DOCTOR AND WORKMAN*

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"It would afford me much gratification if any means could be devised as regards either prevention or remedy, whereby might be lessened the evils of a disease, the ravages of which, upon the most robust constitutions, I have every day cause to deplore." "On Black Expectoration and Black Matter in the Lungs."

(GEORGE STEELE, 1834.)

After 30 years in industry John C. Bridge honoured one above all, the British workman, and with Carlyle could truthfully affirm :

Venerable to me is the hard hand, crooked, coarse ; wherein notwithstanding lies a cunning virtue, indefeasibly royal, as of the sceptre of this planet.

His supreme purpose and constant endeavour was to safeguard and promote the health and welfare of the factory worker and he regarded himself as the father of medical supervision in industry in Britain (Bridge, 1945). This practice is now variously epitomized in industrial or occupational health or industrial or occupational medicine, the virtues of which have been widely acclaimed even at the highest Government levels. But notwithstanding the published reports of the Royal College of Physicians (1945) and the British Medical Association (1941 and 1950), let us not overestimate the progress of our branch of practice and our standing as a group in the profession. No effective impression, so it seems to me, has yet been made either on the profession generally or on the staffs of the medical schools and teaching hospitals particularly. The fault largely is in ourselves, for in a spate of pretentious terms we have failed to convince our brethren of the scope and function of our practice, have failed to assert quite simply that we are concerned as doctors with men and jobs, men at work and men away from work, and all that derives from these fundamental influences on human well-being. Now another development forebodes a further setback ; all too soon under the National Health Service there may arise a generation of medical and surgical specialists who have never known a patient outside a hospital, and so, except in theory, will be ignorant of our existence, problems and purpose and, if teachers, without the practical personal

experience necessary to educate undergraduates in these matters.

In relation to traumatic injuries among manual workers Griffiths (1949) has magnificently thrown down the gauntlet to the surgeons. Now the urgent need for us, individually and as an Association, is likewise to challenge the physicians by ceasing to talk nebulously about health and positive health and admitting frankly that we are doctors concerned with the problems of disease as they occur among workmen. There is no reason for timidity or to invest our practice with a halo of prevention, for the health, safety, and welfare of the workman, individual and group reactions, working morale, education of labour and management, the control of environment, prevention and research, all derive origins, stimulus, and power from the efficient practice of the works doctor in his consulting room, and thence throughout the factory. Both in social and industrial medicine, it is high time for all to recognize that prevention is not properly an independent aim but an incident, albeit important, of efficient, comprehensive work by the doctor and his associates, and not least with the cooperation of the workmen. To pursue it as a supreme aim and as if we alone were concerned, is to neglect our daily opportunities to establish confidence in our purpose and to diminish our achievement. We are doctors, not medical officers or preventive hygienists, and when to the British workman we become good doctors, we shall be established in our duty and in our purpose, for :

To preserve man alive in the midst of so many chances and hostilities is as great a miracle as to create him.

Despite the entry of other experts into the field of personnel management, we by training and experience and as trustees of intimate confidences have the opportunity to become *the* industrial

* The John C. Bridge Memorial Lecture, delivered at a meeting of the Association of Industrial Medical Officers at the London School of Hygiene on April 28, 1950.

psychologists, assessing the whole man, the whole group and the works climate, and only by our exertions and efficient practice shall we resist the modern tendency to regard the workman, individually and collectively, as a disembodied mind. At the same time let us not deceive ourselves that the facile use of an uncomprehended jargon makes a psychologist, and further recognize that by inept practice in this field of the mind more than in any other we may do harm rather than good. Whenever industrial medicine ceases to be personal and individual, so that the workman becomes a catalogue of physical and mental characteristics, skills, dexterities, and aptitudes, or lack of them, a unit within an environment human and material, a guinea-pig for research, then so soon shall we forfeit our supreme justification in industry and our claim to be recognized as a distinct branch of medicine. We are industrial physicians and acknowledge that our speciality is industrial medicine, thus aligning ourselves with and no wise inferior to those working in preventive, social, physical, psychological, and tropical medicine.

Industrial Toxicology

As industrial physicians we do not dispute that ordinary community diseases, especially minor ailments, are among the main causes of sickness in workmen, but nevertheless industrial diseases are our special concern and responsibility. Each year the absolute number of recorded cases of industrial disease is small, so we are criticized (Hobson, 1949) as holding very exaggerated views of their relative importance as a cause of incapacity and death. Merewether (1945) has exposed the fallacies of such a narrow interpretation of published figures, and referring to a particular small group Wyers (1949) pertinently asks: "Must we abandon to their fate such men as those who were poisoned by methyl-mercuric iodide? Three of them are still alive, speechless, deaf, blind, and paralysed."

Did Lane (1949) have an exaggerated idea of lead poisoning when he devoted nearly 20 years to the medical supervision of men engaged in the manufacture of electric accumulators? During this period of unremitting supervision not a single new case occurred in his organization. Are we to consider as comparatively insignificant the cases of cancer of the nose and lung reported from a nickel works (Annual Report of the Chief Inspector of Factories, 1948), or cancer of the bladder in the dyestuffs industry (Goldblatt, 1948)? Certainly not. Whenever a single case of serious industrial poisoning occurs, it represents disaster in some household, factory, and process, and creates a host of problems beyond exaggeration.

