branch of knowledge, for, unlike research in the physical sciences, it is often impossible to realize the complexity of the conditions or to prejudge the relative importance of the factors concerned.

When the critic goes further and extends his criticism from the man's experimental work to his character and to his motives the position becomes intolerable, and it is this feature of the criticisms of Jenner which induced me to make this protest. I have read a good deal about the life and the work of Jenner in the last few days, and I find that the judgments of the above-mentioned scholars on this man are just incredible. My views about Jenner as an investigator can be seen from what I have said, and I think I should add that my judgment about his character is that he was a fine type of man. The whole of his life's history seems to me to point to this: his desire to avoid the scurry and publicity of life, his kindness to his family and relations, the time and trouble he took over his patients, his readiness to participate in the local life of his village community, his interest and participation in the arts, including poetry and music, his social relations with his fellow doctors, as judged by the local medical societies he formed—all indicate a man who both appreciated the best things in life and wished to help to the utmost his fellow-man. Independently of any of his discoveries and their results, he could be regarded as the best type of country doctor.

Outstanding and Successful Pioneer

It is, however, the man in relation to his discoveries whom we celebrate to-day, and I have tried to picture one who was bound to make discoveries wherever he was placed and who deliberately chose the circumstances where in fact he made the greatest of discoveries. This not only gave direct control of one of the most devastating of diseases but it also formed the basis of all modern work on immunology and of the fruitful field of virus disease.

Apart from Jenner's distinction, may I add how proper it seems to me that the Royal College of Surgeons and the Royal College of Physicians should participate in this celebration to-day, even if it serves only as a counterblast to the constant reiteration of public men in Parliament, in the Press, and on the radio that scientific research has as its main object the discovery of weapons and machinery for the destruction of man. All public attention seems to be given nowadays to this point of view, and it is useful to take the opportunity, such as is afforded to-day, of reminding the world that there is at least one branch of science which is wholly directed to the good of man, to the cure and elimination of disease and the prevention of untimely death. Up to the present, even if war is taken as a criterion, medical science in its work for the protection of man against disease and for his defence against injury has nothing to fear from comparison with that prostitution of the physical sciences which has been concerned with the production of methods of destruction.

In this beneficial work we proudly proclaim Jenner as an outstanding and successful pioneer.

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TUBERCULOSIS IN INDUSTRY: AN EPIDEMIOLOGICAL STUDY*

PRELIMINARY REPORT

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During the last 100 years information about death rates in various industries has steadily accumulated, and it is now clear that certain trades are constantly associated with a high tuberculosis mortality. In some cases the exceptional findings are due to a specific industrial hazard, such as silicosis, but in others no causal factors have yet been isolated. A typical example of the latter is the shoe trade, and, although the disease incidence is even higher in other occupations (Registrar-General's Decennial Supplements, 1890-1932), this has been selected for the first of a series of investigations into tuberculosis in industry.

So far working arrangements have been studied only in boot and shoe factories, but there are several reasons for believing that similar conditions prevail elsewhere, and that a systematic examination of other occupational groups will eventually reveal results very much like those which have been discovered during the course of this investigation. Meanwhile a brief account of the findings up to date may serve as a general introduction to the subject.

Present Investigation

The first indication that pulmonary tuberculosis was unduly prevalent in the shoemaking industry of this country was given in 1892, when the Registrar-General showed that the death rate among boot and shoe workers was nearly twice as great as the average for all occupied and retired males. Again, in 1902 and 1912 the Occupational Mortality returns for England and Wales showed a similar excess, and one of the first actions of the newly formed Medical Research Committee (forerunner of the present Medical Research Council) was to appoint a group of workers to investigate the industry.

In the M.R.C. report (1915) the investigators gave a detailed account of the manufacturing processes and described the general working arrangements in factories. They were satisfied that there was more pulmonary tuberculosis among boot and shoe factory operatives than in the rest of the population, and came to the conclusion that "the individual worker is predisposed to infection by the sedentary nature of his employment and possibly by the attitude he adopts at work." It was also suggested that "infection might be favoured by want of light, the presence of infected dust, and inadequate ventilation in the workrooms," but no attempt was made to produce any experimental or statistical evidence in support of these contentions.

Subsequently, despite the fact that the Registrar-General continued to report a high mortality, no further interest seems to have been taken in the subject until 1946, when

*Interim Report of an investigation initiated by representatives of the boot and shoe industry and public health authorities in Northamptonshire. The investigation, which is being financed by the Medical Research Council, is still incomplete.

