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The Medical Surveillance of Asbestos Workers

PLAINTIFF'S EXHIBIT

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THE industrial exploitation of asbestos in Britain has taken place during the past century[1]. Deposits of asbestos were discovered in the province of Quebec, Canada, about 1860, but no serious attempts were made to mine these deposits until 1878.

The origins of Turner Brothers Asbestos Company Limited may be traced back to the corner of a Lancashire cotton mill, Clod Mill in Rochdale. In 1910 the company employed 310 people. Turner Brothers became a 'limited company' in 1899 and its trading name was changed to that of Turner Brothers Asbestos Company Limited in 1916. In 1930 the manufacture of cotton textiles ceased at Clod Mill.

Approximately 80 per cent of the world's asbestos production consists of Chrysotile (white) and it comes chiefly from three regions, the Thetford District of Quebec in Canada, the Brazhenov field in the central Urals (U.S.S.R.), and Southern Rhodesia. Almost all the Amphibole asbestos used in industry is obtained from South Africa, and some of it is Crocidolite (Blue). The remainder of the output of Amphibole fibre from South Africa is almost entirely Amosite, which occurs only in the Transvaal Province.

The best known property of asbestos is its heat-resistance. It also has the valuable property of being a poor conductor of heat.

MEDICAL SURVEILLANCE—HISTORICAL BACKGROUND

THE FIRST report of a death resulting from pulmonary fibrosis apparently due to the inhalation of asbestos dust was reported by Montague Murray in 1900[2,3]. A second case was reported by Cooke[5] in 1924 and again in 1926. He described the unusual and characteristic 'asbestosis bodies'. In 1927 Oliver[7] reported two cases, to be followed by McDonald[8] and Seiler[9]. In 1928 Simson[10] reported two cases in South Africa. Other cases were then reported by Wood and Page[11], Haddow[12] and Wood and Gloyne[13]. The comprehensive report of Merewether and Price[14] appeared in 1930. The statutory Medical Examination of asbestos workers by Silicosis Medical Boards, on an annual and periodic basis, was provided for by the Silicosis and Asbestosis (Medical Arrangements) Scheme 1931 (SR & O, 1931 No. 341)[15]. Workers employed in the following processes were included under this Scheme:

(i) breaking, crushing, disintegrating, opening or grinding of asbestos, or any admixture of asbestos, and all processes involving manipulation of asbestos incidental thereto;
(ii) all processes in the manufacture of asbestos textiles including preparatory and finishing processes;
(iii) the making of mattresses composed wholly or partly of asbestos and processes incidental thereto.

In addition to the recognition of asbestosis as an industrial disease for purposes of compensation, the report by Merewether and Price[14] led to the Asbestos Industry Regulations, 1931[16]. The occupations eligible for compensation were those covered by the Asbestos Industry (Asbestosis) Scheme, 1931[17]. These differed slightly from those occupations defined by the Silicosis and Asbestosis (Medical Arrangements) Scheme 1931[15] and included the following:

"breaking, crushing, disintegrating, opening and grinding of asbestos, mixing or sieving of asbestos or any admixture of asbestos, the manufacture of asbestos textiles, the making of insulation slabs or sections or mattresses composed wholly or partly of asbestos, *other manufacturing processes carried on in the same room as any of the foregoing processes*, the cleaning of machinery and plant used in the processes and of chambers, fixtures and appliances for the collection of asbestos dust, and the sawing, grinding and turning in the dry state of articles composed wholly or partly of asbestos, except articles composed wholly or partly of woven asbestos impregnated with bitumen or other bond of an adhesive nature."

The Medical Arrangement Scheme did not, however, apply to the mixing of asbestos or any admixture of

early stage and that there has been an increased referral to the Boards.

(f) The number of occupations now regarded as likely to result in significant asbestos exposure has been greatly increased with the realization that workers in the vicinity of lagging operations or handling asbestos materials in the course of their duties may be at risk. Dr. J. C. Gilson[33] in 1965 reproduced McVittie's tabulation in a slightly altered form up-dated to 1964. Out of 315 new cases diagnosed between 1955 and 1964, 183 entered the industry after 1933 and 32 after 1950.