One point requires emphasis, namely, that recorded cases represent gross disease, involving invalidism, incapacity, and death. These are few compared with the numerous cases of minor transient sickness, often wrongly diagnosed, which regularly result from the same causes. Both, relative to the potential danger, mark the triumph of preventive measures. The outstanding achievements of the industrial toxicologist and his associates are when by their experience they foresee the possibility of disease and avoid its occurrence by appropriate measures taken in advance. This is excellently illustrated by Hunter's (1950) recent warning on the dangers of parathion and by the highly efficient manufacturing plant and supervision in operation at Ardeer, Scotland.

The Problem of the Pneumoconioses

But if large numbers of casualties, resulting in chronic sickness, incapacity for work and premature death, are required to vindicate industrial medicine and the focus on industrial disease, then surely these are amply provided by the dust diseases of the lungs. At present in Britain these constitute a major social and economic disaster. Due to their character, no substantial benefits from preventive measures can reasonably be expected during the next decade; a generation of workmen is already damaged, and the tragic record must abide its passing.

Among 86,219 men employed underground in south Wales collieries, during the five and a half years 1943-1948, (June 30, 1948), 15,371 men, or 32 cases per 1,000 workmen per annum, were certified by the Silicosis Medical Board to be suffering from pneumoconiosis. McVittie (1949) explains the significance of these figures by the simple statement that during this period from this cause alone, 50 skilled miners each week left the pits in south Wales. If to these are added men who leave the industry on account of accident, social disease, age or other cause, then the entire population of these pits must be replaced every ten years. The whole influence is to deter young men from entering the mines, with the result that wastage of man-power exceeds recruitment (Morris, 1947). At present this net loss from all causes throughout the country amounts to 450 men per week. Fortunately this serious incidence of pulmonary disease has so far not been recorded in the other coalfields, employing 600,000 miners. Fletcher (1949) summarizes the present experience of pneumoconiosis in coal miners by stating that in south Wales the incidence of certified cases is nearly 40 times greater than in the rest of the country. Although the geology of coal-measures, mining

methods, and environmental conditions vary from area to area, it seems very doubtful if such a wide divergence of certified cases can be wholly explained by physical factors operating within the mines. On the other hand, it is not known if the difference is real, that is to say, whether or not certified cases in areas outside south Wales fully reflect the actual incidence of the disease. Recent experience in Scotland and Durham suggests that they do not.

Although the pneumoconioses are outside the sphere of practice of many here, all as doctors and citizens are vitally involved in the inherent social and economic problems, which are much deeper and more subtle than is generally either realized or admitted. It is reasonably simple to calculate the financial cost of compensation payments, the loss of skilled man-years' production per certified case, but who shall even guess at the suffering of the patient and his family, the loss of self-respect of the craftsman in idleness, the domestic infelicity and all the decay, physical, mental, moral, and material in the individual, the family, and the community, which accompanies and follows human decline to a premature grave? Can we fail to recognize, or dare we ignore, the effects on the village community or on the local and central organizations of the National Union of Mineworkers and thence on all trades unions, whereby the disease becomes not only an influence on, but a powerful instrument of, political thought and action, in which, all too often, imperfect understanding, emotion, and sentimentality impair perspective, subjugate reason and distort judgment, to the ultimate detriment of the miners themselves?

Resettlement of Disabled

In south Wales the vast majority of miners suspended from the pits by reason of dust disease of the lungs are only partially disabled for work, and while the urgent need for their resettlement in alternative employment has been recognized by the Government, the optimism of the Working Party (Board of Trade, 1945) has not been justified in practice.

Despite the bitter lesson of the special areas and efforts to encourage firms to establish new industries in the coalfield, heavy industry still predominates in south Wales, and the labour demand is for fit men. These fit men also may become redundant for work in the mines as re-organization and modernization double output per man shift, as other countries, for example, India, invade our coal export markets, and as industry and rail and sea transport adopt new methods of firing without coal.

Experience has already demonstrated that light, neo-technical industries, which in time of keen competition or slump, either close down or rely on the cheaper labour of women and girls, are no

remedy for the problem of the disabled collier. Toy-making or the manufacture of electrical accessories and nylons are not in the epic tradition of the men of the pits. Besides, in our anxiety to resettle the disabled, there is need to ensure that fitness itself does not become a handicap or a bar to skilled, congenial, and progressive employment. Working in-by, two to three hundred fathoms below the surface of the green, sunlit valleys, in dust and fumes, in darkness and noise, often crawling on hands and knees and unable to stand erect, never was and never can be a natural occupation for men. As a factor disturbing the mining communities Zweig (1948) has revealed the deep significance of the "pitman's" life, and has emphasized that disease and accidents are relatively minor causes of the present drift from the mines, even at a time when face-workers are among the highest paid craftsmen in industry. There is one further observation, namely, that the disabled craftsman, especially after a taste of idleness, if given a job—almost any reasonable job—will reveal considerably more ability and staying power than is suggested by the whole range of physiological tests.

In 1948 unemployment among pneumoconiotics and the need to maintain the number of miners at work became so critical that the situation was only relieved by legislation permitting certified cases to obtain Disablement Benefit under the National Insurance (Industrial Injuries) Act, 1946, while continuing, under certain safeguards, to work as miners. This statutory provision marked a complete reversal of established practice.