†With a grant from the Medical Research Council.

the finding of the first Miniature Mass Radiography Survey in Northamptonshire once again drew attention to the prevalence of the disease among men and women employed in boot and shoe factories (Smith, 1947). On this occasion it was possible to make a direct comparison between shoemakers and other factory workers in the county, and it was found that, "compared with all other occupations, there was a statistically significant excess of newly discovered cases of active pulmonary tuberculosis in the boot and shoe industry."

The present investigation was a direct outcome of this survey and was undertaken at the request of the industry in order to discover whether the high rate of infection among boot and shoe operatives could be traced to working conditions or whether it is due to factors outside the control of the industry. Most of the work has been done in Northamptonshire, where shoemaking has long been the staple industry and where at present over one-third of the factory population is employed in this industry; but the section on general physique includes men from the neighbouring county of Leicestershire. The first part of the paper deals with recruitment into the boot and shoe industry, and shows how shoemakers as a whole compare with other workers in respect of their general physique and home environment. The second part relates to findings within the shoe trade, and shows how infection is transmitted from carriers to other workers.

I. Selective Recruitment into the Boot and Shoe Industry

It has often been argued that, because shoemaking provides a light occupation for men and, like old-established industries, is essentially a family trade, a vicious circle has been established which is alone sufficient to account for the high incidence of pulmonary tuberculosis amongst its working population. The argument runs as follows: in the first place, the nature of the work attracts men of poor physique, some of whom are suffering from chronic phthisis; these carriers, by propagating the disease in their homes, pass it on to their wives and children, many of whom, by reason of strong family tradition, become shoemakers and thus replenish the pool of infection.

Before the present investigation was begun no one had attempted to confirm or refute this theory, and even the suggestion that shoemaking was more of a family occupation than other trades was based largely on conjecture. Therefore, before embarking on a detailed study of factory conditions, an attempt was made to discover, first, whether an unusually high proportion of men with tuberculosis and/or low physique are recruited into the industry; secondly, how strong is the family tradition in the trade; and, thirdly, to what extent these factors are responsible for the high incidence of pulmonary tuberculosis among boot and shoe factory operatives.

Fitness for Military Service.—During the war years the Ministry of Labour and National Service instituted a scheme for examining men called up under the National Service Acts in order that they might be classified according to their fitness or otherwise for military service. The actual examinations were carried out by regional medical boards, who were responsible for placing men in four medical grades—namely, Grade I—fit for all forms of active service. Grade II—fit for active service but not for duties involving heavy strain. Grade III—unfit for active service: possible reservists. Grade IV—unfit for active service: rejected outright. Realizing that these records might contain valuable data relating to general physique of shoemakers, two batches of case sheets were inspected. The first referred to 22,620 men examined by one medical board in Northamptonshire, and the second to 33,350 men examined by two similar boards in Leicestershire. Both sets of records had been filed in chronological order, and a convenient sample from each batch was obtained by taking consecutive case

sheets of men employed in boot and shoe factories and pairing them with alternate records for men from other trades. The first sample comprised 2,785 Northamptonshire shoemakers and an equal number of controls, and the second comprised 1,635 Leicestershire shoemakers and 1,635 other men. When these records were inspected it was discovered that in each sample there was a slight but statistically significant difference between the medical grading of the two groups, the controls being more robust than the shoemakers (see Table I).

TABLE I.—General Physique of Men called up for National Service during 1942–3. Comparison of Boot and Shoe Operatives with Other Workers

Region	Occupation	Medical Grade				No. Examined
		I	II	III	IV	
Northamptonshire	Boot and shoe	66	18	8	8	2,785
	Other	74	14	6	6	2,785
Leicestershire	Boot and shoe	58	21	10	11	1,635
	Other	70	14	6	10	1,635
Both counties	Boot and shoe	63	19	9	9	4,420
	Other	73	14	6	7	4,420

Northamptonshire Miniature Mass Radiography Survey (1945–6).—Most of the men examined by the regional medical boards of the Ministry of Labour and National Service were under 40 years of age. In order, therefore, to obtain a more representative sample of shoemakers to compare with other workers the records of men examined by the Northamptonshire Mass Radiography Unit during 1945–6 were inspected. Apart from the high incidence of active pulmonary tuberculosis already reported by Smith (1947), there was nothing in these records to suggest that either heart disease or lung disease other than tuberculosis is more frequent among shoemakers than among other factory workers, and there was no evidence from the x-ray findings to suggest that leather dust causes pulmonary fibrosis. On the other hand, besides the "newly discovered cases of active pulmonary tuberculosis" mentioned in Smith's report there were several men who had already been notified, most of whom were found to be working in boot and shoe factories.