In 1935, Lynch and Smith[35] in the United States, suggested that patients with asbestosis could have an increased risk of developing lung cancer. It is now generally accepted that there is an excess incidence of lung cancer deaths in association with asbestosis[1]. Doll[1] and later Knox, Doll and Hill[36], followed up a cohort of asbestos textile workers since 1955 in an attempt to study the effects of the Asbestos Industry Regulations, 1931 on the health of asbestos workers. They found that when the risk of lung cancer was high, all cases occurred against a background of asbestosis. When asbestosis has markedly declined, the association is lost and the incidence of lung cancer becomes no greater than that expected for the population at large. The incidence of lung cancer appears to be related to the severity of asbestosis and hence to the intensity of dust exposure. The latest available statistics relating to the incidence of lung cancer deaths in the cohort are reported by Knox, Holmes, Doll and Hill[3]. The incidence of lung cancer in asbestos textile workers exposed *before* 1933 and with twenty years employment remains about 10 times the expected. The incidence of lung cancer in workers employed twenty years *since* 1933 is no greater than that expected. The number of asbestosis cases diagnosed at T.B.A. Limited in 1965 has been compared with the number diagnosed in 1930 by McGregor[4] and the incidence reported by Bambini[38] in 1957 and is illustrated in Table II.

Other factors besides the dose-response relationship will also have to be considered with regard to lung cancer are the effects of the different varieties of asbestos fibre, the carcinogenic properties of asbestos and the effects of co-carcinogens or syncarcinogens. Enterline and Kendrick[39] found a stronger relationship between lung cancer and employment in the asbestos textile trade than existed in the less dusty manufacturing of asbestos building products or building materials. Selikoff and his associates[40] have produced evidence that cigarette-smoking asbestos insulation workers have a greater chance of dying of lung cancer than asbestos insulation workers who do not smoke cigarettes, even though the asbestos exposure history of the non-smokers and smokers is the same.

Until recently the discovery of asbestos bodies in the lungs of non-asbestos workers at necropsy was a rarely recorded event but with the development of new techniques they have been found in as many as fifty per cent of all males over 50 years of age coming to autopsy in hospital[41]. According to Selikoff[42], asbestos bodies do not appear to be randomly distributed among the general population of New York but are, to an important extent, occupationally related. The ship-building and the construction industries are rich potential sources of direct and indirect occupational asbestos exposure[43, 44].

The investigation of X-rays of a one in ten sample of workers in the Royal Naval Dockyard in Devonport reported on the frequent occurrence of pleural thickening in dockyard workers exposed to asbestos[45].

In 1959 Wagner[46], reported twenty cases of pleural mesothelioma associated with the North West Cape Province of South Africa. He suggested that these were associated with the presence of crocidolite asbestos because this variety is found in the region. Subsequent surveys demonstrated that this tumour is prevalent in the region and has been recorded in the other asbestos mining areas. Since Wagner's original report the association between exposure to asbestos dust and mesothelioma has been extensively studied. Wright[47] has surveyed the present state of knowledge.

Primary pleural mesotheliomata are rare tumours associated with asbestos exposure in about eighty per cent of cases. Only a small percentage of those exposed develop the tumours and the latent interval between first exposure and diagnosis or death may be 20 years or more. The actual exposure is short and possibly small in some cases. In mines and mills the incidence is apparently related to the type of asbestos and the effects of amosite, anthophyllite and chrysotile are much less than those of crocidolite.

The incidence of mesothelioma is not related to cigarette smoking. Wagner *et al* have surveyed the geographical distribution of the 622 mesothelioma cases registered in the United Kingdom between the years 1962–1969 (including many retrospective series) and indicated the prevalence of these cases in the ship-building and repairing areas as well as the areas with known asbestos industries. A recent report from Scotland[48] indicates that in a retrospective study of cases for the years 1950–1967, the incidence of mesothelioma is similar to that in other parts of Britain.