Without doubt the urgent and paramount need in the mines is to prevent the disease, thereby obviating or at least diminishing claims for benefit and alternative employment. If at the same time output per man shift can be doubled or trebled as envisaged in the Reid Report (Ministry of Fuel and Power, 1945), thereby considerably diminishing the number of men at risk and emancipating them from underground work, so much the better. Control of the dust by various methods is being successfully pursued (Gooding, 1946; Graham and Jones, 1947), but according to Steele (Ministry of Fuel and Power, 1949), a divisional inspector of mines, "not always with vigour and the necessary spirit of cooperation". As the benefits of these measures will not accrue for several years, there is quite justifiably a call for some immediate measure. Fletcher (1948) submits that this can be achieved by "an appropriate system of periodical x-ray examinations", and he makes this arresting pronouncement.

The sincerity of the industry's and the Government's concern with the health of coal miners will be judged

by the speed and thoroughness with which such a system is instituted in this country.

A similar recommendation (for coal miners in south Wales) was made in 1942 by the Industrial Pulmonary Diseases Committee of the Medical Research Council and has since been supported by the Advisory Committee of the Ministry of Fuel and Power (1944), the National Coal Board (Capel, 1948), Gooding (1946), Harper and Morgan (1948), and Hunter (1950). On March 10, 1950, in his maiden speech before the House of Commons on the debate on the King's Speech the honourable member for Bedwelty, Mr. H. J. Finch, M.P., compensation secretary of the Miners' Federation in south Wales, said: "At a time when manpower is so short everything should be done to maintain the supply of labour in the pits. I hope the time is not long distant when it will be possible to apply periodic examinations to all the men in the mining industry" (Hansard).

Altogether this represents an almost irresistible body of authoritative and responsible opinion, and I only venture with trepidation to examine the proposition because, unlike these advocates, I have had some working experience of similar arrangements in other dusty industries in this country and abroad.

Nomenclature

At the outset it may seem strange to suggest that before instituting any scheme of periodic medical examinations the present world-wide confusion in terminology and classification of the dust diseases of the lungs must be resolved. Silicosis and pneumoconiosis must cease to be used as synonyms. Because of the difference in the course and complications and hence in significance and prognosis, wherever possible a clear distinction should be made between silicosis and simple pneumoconiosis of the dust reticulation type of coal miners, although these conditions may co-exist. The present chaos derives chiefly from legal definition for purposes of workmen's compensation, but accepted medical terms should not have their meaning debased either to meet legal convenience or popular use.

Normal Variability and Adjustment

Another relevant observation is that early diagnosis of pulmonary disease necessarily demands a sound knowledge of the clinical and radiographic features of the normal chest. The normal is not identical with the average or mean. There is a "natural" range at each age, which in terms of the Gaussian curve is represented by the mean $\pm$ twice the standard deviation (Lyon, 1942). The recognition of this "natural" and hence slight deviations from it, demands a high degree of clinical skill,

experience, and judgment in which the true physician uses machines and laboratory tests merely as aids. The determination of this natural range of structure, function, and adaptation at various ages is one of the measurements which demands immediate and extensive study. It may not be amiss to emphasize the supreme value of a careful history and the symptomatology, which not only establish material facts but in the intimacy of their recital reveal the patient's mind. Furthermore, inspection carried out as a ritual is still the first cardinal method of clinical examination and is at once sight and insight. And what is true of natural variability of structure and function applies no less to the natural variability of adjustment which different individuals make in response to the same quality and extent of disease.

In support of the demand for periodical examinations of coal miners certain systems in this country and abroad have been cited (Fletcher, 1948), so it may be of value to review these briefly.

Periodic Medical Examination

In Great Britain.—Periodic medical examinations in pneumoconiosis-producing industries in Great Britain are by no means new. Legge in 1900 recommended such a system for ganister miners, but the first application was not made until 1913, and then to china biscuit workers in the pottery industry. These examinations, conducted by the certifying surgeon, completely failed, for it is recorded (Home Office, Departmental Committee, 1928) that "after 15 years and in spite of the serious risk, not a single suspension resulted from 3,886 examinations". The next experiment was under the Refractories Industries (Silicosis) Scheme, 1919, which prescribed examinations to be conducted by specially appointed medical officers (tuberculosis officers). These were equally unsuccessful, due largely to variations in standards applied by the different doctors. Thus "in Sheffield 10% of the examinations resulted in suspension, while in Scotland there were no suspensions, which results could not be explained by dissimilarity of risk" (Home Office, Departmental Committee Report, 1924).

A new scheme was made for the refractories industries in 1925 in which the examinations and certifications were reserved to a full-time medical board. Again the practical result was unsatisfactory, as the doctors were seconded to undertake special inquiries in cognate industries so that the routine inspections were frequently in arrears. Furthermore, the general standard of chest radiology available to the board throughout the country was quite inadequate for early diagnosis. This method, however, is now established and current experience is represented by the work of the Medical Board for

Silicosis and Asbestosis, now the Pneumoconiosis Medical Panel, which, since 1931, has been responsible for periodic medical examinations in the refractories, sandstone, pottery, and asbestos industries.

Many occupations such as sandblasting, steel fettling, masons' work on sandstone and tunnelling in silica rock, involve equal if not more serious dust risks, and so enquiry is frequently made as to why the system has not been extended to include these workers. The answer is quite simple, namely, that for uniformity of standards the medical board system is fundamental, and so for the examinations to be practicable and of any real value the numbers at risk must be substantial, reasonably concentrated, accessible, and stable over a period of years. Coal mining, it must be conceded, broadly satisfies all these requirements.