Family History of Shoemakers.—In order to discover to what extent shoemaking is a family trade, a sample of the Northamptonshire boot and shoe factory population and a control group of workers in other factories were asked about the occupation of their immediate relatives. The sample of boot and shoe workers comprised 1,233 persons from factories in various parts of the country, and the control group consisted of 1,027 workers from other factories in the same towns and villages. Each worker was also asked to state whether he or she knew of any near relative having had tuberculosis. In the boot and shoe sample over 90% of the workers who were interviewed stated that they had a near relative in the same trade, whilst in the sample taken from other industries over half had no family association with the trade in which they were employed. There were also a few more home contacts with tuberculosis among the shoemakers than among the other workers, so it is possible that the disease incidence in the shoe trade has been slightly augmented by passage of the disease through successive generations of workers.

Summary.—From the foregoing account it is evident that there are rather more tuberculosis carriers and men of sub-normal physique in the shoe industry than in most occupations. There also seems to be some indication that shoemakers in Northamptonshire, being more often interrelated than other factory workers in this area, are more frequently exposed to infection in their homes. Since shoemaking in other parts of the country also tends to be an old-established industry the family tradition so clearly demonstrated in Northamptonshire probably exists elsewhere.

II. Spread of Infection in Boot and Shoe Factories

Early in the present investigation it was decided that if infection was *not* being transmitted during working hours it should be possible to demonstrate a disease pattern in the boot and shoe working population which was dependent

solely on *home conditions*. On the other hand, if carriers of the disease were infecting *fellow workers* the disease incidence should be related to *factory conditions*.

Smith had already shown that, according to the results of the first survey of the Northamptonshire Mass Radiography Unit, the rate of infection in certain occupational groups was higher than in others. Since this finding suggested the possibility that working conditions might be contributing to spread of the disease, it was decided in the first instance to make a more detailed study of the mass radiography findings.

Between March, 1945, and Jan. 1, 1947, the Northamptonshire Mass Radiography Unit visited 162 boot and shoe factories and examined 15,911 skilled factory operatives, or 70% of the working population.* They also discovered 101 new cases of pulmonary tuberculosis, which represents an overall rate of 0.6% of the workers who were examined.

The number of newly infected persons in any one factory ranged from 0 to 14.3%, but since most of the factories employed fewer than 100 workers it was impossible to draw

TABLE II.—Incidence of Pulmonary Tuberculosis in Large and Small Boot and Shoe Factories (Mass Radiography)

Group	Size of Factory (Working Population)	No. Examined (Mass Radiography)	Cases of Tuberculosis	Pulmonary Tuberculosis Rate per 1,000
1	1-100	2,934	9	3.1
2	101-200	3,811	20	5.2
3	201-350	3,522	22	6.2
4	351-600	2,580	19	7.4
5	Over 600	3,064	31	10.1
Total		15,911	101	6.3

any conclusion from the experience of individual firms. When, however, factories of different sizes were compared it was found that the overall rate of infection was considerably higher in large factories than in small ones. This is clearly shown in Table II, in which the factories have been classified according to the number of persons employed.

According to this arbitrary arrangement the overall incidence of pulmonary tuberculosis in factories employing more than 600 workers (group 5) was over three times as great as in factories with fewer than 100 employees (group 1), factories of intermediate size showing a steady gradation between these two extremes.

Before deciding that this remarkable relationship was due to any fault in the working arrangements of large factories the following alternative possibilities were considered.

Age and Sex of Workers.—According to the records of the Mass Radiography Unit the age and sex constitution of each factory group shown in Table II was remarkably constant. Hence the greater incidence of pulmonary tuberculosis in large factories (which was found to apply to both sexes) was unlikely to be due to more "susceptible" persons in these factories.

Occupation.—Since boot and shoe factories are equipped with a uniform type of machinery and tend to relegate the same proportion of workers to each process, it was unlikely that the uneven distribution of infection was due to certain factories having unusual working arrangements. Such an explanation became quite untenable when it was found that the difference between large and small factories applied to every shoemaking occupation.