The majority of cases of mesothelioma known to have

TABLE II

New cases of Asbestosis (all or almost all diagnosed at T.B.A. Limited) 1965 (Personnel figures refer to 1.1.1966) compared with the data of Bambini[38] and McGregor[4]

	Personnel 1965			Cases of Asbestosis 1965			1930
No. of years employed	Men	Women	Total	No. of cases	Group incidence %	No. of cases	Group incidence %	Group incidence %
10–14	69	39	139	1	0·72	1	0·44	32·1
15–19	56	24	110	1	0·91	1	0·71	53·6
20–24 & over	53	28	86	2	2·50	1	3·60	80·9
TOTAL	234	101	335	4	1·12	3	0·80	26·2

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TABLE V

A comparison of the number of employees estimated in Scheduled Areas by Personnel Dept. and Medical Dept. in Nov. 1970.

Dept's Records	*Men*	*Women*	*TOTAL*
Personnel	636	277	913
Medical	970	317	1,287

It has become obvious that the definition of an asbestos worker needs to be given consideration. H.M. Senior Medical Inspector of Factories' Advisory Panel on the problems arising from the use of Asbestos[44] has been reconstituted and is attempting to inaugurate a programme for the surveillance of asbestos workers.

For the purposes of their study of asbestos workers the Medical Services Division of the Department of Employment define an 'asbestos worker' as any worker employed in a factory or premises or that part of a factory or premises which attracts the Asbestos Regulations 1969 and who himself is in any employment subject to the Factories Act 1961.

The medical surveillance of asbestos workers poses other problems in addition to the mere definition of such workers. It can be seen from Figure 1 that the labour turnover at this factory results in a preponderance of short-service employees in the younger age groups with very few long-service employees with more than twenty years since first exposure.

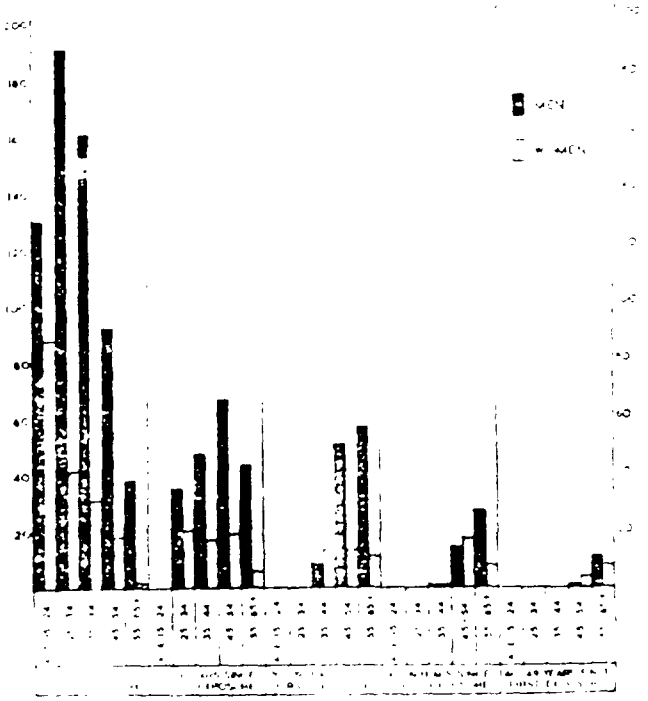

Figure 1

Analysis of 10 year exposure groups by age and sex distribution in the Rochdale factory of T.B.A. Ltd. at 31 December, 1970

According to Smither[45], the diagnosis of asbestosis rests on a table with four legs and may be summarized thus:

(*i*) Exposure (concentration × time)
(*ii*) X-ray changes
(*iii*) Physical signs (basal crepitations, clubbing of fingers)
(*iv*) Altered pulmonary function (low gas transfer-factor and decreased compliance).

Medical examinations have been carried out at T.B.A. since the 1930's and the scope of the investigations performed has increased steadily. Medical records are available from about 1945 onwards and personnel records can be traced back to the beginning of the company. Medical records have been stored in the Medical Department since 1951 when a programme for chest X-rays was instituted. Between 1951 and 1968 all 'scheduled' employees were X-rayed as soon as possible after commencing employment and then at three yearly intervals.