The value of periodic medical examinations in dusty industries and occupations has frequently been examined by departmental committees, and the following advantages are usually mentioned : (1) Elimination of pulmonary tuberculosis ; (2) detection of early silicosis ; (3) evidence of conditions producing the disease ; (4) assistance in diagnosis by providing serial records. Theoretically all are valid ; in actual practice all are ineffective. As often as not the tuberculous workman is absent on the occasion of the medical board's visit and so escapes examination and suspension ; no matter, for the incapacitating effects of the disease itself soon eliminate him from work.

Early diagnosis of silicosis is almost entirely dependent on radiographic changes and with a technically satisfactory film considerable accuracy can be achieved by panels of experts, but unfortunately the standard of chest radiology is still inadequate. This same criticism is even more valid for serial films, which are necessary for detecting or confirming alterations in the disease and its complications. As will appear later, the early accurate and consistent diagnosis of early simple pneumoconiosis of coal miners is a much more difficult problem. But even if the diagnosis is established in the early stages of the disease, the workman usually feels quite fit, and apart from the radiographic evidence the doctor is unable to demonstrate any deviation from health or incapacity for work. Accordingly, if diagnosis does not automatically involve certification and compulsory suspension, advice to the workman to find a safe job out of the dust is summarily dismissed. In our highly industrialized modern state, economic employment and family considerations supersede slight deviations from full health. Even so it may be urged that knowledge of his condition will make the workman

more careful for himself and his mates. But the pay packet recognizes no danger, piece-work and output bonus admit no hindrance, and health seldom becomes a reality until lost beyond recovery.

As to evidence of conditions producing the disease, the examinations have little value ; the necessary exposure period is considerable, and men and working conditions rarely remain stable over an area or for a sufficient period.

Undermining the whole system is the fact that commitments invariably and considerably exceed resources of staff and equipment, so that examinations become sporadic rather than periodic.

Finally, initial and periodic medical examinations as at present prescribed in the refractories, sandstone, pottery, and asbestos industries do not necessarily include radiographic examination of the chest, with the result that only 20 to 30% undergo x-ray examination. This defect alone considerably impairs the value of the examinations and almost entirely defeats their purpose. As a matter of considerable practical importance it should be noted that under the existing clinical system of periodic medical examination one doctor is equivalent to 1,000 examinations per annum.

As an aid to the control of silicosis in the hæmatite mines of the north-west of England, a system of medical supervision has voluntarily been in operation since 1937. The scheme includes a pre-employment general examination, a special examination of the lungs (including a radiograph), and a periodic complete medical examination at selected intervals. Craw (1947) who, as medical director, has frequently reviewed this work, in 1947 recorded : " It was hoped to be able to do a complete medical survey of the mines, but that has been impossible to achieve for many reasons." Yet the total number of men employed is less than 1,500. Again, during the years 1935, 1936, and 1937, 411 men were accepted for employment, but in 1947, when it was desired to study these, only 66 remained in the industry. These facts involve no criticism of the scheme, but merely emphasize the difficulties inherent in such medical supervision.

In the Union of South Africa.—Since 1916, for the purpose of granting miners' tickets, the Miners' Phthisis Bureau in South Africa have carried out initial and periodic medical examinations. This system, of which full details have since been presented regularly in a series of triennial reports, is generally hailed as vindicating the procedure, and the favourable experience of " new Rand miners ", that is, men selected by rigid initial examination as against the unselected " old Rand miners " is cited as the highest recommendation. But can it honestly

be claimed that a system of periodic medical examinations commensurate with the numbers and appropriate to the risk, has ever existed in the Witwatersrand? In the first place the examinations do not apply universally to all miners, but only to those employed or seeking employment in scheduled or registered gold mines. At present, however, according to De Kock, vice-chairman of the Bureau, "two Bureau teams, each with a mobile x-ray unit, are investigating the incidence of silicosis at all non-scheduled mines so that all mines which have a pneumoconiosis hazard may be scheduled or registered and an appropriate system of initial and periodical examinations instituted." Secondly, for all practical considerations, miners may be divided into Europeans and Africans, and the initial selection and periodical supervision is entirely different in the two classes.

Europeans.—According to the latest triennial report (1941-1944), the annual total number of European miners examined was 27,167. Although in the early days on the Rand the white miner actually engaged in rock-drilling on the machines, nowadays his duties include acting as a supervisor of native labour and working conditions and as a shotsman over a mine area, thereby considerably diminishing the period and intensity of his exposure to harmful dust. The sub-division of his working day is very clearly presented in the following job analysis table by the Government mining engineer (Malherbe, 1949).

JOB ANALYSIS TABLE

Job	At Stations and Travelling to and from Working Place (%)		Inspecting Hanging, Walking, and generally Supervising at Face (%)		At Miner's Box (%)		Charging and Lighting Up (%)	
	1949	1926	1949	1926	1949	1926	1949	1926
Shaft-sinkers ..	7.5	9.7	61.4	55.1	22.6	21.8	8.5	13.4
Developers ..	13.0	11.4	53.5	44.3	20.0	28.5	13.5	15.8
Machine stopers ..	14.0	12.2	48.6	58.6	19.3	17.4	18.1	11.8

As the mines are concentrated in an area of gold-bearing reef within a radius of 30 miles of Johannesburg (Smith, 1947), all periodical examinations are made there at the Miners' Phthisis Bureau, an arrangement which greatly facilitates regular completion. This is further ensured because a miner may not continue to be employed in a scheduled occupation unless he is the holder of a valid certificate.

