within the same environment; it should, wherever possible, be a sequel of "employment mass radiography". In the

* Ada C. Reid: *The Control of Tuberculosis*. *J. industr. Hyg. Toxicol.*, 1940, 22, 303, 408; 1941, 23, 35.

† W. A. Sawyer: *Symposium on Tuberculosis in Industry, Saranac Lake*. Nat. Tub. Ass., N.Y., 1941, p. 311.

limitations of war-time, certain groups should be given priority, namely, those known to be at a particular risk or to have a high incidence of tuberculosis, and those where conservation of manpower is specially important. On the basis of information at present available, the Committee regards the following as some of the more important groups: (1) employees in munition works and similar industries where there are large numbers of young adults, particularly young women; (2) nurses and medical students; (3) merchant seamen; and (4) employees in any industrial concern where there has been an unusual number of cases of tuberculosis. In the light of these suggestions, the Committee welcomes the introduction, since the war, of periodic mass radiography in the Royal Navy, in certain British firms, in some additional medical schools, and among nurses in the employment of the L.C.C. General and Special Hospitals. It would favour the introduction of further schemes in the industrial population as soon as the supply of apparatus makes this practicable.

The routine radiography of a community at regular intervals, e.g. annually, will not ensure the detection of all cases of pulmonary tuberculosis, since the disease may progress rapidly in some people. In persons who develop symptoms between any two routine examinations, detection of the disease must still depend upon the subject's taking the initiative and seeking re-examination. This initiative may be made easier by identifying the examination with a Health Centre in the factory.

Mass miniature radiography requires a considerable degree of organisation and planning ahead. The Committee believes that the miniature method should be undertaken, in preference to direct radiography, not merely for reasons of cost, but rather where reasons of speed *plus* cost demand it. There are likely to be many instances in which full-size direct radiography will be equally or more suitable than the miniature method as the basis for a mass radiography scheme. Moreover, until apparatus for miniature radiography becomes available, the Committee recommends that, where indicated, mass radiography schemes should be instituted by means of the ordinary direct method. On this point, the Committee believes that more use could be made of existing apparatus at times when the latter is ordinarily idle, e.g. plants at hospitals or tuberculosis clinics in the vicinity of factories.

Examination of recruits for the Services presents no difficulties of consent, and in the case of entrants into industry and other employments a routine medical examination (including radiography) could gradually be established by agreement. In the same way, periodic mass radiography, introduced into an employee group on a voluntary basis, would by education gradually win public opinion within the group. For a voluntary scheme of periodic mass radiography to succeed in a factory, propaganda must accompany its introduction. The scheme should be associated with the ideals of physical fitness and healthy citizenship.

The Prophit survey of the Royal College of Physicians of London has revealed that in Britain, as in certain other countries where similar surveys have been carried out, there is a significant proportion of young adults who give negative reactions to the tuberculin test (a skin test which detects infection by the tubercle bacillus)*. In view of this and of increasing evidence that primary infection may be followed shortly or within a few years by progressive pulmonary tuberculosis, any scheme in which periodic tuberculin-testing is combined with periodic radiography is to be encouraged, for in this way the particularly susceptible negative reactors can receive special attention. The Committee, however, recognises that under present conditions the combination of large-scale tuberculin-testing and radiography may be impracticable.

* F. Ridehalgh: Tuberculosis in Young Adults: Summary of Interim Report of Prophit Tuberculosis Survey, 1934-39. *Lancet*, 1942, ii, 463.

(c) Care of Those Discovered to have Tuberculous Lesions

Apart from the diagnostic side of periodic mass radiography, organisation is essential for the satisfactory care of those discovered to have tuberculous lesions; an essential preliminary to any action is complete clinical and laboratory investigation to confirm the diagnosis. The cases may be quiescent or arrested, definitely active, or doubtfully active; their differentiation will be aided greatly by the comparative study of films taken over a period. Most of the subjects with quiescent or arrested lesions will need no interference with their lives; most of those with definitely active disease will require institutional treatment; many of the doubtfully active cases may be satisfactorily controlled by close supervision and care, e.g. by reducing overtime and improving diet and environment, while the subjects retain their usual jobs or are placed temporarily on modified or part-time work (*see p. 22*). With early diagnosis the periods of treatment required will often be relatively short; for some of the patients special convalescent homes rather than sanatoria may be adequate. In all these arrangements, co-operation will be necessary between general practitioners, local tuberculosis services and factory medical officers.

The success of treatment is intimately bound up with the removal of certain essential difficulties in its way. One is the financial position of the persons discovered to have tuberculosis and advised to cease work for a longer or shorter period, and of the families dependent upon them. A second is the provision of beds to cope promptly with the favourable cases found to be in the early stages of the disease. A third is the rehabilitation of the patient who has reached quiescence as a result of treatment, as well as of the chronic active type of case. The removal of these difficulties would advance two of the aims of tuberculosis policy—to find and treat the early case, and to find and control the infectious case. These difficulties will now be considered in detail.

(III) TO IMPROVE TREATMENT AND CARE OF PATIENTS IN ORDER TO REDUCE THE RISK OF RELAPSE*(a) Institutional Accommodation*

The greatest difficulty at present confronting the tuberculosis services is lack of usable in-patient accommodation. The total number of available beds was drastically reduced on the outbreak of war by transfers to the Emergency Hospital Scheme, but this deficiency was substantially remedied in the subsequent months; further release of a number of additional beds from the emergency schemes for the treatment of tuberculosis has taken place from time to time, and in some areas it has been possible to provide fresh accommodation, e.g. in the form of hutted wards.

In spite of these improvements, there is still a definite shortage of "approved" beds in some districts. Taking England and Wales as a whole, the total number of approved beds at the end of 1941 was 26,011 and on the 31st March, 1942, was 26,607, as compared with 30,792 at the end of 1938. Of these total beds, however, a proportion was not usable for various reasons, the most important of which was shortage of nursing and domestic staff, other factors including closure enforced by war conditions, etc. Unfortunately, the total figure for these non-usable beds is not known for the country as a whole; but for the Welsh National Memorial Association the figure in respect of shortage of staff alone was given, in a Parliamentary debate at the end of July, as 150 out of a total bed provision of 1,952.

Evidence of the shortage of nurses is shown by the following figures given by the Minister of Health on the 30th June, 1942. The total number of nurses employed in sanatoria in England and Wales (excluding those in the Emergency Medical Service Scheme) was 2,600, but an additional 500 nurses were needed. For the beds in the emergency hospitals another 600 were also required, so that for tuberculosis an immediate total enrolment of about 1,200 nurses was needed.