In 1967 the Company purchased its own X-ray unit and since then *all* new employees have been X-rayed during the first week of employment. Workers in asbestos areas are now X-rayed annually. All new employees are subjected to an initial medical examination as soon as possible after commencing employment. Asbestos area workers are also initially examined by the Pneumoconiosis Medical Panel (P.M.P.) within three months of commencing employment, and are seen periodically at two yearly intervals. Medical examinations by the Company's Medical Officer alternate with the P.M.P. In 1966 the Company decided to equip a lung function laboratory at the Rochdale factory capable of performing full lung function tests including estimation of the gas transfer factor (T_{co}).

The laboratory was operating by May, 1967 and pulmonary physiology then completed the diagnostic and screening facilities available. Preliminary findings on the use of X-rays and lung function tests in the follow-up of asbestos textile workers have been reported[illegible]. The medical examination programme has recently been redrafted and is summarized in Table VI.

TABLE VI

Table of Medical Arrangements Scheme

* When given. *Year*	1-3 months	6 months	1	2	3	4	5	19	20	21	22
PMP Medical	*			*		*			*		*
Factory M.O. Medical		*			*		*	*	*	*	*
X-ray		*	*	*	*	*	*	*	*	*	*
Physiology Lab.	*										
Fu[illegible]		*			*		*	*		*	*

A pre-employment screening examination is used to select employees unsuitable for work in asbestos areas because of the presence of chronic chest disease, previous dust exposure with evidence of pneumoconiosis, thoracic deformity or cardiovascular disease. This examination also provides a base-line for purposes of follow-up. Periodic medical examinations are particularly adapted to detection at the earliest possible time of respiratory signs or symptoms arising from exposure to asbestos. It can be seen from Table 6 that an annual medical examination of workers exposed more than twenty years is suggested and that the frequency of lung function tests also increases.

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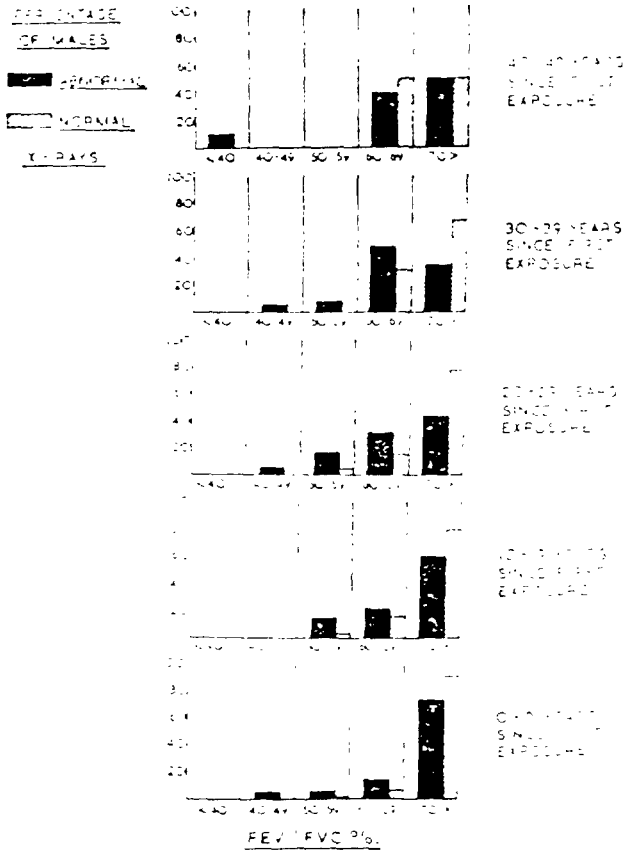

Figure 4

T[illegible] between exposure, radiological abnormality and [illegible] percentage [illegible] employees.