Until 1946 the prescribed interval between examinations for all miners was six months, but because of the low incidence of silicosis in the short

service groups, it was then altered to one year for men with less than six years' service.

The examination is clinical and radiographic (15 in. x 12 in.) and any miner certified to be suffering from tuberculosis as defined in the Act to Amend, Consolidate and Extend the Law relating to Miners' Phthisis, Union of South Africa, 1946, or silicosis in the third stage, is immediately suspended from further work underground. Miners certified to be suffering from silicosis in the first or second stages are permitted, if they wish, to continue in underground work even after taking the appropriate compensation and without prejudice to further benefits. This right of the workman enacted in 1946 marked a radical change of policy, which change, according to Smith (1947), was directly opposed to the frequently expressed views of the Bureau. Under this centralized system, a total of 60,000 to 70,000 examinations is completed annually by a staff of 12 full-time medical officers, which means that one doctor is equivalent to about 6,000 examinations per annum.

Africans.—The system for Africans is considerably different.

African mine labourers are engaged on short contracts for a period of nine months, at the end of which the majority go home, but some return later for further contracts and in the aggregate may serve many years. The average number employed is about 300,000, and this population is replaced, on the average, to the extent of approximately 90%

during each year. Many are engaged in the most hazardous dust risk, machine rock-drilling in quartzitic rocks. All recruits are subject to initial examination, which only in recent years has included radiographic examination, using miniature films, 24 mm. x 19 mm. (Collender and John, 1941). These examinations also are centralized, being made by the medical staff at the Witwatersrand Native Labour Association Central Hospital in Johannesburg (Retief, 1943).

Mine medical officers under the general supervision and control of the Bureau are responsible

for periodic medical examinations. The examination is a rapid rough screen to detect sick persons, especially the tuberculous, and consists of weighing on pay day at intervals of six weeks. "Short weights", as defined, are set aside for medical examination, which only at some mines has hitherto included a radiograph of the chest. In addition to schemes for detecting cases of silicosis provision was made for all Africans who had completed five years' cumulative service with any individual employer to be "stethoscopically" examined at intervals of not more than three months.

Having regard to the fact that recent statistics show that on the average it now requires 20 years for the earliest manifestations of silicosis in Europeans to appear, while the corresponding period for African mine labourers is only 10 years, it is not surprising that the lack of uniformity, one might say of justice, in the examination in the two groups has been adversely criticized (Report of the Miners' Phthisis Acts Commission, 1941-43, Union of South Africa). Since 1944 efforts to adjust the differences have been made, and African labourers with an aggregate of five years' service are now being subjected to a periodical examination, including x-ray examination, at six-monthly intervals. New regulations have been drafted which, when gazetted, will make compulsory a thorough "final" or "discharge" examination, including an x-ray examination in every case (de Kock, 1950).

On July 31, 1944, the Mine Medical Service comprised 68 whole-time medical officers, which included the staff of the Witwatersrand Native Labour Association Central Hospital. Actual certification of silicosis in all cases, of course, is reserved to the Miners' Phthisis Bureau, to which all suspected cases must be referred.

According to authorities in South Africa the system of examinations at present applied to about 27,000 European miners is considered to approach the ideal, while the system applied to about 300,000 African labourers is the best practicable in the circumstances. It is regularly being improved in the direction of uniformity between the two groups.

The important conclusion which emerges for us is that the South African system itself is still in process of evolution and even now, after more than 30 years, cannot provide a prototype for our adoption. Moreover, geographical concentration of the population at risk and the regimentation of African labour combine to make their assignment more simple than ours would be among 700,000 coal miners dispersed throughout Great Britain.

Northern Rhodesia.—Recently on behalf of the copper mining companies of Northern Rhodesia,

I have supported (Commission, 1949) the need for a statutory system of annual periodic medical examinations. This may later appear inconsistent, but support was based on the assurances of the Northern Rhodesia Silicosis Medical Bureau that they would have the staff and facilities to maintain a uniform system of initial, periodical, and final examinations, including on each occasion a full-size radiograph of all miners, European and African, numbering altogether about 30,000. Here again a system of centralized and regimented examination is possible. Besides the value of these measures will be made really effective by the determination of the companies to introduce and maintain the highest degree of prevention and control by suitable mining and engineering practice.

The scheme was finally inaugurated on March 3, 1950, when the Governor of Northern Rhodesia opened the new Bureau headquarters. The staff comprises a medical director, six full-time medical officers, and ancillary staff. Already an excellent scheme for the examination of lungs by the Gough Wentworth technique (1948 and 1949) is being carried out. This includes examination of the lungs of miners killed in accidents, by which means opportunity is afforded of detecting the occurrence, course, and development of the disease in relation to occupation and the period of exposure, and also permits correlation of morbid anatomical and radiographic appearances. This scheme may yet prove to be the greatest contribution of all time to field research into silicosis and its control in metalliferous mining.

Ontario, Canada.—Under the Mining Act of Ontario (R.S.O., 1937), for the purpose of issuing miners' certificates, a system of initial and periodic medical examination, including an x-ray examination of the chest on full-size film, has existed since 1926. The scheme follows closely the South African model. It relates only to metalliferous miners of whom there are 13,000 in three main mining camps at Porcupine, Kirkland, and Sudbury. On an average initial examinations number 4,000 and periodical examinations 22,000 annually. As the prescribed interval between periodical examinations is one year or such shorter period as the examining physician may direct, 22,000 examinations annually among 13,000 miners represents a high incidence of recall. Each of the three areas has a medical centre equipped with stationary x-ray equipment, and the staff comprises one full-time physician, a full-time x-ray technician, and clerical help.