At the same time, it appears that the shortage of domestic staff is at least as acute as that of nurses. For example, in Wales in July the normal establishment was down by 13 per cent. for nurses but 22 per cent. for domestic staff, so that nurses had to do some of the domestic duties. For England and Wales as a whole, it was estimated that 4,800 domestic staff were being employed in sanatoria and that 920 more were required.

In Scotland the shortage of institutional accommodation for tuberculosis has been specially noteworthy in areas like Glasgow, which show a significant increase in this disease; endeavours to meet these needs by using beds of the Emergency Hospital Scheme have been frustrated by lack of staff. In 1941 the beds released by the Department of Health for Scotland from the E.H.S. for tuberculosis cases were nearly 500, but for only 300 of these was staff available; these figures are small in themselves but, when related to the need of the area, the proportion of beds that cannot be brought into use is significant.

The shortage of usable in-patient accommodation in Great Britain is a matter of grave concern. In many areas the time during which patients remain on waiting lists for admission has increased, and in some it may be three months or more, as against the aim of a week or less. The number of patients on these lists has correspondingly increased; for England and Wales as a whole, the number at the end of 1941 was 1,704, and for Scotland, 509; at the end of March, 1942, the figure for England and Wales had risen to 1,907 (400 for Wales), and the Scottish figure to 652, these figures excluding Service cases. It is useless to insist on the need for early diagnosis, if treatment is delayed once the diagnosis has been made. Delay in treatment also prolongs the period during which the patient, if infective, is a danger to adult and child contacts in his home and elsewhere.

A full survey of the existing accommodation would be advantageous, including, in particular, the number of beds actually usable, and future plans need to be based on this knowledge. Probably more could be done through co-operation and pooling of resources between local authorities of the smaller neighbouring areas. It may not everywhere be possible to extend existing accommodation at sanatoria, on account of building restrictions and the greater difficulty in obtaining nursing and domestic staff for institutions situated in the country. Immediate consideration should therefore be given to increasing further the number of beds allocated to tuberculosis in municipal and E.M.S. hospitals. These beds should be under the supervision of the tuberculosis officer, whenever practicable, and could with great advantage be occupied by patients waiting for admission to sanatoria. During this period of bed rest the application of initial measures of collapse therapy might be considered in certain cases.

The problem of attracting the necessary recruits for tuberculosis nursing requires solution before any progress can be made in the institutional control of the disease. Much good advice is to be found in the Ministry of Health circular 2526 (November, 1941). Nursing of tuberculosis cases is as important as that of any other sick persons. It is possible that the appeal to recruitment is still based too much upon the conception of nursing as a calling demanding sacrifices, rather than as an interesting and valuable profession requiring satisfactory working conditions. Should appeals for recruits fail to give the results dictated by the urgency of the tuberculosis situation, it might become necessary to exercise wider powers of direction in this respect. Evidence from research in other countries, and expert opinion in our own, suggest that the risk of contracting tuberculosis from nursing tuberculosis patients in sanatoria is no greater than that involved in general hospital nursing.

The shortage of in-patient accommodation and staff has an important bearing upon mass radiography schemes. Clearly the value of diagnosis at an early stage of the disease will be stultified if immediate treatment is not available. Special provision for such prompt treatment is therefore essential.

On the other hand, these mass radiography schemes will develop only gradually, and the type of case discovered may, on the average, be expected to require a relatively short stay in a sanatorium and less active nursing than do many sanatorium patients diagnosed in the ordinary way. Indeed, it may be practicable, if the number of mass radiography schemes in a given area justifies it, to equip a suitable house, at present used for a convalescent home, as a sanatorium reserved for this class of case. In addition, further loans of beds from the Emergency Medical Service might assist, at least for an interim period.

(b) *Financial Measures*

The Committee would like to draw attention to the financial position of the tuberculous individual and his family. An unsatisfactory contrast can be drawn between the generous financial outlay during the sanatorium phase and the inadequate support after that phase is concluded. In fact, the sanatorium with its protected life is only a first chapter, at the conclusion of which the patient's treatment has step by step to be continued until he can resume his place as worker and citizen. National Health Insurance disablement benefit, following termination of sickness benefit at six months, is inadequate. Extra nourishment in kind, which may be granted as a supplement by local authorities, varies widely in amount, content and duration from one area to another; difficulties associated with this system, and with its lack of uniformity, have been intensified under present conditions, e.g. by the rationing of eggs and other favoured "extras". As an approximation, the monetary value of extra nourishment provided by many local authorities varies between 3s. and 7s. a week.

The result of the reduction in income which is experienced by an industrial wage-earner with tuberculosis, and which is accentuated the longer his illness lasts, is that he must eventually either seek relief from Public Assistance or be supported by his relatives, often themselves on a low income level. Altogether, it seems poor economy to spend large sums on the patient in the early stages of treatment, only to lose too often a useful worker later through a relapse which might have been avoided by more generous financial provisions. National Health Insurance, intended to tide a wage-earner over a relatively short period of illness, was never intended to supply full financial needs for as long as six months or a year. The financial position of the tuberculous worker under National Health Insurance disablement benefit—10s. 6d. a week without an allowance to his family—may be contrasted with the pension to soldiers discharged with 100 per cent. disablement from tuberculosis contracted or aggravated by service—37s. 6d. a week *plus* allowances of 9s. 2d. for wife, 7s. 1d. for first child and 5s. 5d. for each other child.

The marked fall in the standard of living referred to above, and the strong contrast between the financial allocation during the sanatorium phase and that during the post-sanatorium phase, is widely recognised among industrial workers, who often regard tuberculosis as spelling economic disaster. Anxiety lest their families will be inadequately provided for is a strong factor in causing workers to delay in reporting sick, with disastrous consequences to themselves and a prolongation of the period during which their factory group may contain a possible source of infection. Another result of the wide difference between sickness allowance and the normal wage is premature return to work; this is particularly prevalent at the present time, when work is easy to get and when the tuberculous are anxious to take their part in the national effort. It is doubtful, also, whether schemes of periodic mass radiography in factories will succeed in their objects unless the detected individuals—who may, not have suspected their illness and may feel fit enough to continue work—receive financial provision adequate to overcome the disinclination to follow medical advice if it entails treatment in a sanatorium.