Regional Distribution of Large and Small Factories.—There were no factories with more than 600 employees in country

districts, so that it was possible that the higher rate of infection in larger factories was due to differences between urban and rural populations. There was, however, a sufficiently large number of small and medium-sized factories in both regions to show that, whether the factories were in towns or villages, the rate of infection was largely determined by the number of workers.

Factory Conditions.—The next discovery was that the disease incidence bore no relation to at least one estimate of working conditions in the factories. This particular estimate was made by regional representatives of H.M. Inspector of Factories, who visited 114 boot and shoe factories in Northamptonshire during 1945 and compiled a detailed set of records for the Working Party which had been appointed by the Board of Trade to report on the industry. The work was done by trained inspectors, who made systematic notes about the lighting, ventilation, method of dust extraction, sanitation, spacing of workers, cleanliness, and general working arrangements in each factory. On the basis of these notes the working conditions in each factory were graded as "good," "average," or "unsatisfactory." According to this assessment 24% of the factories with fewer than 200 operatives were thought to provide unsatisfactory working conditions, whilst in all the factories with more than 600 operatives the working conditions were well above the average. In these same factories the incidence of pulmonary tuberculosis, as discovered by the Mass Radiography Unit, was over four times as great in the large factories with "good" conditions of work as in the small factories, where the general layout was so much less "satisfactory." There remained one obvious difference between large and small factories which might account for the higher rate of infection in larger factories—namely, the greater number of persons in any one workshop. At first sight the more spacious rooms in large boot and shoe factories look more attractive and seem to offer better working conditions than rooms in small factories, which by comparison often seem dark and dingy. On the other hand, since infectious diseases usually spread more rapidly in large than in small communities, it was decided to explore the relation between number of workers per room and the incidence of pulmonary tuberculosis.

Size of Working Units in Large and Small Factories.—When the factories were arranged according to the average number of operatives per room a close correspondence between the overall working population and the size of the working units within the factories was found to exist. Thus, over 80% of the factories with fewer than 100 workers had fewer than 20 operatives per room, and all the factories with more than 600 workers had more than 60 operatives per room. It follows, therefore, that there is a close association between the incidence of pulmonary tuberculosis and the size of working units.* (See Table III.)

TABLE III.—Incidence of Pulmonary Tuberculosis in Boot and Shoe Factories with Large and Small Workshops

Workshops		Mass Radiography Survey		Pulmonary Tuberculosis Rate per 1,000
Workers per Room	Floor Area per Worker (sq. ft.)	No. Examined	Cases of Pulmonary Tuberculosis	
1-20	115 (10.7 m. ²)	3,474	10	2.9
21-30	91 (8.5 m. ²)	2,278	11	4.8
31-40	84 (7.8 m. ²)	2,763	14	5.1
41-60	82 (7.6 m. ²)	3,266	24	7.3
61-80	101 (9.4 m. ²)	2,205	21	9.5
Over 80	95 (8.8 m. ²)	1,925	21	10.4
Total	96 (8.9 m. ²)	15,911	101	6.3

More statistical work will have to be done before we can be sure that this is the fundamental cause of the high rate of infection in large factories. But the findings suggest that, under conditions which prevail in boot and shoe factories,

*In very small factories the space allotted to individual workers is usually greater than in larger factories, but where there are more than 20 persons per room the floor space per worker remains fairly constant. A more detailed study of the relation between floor area and workers per room is at present under consideration, and results will be published later.

*The published report of the medical officer of health for Northamptonshire, already referred to in the first part of this paper, covered the period March 1, 1945, to June 30, 1946, by which time 153 boot and shoe factories and 17 subsidiary factories (heel-making, closing, etc.) had been visited. In the following account all workers in subsidiary factories as well as the office staff of boot and shoe factories have been excluded, and the findings refer only to *skilled operatives in boot and shoe factories*.

operatives often become infected during working hours, and that in factories with large workshops carriers have actually caused local epidemics of tuberculosis.

Since there also seems to be some relation between rate of infection and factory size in the clothing industry (see Table IV) it is likely that the high death rate from pulmonary

TABLE IV.—Incidence of Pulmonary Tuberculosis in Large and Small Clothing Factories

Factory Size (Working Population)	No. Examined (Mass Radiography)		Pulmonary Tuberculosis (Rate per 1,000)	
	Males	Females	Males	Females
1-100	103	636	—	4.7
101-500	60	810	—	6.2
Over 500	166	1,312	—	9.2
Total	329	2,758	—	7.3

tuberculosis in other occupational groups (Registrar-General's Decennial Supplements, 1890-1932) is also due to spread of infection from carriers to fellow workers, and that there is nothing fundamentally different between the working arrangements in boot and shoe factories and those in other industrial communities. There can also be no doubt that mass radiography statistics contain valuable material for studying disease incidence in various occupational groups and that there is an urgent need for a more detailed study of these records.