According to Dr. Cunningham (1950), Director of the Division of Industrial Hygiene, "some preliminary testing has been made, using 70 mm. films,

but no decision has been taken yet as to whether they will be adopted for this work. They may prove to be unsatisfactory for the detection of the earliest specific indications of the effects of dust. Assessment of the value of these examinations is, of course, difficult to make, mainly because of other measures which have been taken to control the disease. There seems no doubt that the examinations are of importance, when it is considered that the number of cases of silicosis developing in the Porcupine Mine Camp, where a large proportion of the cases has arisen, is very much less among those employed since the examinations started in 1926. This aspect of the case requires some study before any public statement can be made about it."

Meanwhile, the system has not been extended to other silicosis-producing industries in the province, and after more than 20 years' experience of operation this quotation does not represent a very enthusiastic recommendation.

France.—In France where, we are informed, the problem of pneumoconiosis among coal miners is almost as severe as in south Wales, it is claimed that a system of periodical x-ray examinations has been initiated (Fletcher, 1948). The subject was discussed at a conference of mine medical officers held at Grand' Combe in March, 1947, and the following passage, translated from the Congress Report, appears to reveal the facts.

"The periodicity of the radiological examinations and the occupational groups of miners included, varies between coal fields. Only in one are periodical examinations of all underground workers made (theoretically), namely, in the Loire coal field, where coal-face workers with less than 10 years' service are examined every two years, and those with more than 10 years, annually. In other areas periodical examination of all underground workers has not yet been undertaken but rockmen are seen every six months."

Miniature radiography (70 mm. film) is used, and I am informed (Cochrane, 1950) that the quality of the radiographs is quite inadequate for early diagnosis of the disease.

Future Development of Periodic Medical Examinations among Coal Miners

If the preceding observations are substantially true, and every effort has been made to verify them, it is reasonably possible to institute and maintain a scheme of periodic medical examinations throughout Great Britain from Kent to Ayrshire and from Glamorgan to Fife?

As already suggested, there is no extant system either in this country or abroad which would fulfil the purpose. It would be necessary to devise a special scheme which would have regard to the very large numbers (700,000 persons) employed on shift

work and distributed throughout the country in over 1,000 collieries of varying population, and with or without change-houses or pithead baths, which facilities would be necessary for the operation. Fletcher (1948) speaks of "an appropriate system of x-ray examinations"; in other words, mass radiography. This system for several years now has been established for the detection of latent tuberculosis among service personnel, school children, factory groups, and the general community, in many ways a much less difficult administrative task. During 1949, 60 civilian units each employing one medical director together with five nursing and other staff, each completed on the average 45,000 x-ray examinations (Kerley, 1950). These figures are not encouraging to such a new venture among 700,000 coal miners. Moreover, let us not be misled by the emphasis on x-ray examination, for this is only the preliminary means of selection; experience in tuberculosis surveys shows that between 6% and 10% of examinees require recall for large films and full clinical investigation. Even more important is the fact that such examinations, whether in relation to tuberculosis or pneumoconiosis, have no separate existence, but are merely the opening incidents in a very difficult and responsible administrative procedure. As an index of the significance of these observations to our present problem, it may be worthy of notice that Cochrane (1949) in the course of an x-ray survey of a "low incidence mine" in the north of England detected 264 cases (26.6%) of simple pneumoconiosis, and one case of progressive massive fibrosis among 991 underground workers. Admittedly 247 of these cases were classified in categories 1 and 2 (Fletcher and others, 1949), but if it is intended that these workmen should not be recalled for full clinical investigation then these categories should be abandoned as stages of disease. This, of course, is not possible, because Fletcher (1950) admits that "two small items of evidence suggest that some cases with categories 1 and 2 simple pneumoconiosis may be as disabled as cases with more advanced simple pneumoconiosis", a fact which certifications by the Silicosis Medical Board have long confirmed. If periodical x-ray examinations are carried out the workman and his union will want to know whether he has contracted pneumoconiosis, not if he has reached the critical level of severity.

Capel (1948), Principal Medical Officer, National Coal Board, while favourable to the idea of periodical examinations, but aware of the difficulties, suggests that "any such development would have to be limited initially to south Wales". McVittie (1949), than whom none is better qualified to speak, records that through a variety of channels a measure

of periodic radiographic examinations has existed among coal miners in this very area for the last 10 years. As a result of this campaign, which was largely under the direction of the miners' lodges, not only did the miners and their agents become dust-disease conscious, but they developed a dust-disease phobia which was constantly intensified through every medium of presentation and discussion. Pneumoconiosis became a mass psychosomatic disorder affecting the whole local community; the valleys became tense, breathless, apprehensive, and querulous. This mass "check up" alone may help to explain the very diverse incidence of certification between south Wales and the other areas, where claims by contrast almost entirely have their origin in incapacitating sickness. Universal periodical x-ray examinations might considerably even out the order of incidence in the coal fields throughout the country.