The Committee considers that there are cogent reasons for ameliorating the present financial provision for tuberculous patients. Tuberculosis is a special case, the needs of which the ordinary National Health Insurance scheme was not designed to meet. The special character of the disease lies in the facts (1) that it affects the productive groups of the population, (2) that it usually extends beyond six months (the point at which the full N.H.I. sickness benefit of 18s. falls to the disablement benefit of 10s. 6d.), (3) that it tends to reduce the standard of living of the patient and his family, yet requires a high standard of living for its successful treatment, and (4) that, whereas if the disease is allowed to progress it may render the patient infective to others, there is a good chance of full recovery and restoration to work if it is diagnosed early and the economic circumstances are favourable.

The Committee therefore recommends that special financial provisions should be made to meet these conditions. While it is not in a position to work out a detailed scheme, it wishes to make certain suggestions. The special provisions, which might be made under the N.H.I. or in the form of a special tuberculosis fund, should be designed to ensure an adequate allowance for a period of, say, up to one year after notification, if this be required; the cases of persons still unfit for work at the end of this period could be reviewed by a suitable authority. The amount of benefit would have to vary according to the needs of the patient and his family. This financial scheme might also be linked with a fund for providing payments to supplement, to their full amount, the wages of those returning to their employment on the basis of part-time or modified work.

In the Committee's opinion, a financial scheme of this kind at the present time would contribute both directly and indirectly to the control and prevention of tuberculosis. It would help directly by giving the patient an adequate standard of living so as to aid in the conquest of his disease, and would similarly lessen the risk of its development in his family. Indirectly it would contribute too, by making it easier to persuade the patient to complete his treatment and not return to work prematurely, by removing some of the fear which prevents many adult home-contacts from attending for examination, and by increasing the acceptability to workers of mass radiography schemes.

(c) *Industrial Rehabilitation*

Industrial rehabilitation means the re-introduction of the tuberculous into employment after treatment. Practically, this can be considered under two headings (1) the convalescent non-infective,* (2) the chronic active case.

(i) *The convalescent non-infective case.*—For the tuberculous patient who has reached the quiescent non-infective stage of the disease there comes a time when a decision has to be made. Is he to re-enter employment and hope to complete the healing process while at work, or is he to wait until further healing can be presumed to have taken place and the doctor is satisfied that the danger of breakdown is minimal? The first alternative entails a sharp change from no work at all, or from a limited amount of work under sanatorium conditions, to ordinary full-time employment with the danger of relapse, a danger that is enhanced under the stress of war-time working and transport conditions. The second alternative may entail a period of convalescence so long beyond the time when the patient feels fit that it conflicts with his natural desire to restore his standard of living and, at the same time, to play his part in the

* The term "convalescent non-infective case" relates to a tuberculous person who has recently completed institutional treatment, and whose disease is in a quiescent stage. "Quiescent" is applied, according to Memorandum 37/T of the Ministry of Health, to "cases which have no symptoms of tuberculosis and no signs of tuberculous disease, except such as are compatible with a completely healed lesion, and in which sputum, if present, is free from tubercle bacilli." See also definition of "arrested", p. 23.

national life. In actual practice the first of the two alternatives must too often be taken before the doctor would wish, and it is certain that many relapses, most of which occur within two years of the return to work, can be ascribed to this cause.

In the Committee's opinion, an intermediate phase is needed, during which a tuberculous person whose disease has become quiescent can do either part-time or "modified" work, preferably in normal industry, before resuming full-time employment under ordinary industrial conditions. Wherever possible, such work should be in the patient's own occupation; for change to a new type of work would involve both mental strain, which is likely to be harmful to him, and less chance of returning to his previous standard of living.

By "part-time" work is meant ordinary work but with the number of hours reduced, e.g. to one half. By "modified" work is meant work, either full-time or part-time, carried out under less strenuous conditions than usual.

We are informed that both part-time work and modified work have been used extensively for some years in the U.S.A. and the U.S.S.R., with encouraging results.

In the U.S.A., particularly noteworthy is the "Altro" municipal workshop scheme in New York. Part-time sheltered work is provided for suitable patients, working hours being fixed in accordance with the history of the case and the clinical findings. The earnings are amplified by subsidy so that the patient and his family attain the necessary level of income. The wages paid are Trade Union rates. The advantage of the subsidy is that it makes a short working week possible.*

In the U.S.S.R., one method is for ordinary factory work to be carried out for half time or less at standard rates of pay, the balance of wages being made up from the social insurance funds. Another method is to reserve a shop or section of a shop in a factory for suitable cases, where the conveyor belt may move at reduced speed. A third is to provide special workshops, financed from the social insurance funds. Stress is laid on keeping the skilled man in skilled work, even though his actual occupation be changed. The medical officers of the factories are responsible for the arrangements for tuberculous workers, and for their supervision in the factory. "Night sanatoria" have been found useful adjuncts for certain persons whose home conditions are unsatisfactory, and for providing part-time workers with rest and relaxation under medical supervision. The outputs of these various rehabilitation schemes are considered as additional to the factories' own quotas, though studies of productive capacity have indicated that in certain tasks tuberculous workers have proved more efficient than their healthy comrades.†

In Great Britain the following possibilities might be considered at present.

Although not strictly comparable, part-time work for convalescents from tuberculosis might operate in a manner similar to part-time work for married women, the part-time workers being, for example, employed conveniently for half-shifts and relieving one another in the middle of their shifts. The part-time work would be regarded as a temporary phase for a convalescent tuberculous individual, the aim being eventually to place him on ordinary full-time work again.

The provision of modified work might require a certain amount of rearrangement within the factory. Two suggestions which might be adopted (during the war) when arranging modified work are:—

- (1) A portion of an existing factory would be set aside for tuberculous ex-patients; the conditions of work would be made less arduous by the type of work undertaken, the speed of the belts, etc. Persons on this modified or sheltered work might be employed for full-time, half-time

* See *Tubercle*, Lond., 1942, 23, 1, 25.

† *Problemy tuberkuloza*, Moscow, 1933—1941; and see *Lancet*, 1937, i, 969.

or less, according to medical advice. They would be subject to general medical supervision at work by the industrial medical officer or the tuberculosis officer; they would live at home, or possibly, in hostels on the model of the night sanatorium. This plan might be practicable in a factory in an industrial area where there were enough suitable ex-patients to be placed together. The separation from other workers would be only for convenience of organisation, since the cases would not be infective.

- (2) A plan somewhat similar to the foregoing would be to take advantage of the conversion of many garage businesses to light engineering shops. These shops produce small parts and act as sub-contractors for the larger contractors of the Ministry of Supply. The "Spero Industries", which are already designed for tuberculous workers, offer similar advantages of a self-contained factory already equipped and adapted for various kinds of modified work; at present this particular undertaking is not working to full capacity, largely through lack of funds. As soon as the disease has been arrested, workers in these various small factories or local workshops might (if necessary after re-training) be absorbed into normal industry.