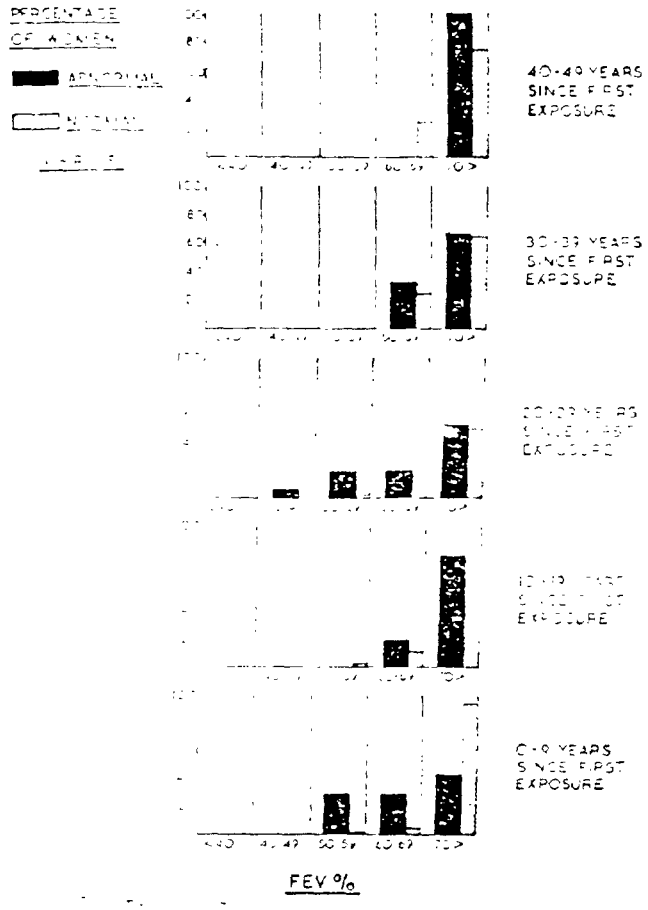

Figure 5

[illegible] between exposure, radiological abnormality and [illegible] employees.

and oxygen desaturation of arterial blood[illegible].

Ha[illegible] has described a study using lung function tests in an asbestos textile factory in the West Riding of Yorkshire. He feels that he has established the value of lung function studies both as a pre-employment screening technique and as a biological monitoring procedure for exposed workers. He is a protagonist for the theory that asbestosis can be detected by lung function tests before it appears radiologically. In advanced stages of the disease the lung function results correlate well with X-ray findings and physical signs.

In 1966 Gandevia[illegible] suggested that serial lung function tests are likely to be more useful than serial chest radiography in the supervision of asbestos workers, but his conclusions are based on only three years of follow-up. After studying a group of asbestosis patients and monitoring unaffected workers, Leathart[illegible] concludes that diffusing capacity appears to be the best measurement for making an early diagnosis but the clinical signs sometimes precede a drop in diffusing capacity.

Becklake[illegible] finds the characteristic restriction of all sub-divisions of lung volume to be present only when radiological changes are definitive. She finds that the two function measurements which most closely parallel the radiological development of asbestosis are decreased vital capacity and decreased exercise tolerance.

In studying Figures 7 and 8, the findings previously reported[illegible] must be borne in mind. Reduced transfer factor [illegible] the non-exposed new starters with abnormal findings is surprisingly high, accounting for nearly 37 per cent of the [illegible] results, but transfer factor decrease plus restrictive changes, obstructive airways disease or both only increases this to 48 per cent. In the exposed population previously reported, in those with abnormal results, reduced transfer factor occurs in 11 per cent of this group and in combination with restriction, obstruction or both accounts for 37 per cent.

The incidence of airways obstruction and gas transfer defect in non-exposed new starters must be taken into account. This is probably a reflection of the reported high incidence of bronchitis, and other respiratory ailments in the Rochdale area.[illegible] It would appear from Figures 7 and 8 that, regarding T_L as within normal limits if it is between 100 and 80 per cent of the predicted normal value, and possibly still normal if between 79 and 70 per cent, there is no marked increase in the percentage of men or women studied with an abnormally lowered gas transfer factor, in the various exposure groups. This study is to

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educational policy for workers includes an induction course and comprehensive training schemes to ensure that all are aware of their role in running the operation safely. A booklet is issued to new employees outlining the need for the Asbestos Regulations and giving details of the diseases associated with asbestos exposure. Managers and other supervisors have all been briefed sufficiently to cope with enquiries from their operatives.

The medical surveillance of asbestos workers is based upon the foundations of enlightened management, an educated labour force, sound industrial hygiene methods and truthful interpretation of the facts pertaining to the group as a whole with particular emphasis upon collection of *relevant* data.

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