In passing it must be testified that the Welsh valleys were peculiarly vulnerable to such a disaster. As a group the south Wales coal miner is probably the most intelligent working man in Britain. Education for himself and his family is a lifelong devotion, and he seeks detailed knowledge and understanding of his personal problems, such as pneumoconiosis. Furthermore, his reactions are influenced by a deep spiritual emotion, which is rooted in family life, the chapel, and the rights of man, individually and as a community.

If, as claimed by Fletcher (1948), "periodical x-ray examination alone can give coal miners security from pneumoconiosis", it is difficult to understand how such a salutary measure could be restricted, even temporarily, to any particular area or group. Besides, any system to be workable must involve compulsory submission to examination and to any resultant administrative action. This could only be achieved by statute, which could not reasonably or equitably have a selective geographical application within a single industry. The plain fact is that to be of any value whatsoever the examinations would require to be comprehensive of all areas, age and exposure groups, and, as a small practical point, the prescribed interval between examinations within an industry must be uniform and not exceeding two years, otherwise the result is chaos. Without delaying to examine the relevant problems of staff, their number, special experience, remuneration, and location, my humble submission is that the huge number of the population involved alone makes it impossible to institute and maintain (and this is the operative word) any efficient system of periodical examination for all coal miners.

In these days of financial crisis some of you may rightly be thinking of the cost. Relative to this

McVittie (1949) has admirably remarked "we are all conscious of the cost of further measures to prevent the disease, but we seem to be unconscious of the cost of allowing it to continue".

Assuming, however, that it is possible to complete the radiographic examinations at the prescribed intervals, certain practical implications immediately present themselves. The examination must be individual and personal, and must manifestly confer benefit on the miner and his mates. The failure of an examination on these points, as many of you know from experience, is responsible for a growing antagonism to tuberculosis surveys in factory groups. The tragic psychosomatic disaster of south Wales must not be excited or re-enacted in other areas. Every affected workman, at least, must be advised not only of the diagnosis but must also receive expert advice and help in the course of action which he should follow. His private doctor also must be kept fully informed on all these matters, an omission which hitherto has been a grave defect of the existing system.

The primary purpose of the examinations is to detect the disease in its earliest stage. During life a technically satisfactory radiograph provides the best single piece of evidence in the diagnosis, and also of the stage and type of the disease. Despite the criticism and protests which have been made from time to time, a diagnosis of pneumoconiosis during life cannot with assurance be maintained unless substantiated by specific radiographic changes, and sound consistent practice can admit none other. The alternative is, as Bridge (1945) recommended, to equate health and industrial injury benefits, an aspect of egalitarianism apparently quite unacceptable to trades unions. Serial radiographs, even when adequate, only assist in the determination of changes, because the disease, which includes the integral complications such as focal emphysema, may advance considerably, as manifested by the deterioration of the patient, without any detectable alteration of the radiological appearances.

Without seeking to explain the reasons, there can be little dispute that the general standard of chest radiography at present available throughout the country is quite inadequate to form the basis of a system of periodical examinations of coal miners. This is certainly true of large films, it may be even more true of miniature films as suggested by the experience of Retief (1950) in South Africa, who states: "Silicosis is definitely difficult to diagnose, I think, on a 35 mm. film". What then of early coal miner's pneumoconiosis of dust-reticulation type, which is a much less determinate radiographic appearance than early silicotic nodulation? So far as the work of the pneumoconiosis panels is involved,

considerable improvement in the quality of radiographs could be achieved if each centre was equipped with an x-ray unit as at Cardiff. No doubt the proposed system of periodical examinations includes the use of new stationary or mobile x-ray units of a selected type. Even these, however, although improving the standard of radiography, would not ensure consistently satisfactory films, for there are still imperfections in the machines and accessories, and particularly in the processing of films. In the recognition of the early stages of the disease the menace of the poor film is twofold: on the one hand it may obscure disease which is present, and on the other hand may suggest its presence where none exists. These facts almost alone explain the diagnostic arguments which regularly occur between doctors whose opinions are based on different films of the same case.

Even when adequate radiographs are available the problems of interpretation follow. The recognition of early simple pneumoconiosis is the objective and Fletcher and Oldham (1949) at the Pneumoconiosis Research Unit have demonstrated quite conclusively, though not surprisingly, that, by present methods, in relation to early simple pneumoconiosis experts are not capable either of accurate or consistent diagnosis even of the same films. Accordingly, would it be prudent at this stage to proceed, recognizing, as we must, that the decisions involve human welfare and happiness? As a means of increasing accuracy and consistency of diagnosis these same authors advocate a system in which the unknown film is matched against standard reference films. It has yet to be established that it is possible to provide a complete range of standard films of general application to all coal fields, and that examiners are capable of accurate and consistent matching. In a recent experiment Fletcher (1950) records that a series of 64 films of miners ranging from normal to category 4 simple pneumoconiosis were presented to ten different experts. Individual inconsistency of diagnosis amounted to 36%, but when aided by the use of standard films the inconsistency decreased to 28%; a decreased inconsistency admittedly, but still too substantial, especially as it is remarked that "all the films were of good technical quality".

But even if agreement is reached as regards the diagnosis and stage of simple pneumoconiosis, what administrative action should follow? In other words, when should the miner be advised that the disease has reached a stage at which it is dangerous for him to continue in the dust?

Here again Fletcher and his colleagues, using their own classification (Fletcher and others, 1949) have, after certain investigations, fixed an arbitrary

limit, but this is based almost entirely on south Wales experience, which need not necessarily apply equally to other coal fields where the quality of the mine dust and associated conditions may be substantially different, thus modifying the significance of the pathological lesions, although the radiological lung changes appear identical.