The question which of the two methods, part-time or modified work, is practicable would depend upon conditions in the individual factory, and it might be possible for industrialists to devise other arrangements.

Unlike the employment of married female part-time workers in industry, an essential accompaniment to any large-scale introduction of industrial rehabilitation for the tuberculous, on the basis of modified or part-time work, is the establishment of supplementary payments to make up the wages to, or nearly to, the normal amount. The arguments in favour of the principle of subsidised wages are impressive. For since it is generally agreed that it is sound economy to spend money in order to make the tuberculous patient fit for work, it would seem wise also to give him financial security against a temporary physical handicap when he actually re-enters employment. The supplementary payments would assist in creating conditions that would allow healing to continue with minimal risk of relapse. Without such payments, the convalescent patient will still too often be apt to yield to the natural temptation to return, on his own initiative and before his doctor has so advised him, to full-time ordinary work, particularly at a time when the demand for labour makes this easy. The Committee realises that measures will need to be taken to ensure that during the period of subsidy the patient will follow the advice of his tuberculosis officer as to the proper use of his leisure time.

The Committee regards the introduction of satisfactory arrangements for industrial rehabilitation of the tuberculous as one of the most pressing needs for the control of this disease. Some advance has already been made in recent months by the inclusion, under the Ministry of Labour's Scheme for Training and Resettlement of Disabled Persons, of quiescent (and sputum-negative) cases of tuberculosis in which the individuals are considered capable of re-introduction into whole-time employment under ordinary industrial conditions (Ministry of Health circular 2576, February, 1942). This move is good within narrow limits, but these limits restrict the application of the scheme to a minority of cases—arrested* rather than quiescent—consisting, moreover, of persons who can usually obtain employment without such assistance; it fails to meet the special needs of the tuberculous ex-patients for whom a slow and graduated resumption of work under medical supervision is required. To cover such

* "Arrested" applies to "cases which have been 'quiescent' for a period of at least two years" (Memorandum 37/T of the Ministry of Health). For definition of "quiescent", see footnote on p. 21.

cases, the Committee recommends that the principle of modified or part-time employment with subsidised wages in normal industry should be established.

The selection and industrial assessment of cases, and their disposal, might be the responsibility of the representative of the Ministry of Labour, under the advice of the tuberculosis officer and the medical superintendent of the sanatorium where the patient has been treated. This would involve a fuller knowledge by tuberculosis officers of industrial conditions.

The establishment of the rehabilitation schemes envisaged would be directly linked with the success of mass radiography, for the acceptability of the latter in factories would be increased if the affected workers knew that, provided their treatment went well, they would be assured of suitable and adequately paid jobs. Furthermore, an agreed rehabilitation scheme would enable certain persons with abnormalities discovered by mass radiography, who require medical supervision only, to continue in employment without undue risk to their health, as it would be possible to arrange a temporary modification of their work.

(ii) *The chronic active case.*—The previous section was concerned with the quiescent, non-infective case likely to achieve arrest under sound industrial conditions. We have now to consider the large number of persons whose disease is chronic and fairly well stabilised but, in spite of treatment, still active. Many of these are suitable for some degree of work and so represent another reserve of manpower, but one of which it is less easy to make use on a large scale, because of their greater liability to break down and to spread infection. It should be emphasised, however, that many such persons are actually engaged in industrial work under ordinary conditions, though their disease is often unknown to their employers and fellow-workers, and even to themselves. The number of these unsuspected cases has probably increased during the war, not only as part of the general increase in the incidence of the disease, but also on account of the greater ease of obtaining and retaining employment; the uncontrolled presence in factories of these persons maintains sources of tuberculous infection dangerous to the healthy workers, and, as the war progresses, this danger will become greater.

The chronic active case provides an industrial problem which has never been sufficiently tackled in this country, though the Papworth and Preston Hall Village Settlements have demonstrated one possible solution. The present time is opportune for a wide effort in this direction, firstly, to reduce the danger of tuberculous infection incurred by the healthy, and, secondly, as a contribution to the rational employment of this class of tuberculous persons, in the interests both of themselves and of the community.

As to the type of work envisaged for the person with chronic active disease, the Committee realises that part-time ordinary work might not commend itself either to employers, who might fear that production would be interrupted by frequent absence or by actual relapse, or to workers, who would undoubtedly dislike the presence of potentially infectious persons among them. Modified work may, however, be practicable, and suggested varieties are as follows:—

- (1) A section of a factory might be given over to modified work under medical supervision, with separate accommodation for meals. Where circumstances indicate, a night sanatorium might be tried as an experiment.
- (2) Smaller, individual, local workshops, such as converted garage businesses, might be similarly reserved.
- (3) Industries might be set up in connection with certain of the larger, well equipped sanatoria. These industries could be used for ex-patients as well as for resident patients. Although they would provide employment only for a certain group of people, they could form the basis of future village settlements on the Papworth model, any such future schemes being established on a regional basis.

In tuberculin reactions work the worker with chronic active disease will also receive tuberculosis disallowance supplemented by subsidy. Unlike the payments in the favour of 5 year convalescent case, however, these subsidised wages might have to continue indefinitely, and the financial problem is therefore greater. In the Committee's view, it is nevertheless a problem worth trying to solve, both as part of the war-time control of tuberculosis and as part of the drive to increase total production.

The Committee therefore recommends that, so far as may be practicable, suitable industrial rehabilitation of selected persons with chronic active tuberculosis, by means of modified work, should be undertaken on the lines indicated, possibly through an extension of the present Ministry of Labour scheme, on a regional basis throughout the country.

The Committee recognises that some tuberculous persons will be unable at any time to resume their previous occupations, either because the nature of the work or its environment is entirely unsuitable. For these persons it will be necessary to arrange a scheme of vocational training to fit them for their new work, and the Committee suggests that the training centres connected with the Ministry of Labour scheme should be used for this purpose, not only in convalescent non-infective cases but also in suitable chronic active cases, under satisfactory medical supervision. The need for such vocational training should be determined, if possible, at an early stage of the patient's stay in the sanatorium, the decision being based on his previous occupation, his social and economic circumstances and his medical prospects. The patient could then be psychologically prepared for the proposed change in his vocation, and at a later stage of his treatment it might be possible to arrange occupational therapy which has some bearing on his future work, so that the transition from the position of patient to that of trainee is effected smoothly and economically.