Summary

An investigation has been made in Northamptonshire in which mass radiography records and other statistics have been explored. The investigation is still incomplete, but the findings to date suggest that the death rate from pulmonary tuberculosis in the shoe industry, which is high compared with all occupied and retired males but not much higher than other industrial communities, is due partly to selective recruitment and partly to working conditions.

There seem to be three aspects to selective recruitment: first, boot and shoe factories employ more men with chronic pulmonary tuberculosis than most other trades; secondly, the physique of the men is slightly subnormal; and, thirdly, there is a strong family tradition in the shoe trade, so that the workers are often interrelated.

There is no evidence of a specific industrial hazard in boot and shoe factories, and the death rate for diseases other than tuberculosis is below average.

Although workers with poor physique and chronic tuberculosis are found throughout the shoe industry, the incidence of active tuberculosis is not uniformly distributed, men and women employed in factories with large workshops contracting the disease more often than those who work in factories with small workshops.

In the clothing industry there is also more pulmonary tuberculosis in large factories than in small ones, so that it may yet be shown that size of working unit is an important factor in determining disease incidence in any occupation.

We are deeply indebted to Dr. Smith, medical officer of health for Northamptonshire, who was chiefly responsible for initiating the investigation and who allowed us free access to the records of the Northampton Mass Radiography Unit; also to the Incorporated Federated Associations of Boot and Shoe Manufacturers, the National Union of Boot and Shoe Operatives, the British Boot and Shoe and Allied Trades Research Association, H.M. Inspector of Factories, and owners of individual boot and shoe factories, who have provided us with invaluable assistance at every stage of the investigation.

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SOME ASPECTS OF PARTIAL GASTRECTOMY

BY

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Although a number of series containing several hundred cases of partial gastrectomy have been reported in detail from time to time in this country there are still some points which worry the occasional gastrectomist and about which gastric experts differ—points that have only been lightly touched upon. In the hope of understanding certain things more fully I have reviewed my own cases again recently, but the truth is very elusive.

The material under review is the first 200 consecutive cases of my own upon which a partial gastrectomy has been performed for a peptic ulcer at St. Bartholomew's or Hill End Hospitals. The first was in 1936 and the last at the end of 1947. The number is not large, but the cases have been carefully considered. They were not treated and operated on in any special wards or gastric clinic, but were simply included in the ordinary run of cases in a general surgical ward of a teaching hospital. The sex incidence is shown in Table I.

TABLE I.—Sex Incidence

	Males	Females	Total
Duodenal ulcer ..	99	8	107
Gastric ulcer ..	55	28	83
Anastomotic ulcer ..	9	1	10
Total	163	37	200

The proportion of duodenal to gastric ulcers is not nearly so high as in some reported series, probably owing to the fact that the former were not so readily accepted for operation, and certainly not until medical treatment had been given a very fair trial. The average age of the patients at the time of operation is shown in Table II. The youngest was a girl of 16 with a very tough adherent duodenal ulcer of seven years' standing which had resisted several courses of strict medical treatment. The oldest was a man of 69 with a duodenal ulcer.

TABLE II.—Average Age of Patients

	Males	Females
Duodenal ulcer	44 years	36 years
Gastric ulcer	48 "	49 "
Anastomotic ulcer	45 "	25 " *

* One case only.

Twenty years ago the position of partial gastrectomy as a treatment for gastric ulcer was not fully recognized; ten years ago the same applied to duodenal ulcer. The operation is now fully acknowledged by physicians as well as surgeons, but it is still uncertain whether it will be replaced, at any rate for duodenal ulcer, by vagotomy before the true and whole cause of peptic ulceration is revealed and operations finally give way to a certain and easy cure by some balm, wave, atom, or other undreamed-of agent.

In an endeavour to obtain the best results from a procedure such as partial gastrectomy attention must primarily be given to the causes of post-operative mortality, and, secondly, to planning of the operation so that the type of gastrectomy chosen is that which will give the best results after weeks, months, and years. This paper is devoted to these two aspects of partial gastrectomy.