Recommendations

Let us be quite unequivocal in our opinion that, having regard entirely to medical considerations, pneumoconiosis of any type, as soon as diagnosed, has reached a dangerous degree, and ideally the workman should permanently cease work in a dusty occupation. The danger, however, depending on many other factors, may be trifling or considerable, so that each case must be decided entirely on individual circumstances. It is my considered opinion that no workman unless suffering from active tuberculosis, in which case he may be dangerous to others, should be compulsorily suspended from his occupation in the mines. The examining doctors should give the workman the full benefit of their experience, but he alone should decide whether or not to continue in his job. Whatever else happens, one purpose must stand inviolable, namely to keep the man working up to his capacity, and for a time this may involve living dangerously. Experience of the many practical difficulties, however, already permits of certain general conclusions.

As a rule, for the patient over the age of 40 years there is no choice of work if he is to maintain any real measure of happiness, self-respect and status, and so he, so far as his physical condition permits, must continue in his own job; perhaps he should even be encouraged to do so. Under 40 he should try and have every assistance to find suitable—and what anguish of tears and sweat is in that qualification—alternative employment. But this is important, and so seldom understood, that there is no great hurry, even up to a year, so long as he is under supervision. I would go so far as to advise that every workman, if fit, should as soon as possible after certification resume his old work at his old place, regardless of what are speciously designated "approved conditions". It will do him good to be back among his own mates and enable him and his family to regain some peace of mind and perspective while they adjust their affairs and commitments. This observation is of importance to many of you here; there is no need to upset yourselves and your management by a panic search for alternative work on behalf of the pneumoconiotic patient. At the same time this does not mean that the matter

should not have your immediate and constant attention until satisfactorily adjusted.

Having already submitted that numerically the assignment is probably quite impracticable, I would now venture to add that our medical and social knowledge of the varying problems throughout the coal fields are not yet nearly adequate to enable us to undertake the responsibility of periodical examination of all coal miners, and indeed more harm than good might result. McKeown (1950) has aptly remarked: "It will be a poor bargain if for every new case of early disease which we uncover we precipitate a further two into anxiety states." From what I have previously said the influence extends not merely among the workmen but to their families and to the village community. The real tragedy of pneumoconiosis in coal miners is that all along there has been too much emphasis on disease and doctors and far too little on dust and engineers. The urgent need is not so much for more extensive medical exploration but for more intensive engineering practice. At this phase of dustiness in the mines, there is no occasion to dilly-dally in discussing safe levels as expressed by maximum permissible dust counts; the target must be the minimum which can progressively be achieved and maintained. Instead of medical panels engaged in periodical examinations, the need is for colliery panels representative of all concerned, relentlessly examining and promoting dust control and ruthlessly suppressing the abuse of shot-firing at the coal-face (Hall, 1950). Our supreme effort should be directed to the control of pneumoconiosis through dust suppression rather than of the pneumoconiotic through earlier diagnosis. If a combined offensive can be achieved so much the better. Without organized periodic medical examinations medical supervision can still make a substantial contribution through extension of the mines medical service under the National Coal Board. In the first instance the need is for a few specially equipped and specially staffed units in each division, together with the establishment of health centres in a few self-contained colliery areas, where general, industrial, and social medical services can be combined. The object is to conduct global research not as an independent aim but through routine medical practice and without the handicap of legislative provisions.

While from medical considerations it may be impossible and even undesirable immediately to institute examinations for all coal miners, one group demands our immediate and unremitting care if we are to ensure a future for British mining and the British miner. Each year 16,000 to 18,000 juveniles are engaged for work in the pits. All these recruits should undergo careful pre-employment

selection, including complete medical examination, and the x-ray film of the chest made on this occasion will provide an individual standard for future comparison. A start along such lines was made in south Wales in 1944, and is steadily being extended throughout the country (Coal Mining (Training and Medical Examination) Order, 1944). From this beginning it may be possible later to develop and maintain a system of periodical examination of these new entrants as for the new Rand miners.

If we as doctors are to certify the mental and physical fitness of workmen to engage or continue in an employment, it is the duty of employers through other experts to provide certificates of fitness of the working places.

In conclusion, medical supervision of men at work represents one of the most powerful ideas in medicine today, but for such specialized methods as periodic medical examination the time is not yet come in every field of employment. We as physicians in industry have an opportunity not given to all our colleagues to be the whole doctor caring for the workman and the group during a substantial period of their daily existence. So long as we keep that trust, jealously guarding the dignity and integrity of our calling and all the time remembering that we are only members of a team, the memory of John C. Bridge will endure, and as much as any we may deserve the tribute of Robert Louis Stevenson:

"The physician is the flower (such as it is) of our civilisation; generosity he has, such as is possible to those who practise an art, never to those who drive a trade; discretion, tested by a hundred secrets; tact, tried in a thousand embarrassments; and what are more important, Heracleian cheerfulness and courage."

I should like to record my gratitude to the British workman to whom I owe my experience of the problems of medical supervision in industry.

In the preparation of this lecture I have been indebted to published work and to personal communications, advice, and criticism from many friends at home and abroad. To all who have assisted me in any way I wish to record my sincere appreciation. In particular I pay my sincere tribute to the members of the Medical Board for Silicosis 1931-1946 and to the Pneumokoniosis Research Unit, Cardiff.

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