In this section the Committee has attempted to set out some lines on which it believes the employment of tuberculous and ex-tuberculous persons can usefully proceed. For implementing its recommendations technical knowledge of industrial organisation is required, and the details of the schemes would necessarily have to be worked out with the expert assistance of the representatives of industry itself.

The Committee would direct attention to the Fifth Report of the Employment Committee of the Joint Tuberculosis Council* in which it is suggested that a national board might with advantage be established, in order to co-ordinate the various interests in preparing a rehabilitation scheme.

Before concluding this section, the Committee would like to emphasise that an appreciable proportion of tuberculous patients who have received the maximum benefit from institutional treatment will be found incapable of doing any work even under the favourable conditions described above. In the interests of the public health it is clearly essential that some form of segregation for these sufferers should be provided. Such segregation should benefit them also, since it would provide nursing and amenities otherwise unobtainable by the vast majority of such people.

(IV) TO RAISE RESISTANCE TO THE TUBERCLE BACILLUS, PARTICULARLY IN SUSCEPTIBLE GROUPS OF THE POPULATION

The efforts already being made by the Government to maintain in general the national health under the stress of war can be expected to assist in promoting resistance to tuberculosis, owing to the extreme sensitiveness of this disease to social conditions. Particularly important are the maintenance of good nutrition, favourable working conditions, the avoidance of fatigue caused by over-long working hours, and mitigation of domestic overcrowding.

* The Rehabilitation and Care of the Tuberculous. *Tubercle, Lond.*, 1942, 23, 1, 25.

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If any specially susceptible age-groups are to be selected for special measures, these should be children and young adults, particularly those who are in close contact with cases of tuberculosis. School meals should play an important role in the protection of children. As regards men and women, the large increase in the industrial population offers opportunity for enlightened supervision, in order to maintain their health and resistance. Some of the measures which should help in this may be summarised briefly: provision of adequate canteen facilities; timing of meals in relation to day and night shifts; scientific adjustment of hours of work to optimum production, as indicated by the work of the Industrial Health Research Board; proper spacing of workers and ventilation of shops, particularly under black-out conditions; sufficiency of rest periods, reduction of unnecessary fatigue, alleviation of transport difficulties, and a high level of welfare work; provision of satisfactory hostels where indicated. While there is a general tendency in these directions, there are local variations and many factories with deficiencies. Progress is greatly hastened in those factories where industrial medical services and welfare departments are provided, and where the workers have a share in improving working conditions; as by joint production committees, works' councils, canteen committees, etc.

(V) ADDITIONAL MEASURES

(a) Examination of Contacts

Home-contacts of known cases of tuberculosis are the most fruitful source of new cases. Thus, in a clinic of a member of the Committee, where it is the practice to X-ray every adult and every tuberculin-positive child contact, 5.8 per cent. of a series of 730 child and adult contacts were found to have active tuberculosis; this may be contrasted with the incidence among the general population, which, according to the evidence available, is of the order of 1 per cent. when the diagnosis is made on a radiological basis.

The examination of contacts is, therefore, worth a great expenditure of effort. Although the average number of contacts examined by tuberculosis dispensaries for every new case of tuberculosis had been gradually increasing up to the war, there was still considerable room for improvement. In England, taken as a whole, the proportion examined was only one-half, and in Wales less than one-third, of the possible number of home-contacts; in certain areas, e.g., London, the proportion was more satisfactory. No corresponding information is available for Scotland. Analysis shows that the deficiency related to both adults and children. The foregoing remarks apply to first examination of contacts; re-examination was far more deficient. Since the war, examinations of home-contacts have become more difficult, and in certain areas they are now often seriously affected by industrial overtime work; air raids and the black-out have also aggravated this problem.

The Committee recommends that continued emphasis should be laid on the examination and supervision of all possible child and adult home-contacts by tuberculosis officers, as a substantial contribution to early diagnosis and prevention. No effort should be spared to obtain a first examination of every contact, whatever the age. The re-examination of young children (under 5) and young adults (15-30) is also very important, and there is some evidence to show that the period of risk of the latter extends up to at least two years after contact has been broken; re-examination of contacts of over 30 years of age is less likely to be productive of cases, and, at least under present conditions, a first examination could suffice for this age-group. First examination and subsequent re-examinations of adult contacts should invariably include a chest X-ray examination, preferably a radiograph so as to give a permanent serial record. In the case of children, X-ray examinations can be restricted to those with

positive tuberculin reactions, and the Committee would urge the routine use, in all tuberculosis dispensaries, of the tuberculin test in children, particularly those under 5 years of age.

In view of the predominance of meningitis in the increase of child tuberculosis since the war, special emphasis should be laid upon following up all contacts in the homes of those affected by this condition. Moreover, it would be helpful, where information on the occurrence of tuberculous meningitis is first derived from post-mortem examination, if the communication to the local health authorities about this could be speeded up, so that examination of contacts for a possible source of infection could be instituted at the earliest possible moment. Similarly, whenever at post-mortem previously unsuspected active tuberculosis of any form is found, whether as the primary cause of death or incidentally, the appropriate tuberculosis officer should be informed as rapidly as possible.

To reduce the risks incidental to billeting (mentioned on p. 8), we suggest that the billeting authorities should be made aware of homes that are unsuitable for billeting, because of the presence of a person suffering from tuberculosis; if practicable, they should also be notified of any cases of tuberculosis among those to be billeted. Where risk of infection has already been incurred through billeting, examination of all contacts on the lines indicated above should take place without delay. These measures are particularly important for the protection of young children.

(b) *Tuberculosis in Mental Hospitals*

In the war of 1914-1918 a striking feature was the great increase of tuberculosis mortality among patients in mental hospitals, a section of the population always subject to a heavy death-rate from this disease. In peace-time the rates of mortality from tuberculosis among patients in mental hospitals had been approximately eight or nine times that of the general population; it varied between 15 and 17 per 1,000 resident patients between 1910 and 1914. During the war it rose to 37 per 1,000 in 1917 and to as much as 52 per 1,000 in 1918. In 1923 the rate had fallen to 10, i.e. to below the pre-war level.

In the present war, a similar trend has already been apparent, in that a large relative increase in tuberculosis mortality took place in 1940, and an even greater increase in 1941. The observed deaths in the county and borough mental hospitals in England and Wales exceeded in 1940 the expected deaths (on the basis of 1937-39) by about 40 per cent. for both sexes, and in 1941 the excess was 185 per cent. for males and 85 per cent. for females. It should be noted that, although the trend is similar to that in the last war in a *relative* sense, the *actual* deaths involved are much less, being about one-fourth of the figure of 20 years ago.

There has also been an increase in tuberculosis mortality in mental deficiency institutions. In ten of the larger institutions, with an aggregate population of nearly 11,000 patients (6,000 males, 5,000 females), the tuberculosis death-rate in 1941 exceeded that in 1937-39 by 170 per cent. for males and 110 per cent. for females. In all the institutions of England and Wales taken together (22,000 males, 22,000 females), the excess was 80 per cent. for males and 33 per cent. for females.

That the increase of tuberculosis mortality in mental hospitals in the last war was mainly due to insufficient dietaries was the considered opinion of those who investigated the matter then. The Committee is not prepared to pass the same judgment now. Food may be a factor, though much more attention is being paid to dietaries both in quantity and quality in this war. On the other hand, circumstances have necessitated the transfer of a large number of beds in mental hospitals for the E.M.S. and for military and other Service mental units. The effect of the resultant overcrowding upon a receptive population may well be a

factor in the present increase, though in some mental hospitals not subject to overcrowding the same trend has been observed. The effect of the black-out is, of course, to intensify the overcrowding factor. Black-out, moreover, by reducing ventilation, has a specially adverse influence in mental hospitals, since many of the patients are unable to control their coughing and expectoration, and this tends to promote the dissemination of tubercle bacilli.

Both in respect of accommodation and on the question of rationing with protective foods, special attention might be paid to schizophrenics, for whom a particular vulnerability to tuberculosis is claimed in a significant body of technical literature.

Mental hospitals represent a semi-closed community, and efficiency of case-finding, combined with adequate segregation of active cases, is of paramount importance for the control of endemic tuberculosis and for limitation of its further increase during the war. The unsatisfactory results of postponing X-ray examination until symptoms or physical signs dictate it, which have been emphasised in earlier sections of this report in respect of the general population, are greatly enhanced in the case of mental patients, who are often less capable of taking the initiative. This, however, is the general procedure in mental hospitals, and the result is that by the time the disease is discovered it is too often in a hopeless and highly infective stage.

The Committee therefore recommends that in order to improve case-finding in mental hospitals, efforts should be made, so far as possible, to take periodical chest radiographs of all residents, whether they have symptoms or not, in order to discover and treat early cases. Many mental hospitals already have X-ray apparatus suitable for this purpose; in others a transportable apparatus of adequate power may temporarily be required. In such case-finding the co-operation of the tuberculosis officers should be sought. These suggestions and recommendations for mental hospitals should be taken to apply also to institutions for mental defectives.*

(c) Propaganda

If the recommendations of the Committee are implemented, it would be desirable that this should be accompanied by definitive information and propaganda both to the medical profession and to the general public.

One of the most important points to be made to general practitioners is that, under war conditions, the occurrence of primary infection among those who have reached adult life uninfected has probably increased; the increase in tuberculous meningitis among young adults certainly suggests this. Special attention should therefore be paid by practitioners to all cases of pleurisy, erythema nodosum, and probably also phlyctenular conjunctivitis,† and every encouragement should be given to refer such cases to tuberculosis officers for full investigation and follow-up re-examinations, and for a search for a source of infection within the families. The importance of this is shown by the finding in a recent survey in the U.S.A.‡ that 18 per cent. of patients with pleural effusion developed tuberculous lesions in the lungs within five years. In another investigation, by one of our members, of the past histories of 2,000 patients with tubercle bacilli in the sputum, 27 per cent. had a history of untreated pleurisy or of blood-spitting (often an early symptom of tuberculosis) three to four years before the diagnosis of pulmonary tuberculosis was made.

For the general public, propaganda should emphasise that with early diagnosis and treatment the incidence of pulmonary tuberculosis can be reduced, and the

* The tuberculosis control programme for institutions in the New York State Department of Mental Hygiene, which has recently been started, is outlined by R. E. Plunkett and W. J. Tiffany, *Amer. J. Publ. Hlth.*, 1941, 31, 769.

† See A. Sorsby: The Aetiology of Phlyctenular Ophthalmia. *Brit. J. Ophthal.*, April-May, 1942, p. 159.

‡ C. Schuman: *Quart. Bull. Sea View Hosp., New York*, 1941, 7, 69.

chances of recovery improved, even in war-time. In such propaganda, tuberculosis officers, health visitors and existing organisations will continue to play an important part.

(d) *Re-organisation of Tuberculosis Services*

The need for some re-organisation of the tuberculosis services has been felt for some time, and this need will tend to become accentuated as the measures we have recommended are increasingly put into practice. While, therefore, the Committee is not prepared at this stage to offer concrete recommendations concerning the possible re-organisation of the tuberculosis services in the near future, it does consider that steps should now be taken to study the best methods by which such re-organisation could be accomplished when circumstances permit.

5. Summary of Findings

(1) There has been a real increase in deaths from tuberculosis since the beginning of the war.

(2) All age-groups have been involved to some extent in the increase, and the participants up to the present have not been predominantly young women—as seemed likely early in the war—but include, particularly recently, children and the older male age-groups as well.

(3) Although there has been a slackening in the increase in tuberculosis mortality in the second year of the war, *e.g.*, in young adult females, the position is still unfavourable in relation to the pre-war figures.

(4) In view of the similar, though only temporary, slackening in the rise of tuberculosis at a corresponding time in the last war, together with what is known of the course of tuberculosis, we must be prepared for a further increase as hostilities continue.

(5) A disquieting feature of the present position is the increased mortality of children from tuberculous meningitis. Measures have been indicated which should reduce the deaths from bovine infection. To reduce human infection it is necessary not only to take special measures with children, but also to control pulmonary disease in the adult. The suggestions which have been made for the early detection, segregation and adequate treatment of the tuberculous adult should have an indirect effect in reducing infection among children.

6. Summary of Recommendations

Mass Radiography

(1) Subject to limitations of apparatus, the controlled use of mass radiography before, or as soon as possible after, employment, should be extended, especially (a) in the Services, (b) among men and particularly women entering the war industries, and (c) among those taking up certain other occupations (pp. 14–15).

(2) A single mass X-ray examination should be carried out, where practicable, upon those already employed in certain industries, *e.g.*, munition factories (pp. 15–16).

(3) As an extension of the preceding, but probably practicable to a much less extent in war-time, X-ray examinations should be repeated at regular intervals upon certain groups of the population, including (a) employees in factories which contain large numbers of young adults, (b) nurses and medical students, and (c) merchant seamen (pp. 16–17).

(4) Where speed and cost dictate, the miniature method is the one of choice for mass radiography. In certain circumstances it may be practicable to make use of existing full-size apparatus (pp. 13–14 ; 17 ; 35).

Institutional Accommodation

(5) Accommodation for institutional treatment of tuberculous persons is presently required. A good deal is now available but cannot be used because of a lack of nursing and domestic staffs. Until these staffing problems are solved, no advance can be made in institutional control of the disease (pp. 18-20).

Financial Provision

(6) In view of the special character of the disease and the prolonged treatment usually required, special financial provision greater than that obtainable under the National Health Insurance scheme should be made for persons with tuberculosis (pp. 20-21).

Rehabilitation

(7) Rehabilitation should be considered an essential part of the treatment of tuberculous persons, and arrangements should be made for the gradual return to industry of such patients on a basis of part-time or modified work. During the period of rehabilitation a supplement to wages should be provided, in order that an adequate standard of living can be maintained by the patient and his family (pp. 21-25).

Examination of Contacts

(8) The examination of all home-contacts must be energetically pursued, a first examination being the chief requirement. The re-examination of children under five years of age, and of young adults, is highly desirable (pp. 26-27).

Examination in Special Cases

(9) X-ray examination, and re-examination at intervals, should be undertaken for all cases of pleurisy and erythema nodosum in young people, whether institutional treatment has been given or not (p. 28).

Mental Hospitals

(10) The special conditions prevailing in mental hospitals make it desirable that an effort should be made as soon as practicable to X-ray periodically all residents of such institutions (pp. 27-28).

General Working Conditions

(11) It is of the first importance that continued watchfulness should be maintained upon the working conditions of young employees, particularly in regard to hours of work, transport difficulties, rest periods, factory canteens and hostel arrangements, and their relation to sickness absence (pp. 25-26).

Milk

(12) The pasteurisation of milk should be extended throughout the country, and, where this is not practicable, all milk consumed by children should be boiled or dried milk should be provided (pp. 10-12).

Propaganda

(13) The implementing of these recommendations should be accompanied by information and propaganda both to the medical profession and to the general public (p. 28).

TABLE I
Tuberculosis Deaths (including non-civilians), 1938-41

(a) *England and Wales*

<i>Year.</i>	<i>Respiratory.</i>			<i>Other forms.</i>			<i>All forms.</i>
	<i>Males.</i>	<i>Females.</i>	<i>Persons.</i>	<i>Males.</i>	<i>Females.</i>	<i>Persons.</i>	<i>Persons.</i>
1938	12,445	8,837	21,282	2,261	1,996	4,257	25,539
1939	12,702	8,840	21,542	2,229	1,852	4,081	25,623
1940	13,922	9,740	23,662	2,382	2,107	4,489	28,151
1941	13,986	9,646	23,632	2,651	2,384	5,035	28,667
Percentage increase of 1941 over 1938-39 ..	+11.2	+ 9.1	+10.4	+18.1	+23.9	+20.8	+12.1

(b) *Scotland*

<i>Year.</i>	<i>Respiratory.</i>			<i>Other forms.</i>			<i>All forms.</i>
	<i>Males.</i>	<i>Females.</i>	<i>Persons.</i>	<i>Males.</i>	<i>Females.</i>	<i>Persons.</i>	<i>Persons.</i>
1938	1,396	1,185	2,581	435	416	851	3,432
1939	1,506	1,211	2,717	411	398	809	3,526
1940	1,668	1,368	3,036	487	480	967	4,003
1941	1,644	1,472	3,116	516	542	1,058	4,174
Percentage increase of 1941 over 1938-39 ..	+13.3	+22.9	+17.6	+22.0	+33.2	+27.5	+20.0

TABLE II (A)

Tuberculosis Deaths, England and Wales, by age (including non-civilians), 1938-41

(a) *Respiratory tuberculosis*

Year.	Males.							Females.						
	0-5	5-15	15-20	20-25	25-45	45-65	65-	0-5	5-15	15-20	20-25	25-45	45-65	
1938	92	101	606	1,121	4,910	4,777	838	61	161	1,047	1,479	4,027	1,635	427
1939	79	69	665	1,019	4,933	5,043	894	53	157	1,080	1,437	3,996	1,612	445
1940	73	97	644	1,155	5,566	5,402	985	77	182	1,242	1,660	4,356	1,737	486
1941	193	112	710	1,069	5,532	5,410	1,020	117	189	1,176	1,700	4,291	1,715	458
Percentage increase of 1941 over 1938-39	+54.7	+31.8	+11.6	- 0.1	+12.4	+10.2	+17.8	+105.3	+18.9	+10.5	+16.6	+ 7.0	+ 3.7	+ 5.0

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(b) *Other forms of tuberculosis*

1938	649	355	252	177	486	258	84	569	347	228	148	398	216	90
1939	596	337	255	165	489	300	87	497	308	246	136	373	198	91
1940	657	330	261	200	523	315	96	563	327	261	201	426	237	92
1941	853	418	276	206	515	290	93	712	422	292	206	408	225	93
Percentage increase of 1941 over 1938-39	+36.9	+20.8	+ 8.7	+20.5	+ 5.5	+ 3.9	+ 8.1	+33.6	+28.7	+23.2	+45.1	+ 5.7	+ 8.7	+ 2.2

* Based on figures supplied by Dr. Percy Stocks, General Register Office.

TABLE II (B)
Tuberculosis Deaths, Scotland, by age, 1938-41*

(a) Respiratory tuberculosis

Year.	Males.							Females.						
	0-5	5-15	15-20	20-25	25-45	45-65	65-	0-5	5-15	15-20	20-25	25-45	45-65	65-
1938	31	22	91	161	588	421	82	26	38	187	245	465	167	57
1939	18	19	102	175	622	481	89	15	28	203	233	516	176	40
1940	26	14	130	179	718	508	94	21	36	215	256	598	187	55
1941	37	25	124	159	706	501	94	33	39	258	314	603	186	39
Percentage increase of 1941 over 1938-39	+48	+19	+28	- 5	+17	+11	+ 9	+57	+18	+32	+31	+23	+ 8	-20

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(b) Other forms of tuberculosis

1938	133	88	46	36	65	51	16	111	87	65	31	61	33	28
1939	119	71	56	31	71	45	18	90	84	60	33	69	40	22
1940	174	91	69	38	68	32	12	128	92	94	36	67	43	20
1941	161	105	77	39	75	50	9	157	95	119	50	66	43	12
Percentage increase of 1941 over 1938-39	+28	+31	+51	+15	+10	+ 4	-47	+55	+10	+89	+56	+ 2	+16	-52

* Based on figures supplied by Dr. P. McKinlay, Department of Health for Scotland.

TABLE III

Comparison of Tuberculosis in England and Wales in the Last and in the Present War

(a) Deaths in 1913-20* and 1938-41†

Tuberculosis.	1913	1914	1915.	1916	1917	1918	1919	1920	1938	1939	1940	1941	
All forms	M.	27,657	28,076	30,345	29,726	30,359	31,027	24,550	22,918	14,706	14,931	16,304	16,837
	F.	21,819	22,222	23,950	24,132	25,575	27,046	21,762	19,627	10,833	10,692	11,847	12,030
Respiratory	M.	20,601	21,417	23,167	22,850	23,276	24,371	19,248	17,872	12,445	12,702	13,922	13,986
	F.	15,602	16,421	17,636	17,919	19,059	20,967	16,736	14,919	8,837	8,840	9,740	9,646
Meninges and nervous system	M.	2,678	2,482	2,788	2,590	2,557	2,283	1,887	1,885	918	868	958	1,197
	F.	2,340	2,185	2,541	2,390	2,439	2,096	1,809	1,700	873	816	929	1,170
Other sites	M.	4,378	4,177	4,390	4,286	4,526	4,373	3,415	3,161	1,343	1,361	1,424	1,454
	F.	3,877	3,616	3,773	3,823	4,077	3,983	3,217	3,008	1,123	1,036	1,178	1,214

(b) Percentage net increases at various ages in death-rates between 1914 and 1916‡ and in deaths between 1939 and 1941† (tuberculosis all forms)

	0-	5-	10-	15-	20-	25-	35-	45-	55-	65-	75-	All ages	
Males (including non-civilians)	1914 to 1916	- 6	+16	+25	+15	+ 3	+ 3	+ 6	+ 4	+ 4	+ 4	+19	+ 5
	1939 to 1941	+46	+33	+28	+ 7	+ 8	+ 7	+16	+ 6	+ 7	+10	+42	+11
Females	1914 to 1916	- 2	+17	+10	+22	+14	+ 7	+ 7	- 4	+ 1	+ 2	+ 9	+ 7
	1939 to 1941	+51	+53	+14	+11	+21	+ 7	+13	+2	+ 9	+16	+11	+11

* From Registrar-General's Statistical Review of England and Wales for 1923, Tables, Part I (Medical), Table 4.

† From figures supplied by Dr. Percy Stocks, General Register Office.

‡ From Registrar-General's Decennial Supplement, 1931, Part III, p. xciv.

APPENDIX

REPORT BY TECHNICAL SUB-COMMITTEE
 APPARATUS FOR MASS MINIATURE (INDIRECT) RADIOGRAPHY FOR
 DETECTION OF PULMONARY TUBERCULOSIS

TECHNICAL SUB-COMMITTEE

S. COCHRANE SHANKS, M.D., F.R.C.P., F.F.R. (*Chairman*).
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 P. D'ARCY HART, M.D., F.R.C.P. (*Secretary*).

In the opinion of the Technical Sub-Committee, full-sized direct radiography on a first-class apparatus is the best method of mass radiography, but, where the numbers are too great to make this method practicable and speed is essential, the most suitable means at present is indirect radiography with miniature films. From experience of the existing plants, after special tests and comparisons, the Sub-Committee makes certain recommendations on apparatus, to serve as a guide to those wishing to carry out examinations of large numbers of persons by miniature radiography.

There are two main types of apparatus:—

- (a) 5 by 4-inch individual films, and
- (b) 35 mm. cine film.

Type (a) is becoming popular in the U.S.A., and the Ministry of Health has taken steps to import a small number of complete units. This type is not at present obtainable in Great Britain; nor is its manufacture at the moment practicable, on account of the difficulty in obtaining the special lens required for the camera.

Type (b) (the results with which are at least equal to those with Type (a)) can be produced in this country because suitable lenses are available, and plants are already in use in the three Services and in certain industrial centres. In the Sub-Committee's view, an apparatus of this type can give satisfactory results for mass radiography at speed, provided that the following essentials are embodied in the manufacture:—

- (1) A high tension power unit with 4 valve rectification, having an output of at least 100 mA at 90 kVp, and 200 mA at 80 kVp.
- (2) A rotating anode tube of fine focus, not exceeding 1.5 mm. square, with a reserve tube.
- (3) An efficient stationary radiographic grid and a suitable fluorescent screen, both of which should measure not less than 16 by 16 inches.
- (4) An electrically controlled camera, the control being linked with the X-ray exposure switch. It should take 50 to 100 feet of film which can be removed in exposed lengths as required. A 5 cm. f 1.5 Sonnar Lens is recommended until such time as a special approved lens is manufactured for the purpose.
- (5) A photographically-recording identification device, with electrical control linked with the X-ray exposure switch; identification of film with patient must be infallible.
- (6) Provision for taking full-size radiographs of the chest.
- (7) Provision for a wide range of heights of subjects, including children.
- (8) The apparatus should be made to permit the subjects to pass rapidly through in one direction.
- (9) Adequate protection for operators from excessive radiation.
- (10) The question of mobility should be considered before manufacture. If necessary, the apparatus should be built for transportability by van, and for rapid re-assembly within a few hours. Precision of assembly is imperative.
- (11) It is advisable that the van used for transporting the apparatus should be as a darkroom.
- (12) At each centre an adequate electric main supply is necessary. A mobile generator should be incorporated with the unit.

The number of staff and the available accommodation will determine the speed of working such an apparatus. For mass radiography at speed the following staff might be required :—

- (1) A radiologist with special experience of chest work, working in conjunction with a chest physician, e.g. a tuberculosis officer. Familiarity with the work done at established miniature radiography centres is desirable.
- (2) Two radiographers, specially trained for this work.
- (3) Darkroom assistant, also specially trained for this work.
- (4) Marshals and clerical staff (four to six).

The Technical Sub-Committee recommends that the miniature films should be processed locally. Persons whose films show a suspected radiographic abnormality should be examined by a full-sized radiograph; if this confirms the abnormality, the individual should have full clinical and laboratory examination. No diagnosis other than "suspected abnormality" should be made on the miniature film, the full diagnosis depending on the further examination.

The above description gives only the essential features of the apparatus, staff and procedure recommended. A miniature radiography unit of this type is being made at present for the Medical Research Council.

Finally, the Technical Sub-Committee wishes to emphasise that mass miniature radiography should not be lightly undertaken. A very high standard of quality of miniature radiograph is necessary for correct interpretation, and the latter requires the highest radiological skill. The making-up of compromise apparatus cannot be too strongly condemned and would bring the method into disrepute.

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