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THE PNEUMOCONIOSES – BRICKS IN SEARCH OF AN ARCHITECT*

The problem of pneumoconioses and its historical background are reviewed. Pneumoconioses present a very difficult economic problem. In 1951 1300 workers in England died of pneumoconioses. In the same year 5250 persons died from traffic accidents and in the same period tuberculosis was responsible for the death of 11.631 persons. If these numbers are compared with the population at risk, the danger of pneumoconioses becomes evident. Pneumoconiosis is not accompanied only with tuberculosis; among 300 workers who died from asbestosis 16% had primary lung cancer. At the same time among 6000 death of silicosis 1.3% had primary lung cancer. This is very interesting fenomenon which should be carefully examined. More attention be paid in future to the prevention of silicosis and other pneumoconioses.

It is fascinating to look backwards on the mutability through the ages of views on dust and disease of the lungs, picking out factors which have aided or hampered progress and, looking to the future, considering how best to direct our efforts today.

When we do so, we see at once that progress has hardly been swift nor its pattern spectacular, although arguments between the giants has often been fierce and sometimes, literally arresting, as for instance that so long proclaimed by the great Virchow that dust could not penetrate into the lung itself.

It is my thought therefore, to explore whether the vicissitudes of the past cannot fortify the future by focussing our efforts more profitably towards the ultimate elimination of the pneumoconioses as an international menace.

This disease or, nowadays, group of diseases, is older than Babylon, older than the Pyramids and – as is evident from the discovery in Europe of early Stone Age factories for the fabrication of flint implements – much older than writing itself. This is perhaps fortunate, since the literature of the last 100 years alone is sufficiently formidable, provocative and contradictory to satisfy the most earnest of modern enquirers!

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In England and Wales it caused some 1300 deaths in 1951. This does not seem many when compared with the slaughter on the roads (5250) or the deaths from pulmonary tuberculosis alone (11,631), but if we go further and try to relate these causes of death to the population at risk, then the risk from pneumoconiosis appears exceedingly high.

Pneumoconiosis stands out in history as a mysterious and baffling disease which, although it has caused countless deaths through the ages. still eludes control and remains one of the major problems of today.

We may well ask why this is so and what in fact has been achieved? Not much, we may say, if man has busied himself with this problem for 2000 years or so, and that it is only in the last 100 years that we have got further than the bare appreciation that dust on the lungs is harmful.

It may be that progress in identifying and controlling the disease was so slow partly because useful knowledge for this purpose was scanty and hard to come by because of certain features of the disease and of dust, and perhaps most important – since until recent times it was nobody's duty to apply such knowledge as it became available; so it tended to remain locked in academic bosoms, dissemination of it was slow and its application negligible.

In this connection, we should not forget that the most pertinent observations of Hippocrates, Ramazzini, Agricola and of other of more recent times that research has disinterred for us, did not become current knowledge until long after they were made, and some are not generally known even now.

The disease is slow, silent, bilateral, insidious, inexorable and incurable. And there is little obvious or dramatic in its signs and symptoms until its tragically weary and exhausting later stages: moreover, it masquerades in the clothes of other ailments. Diagnosis is difficult. therefore, in the stages when removal from exposure to dust is compatible with a long and useful life, and particularly is the underlying disease liable to be missed if an intercurrent bronchial catarrh or pleurisy obtrudes on examination or when tuberculosis supervenes, as so often it does when only what may be described as the oasis of tuberculosis may be observed, and the desert of diffuse fibrosis go unrecognised.

No doubt these shy attributes of the disease did much to obscure recognition in individuals even that their malady was likely to be occupational in origin, so delaying for long periods the limelight of enquiry being cast upon this possible occupational cause of a high death rate in dust ridden communities.

There is no doubt that man's intelligence has not improved since the dawn of written history and that our ancestors were perfectly capable of detecting or surmising fundamental facts and studying them logically with enduring results, but the spread of knowledge was hampered in so many ways in earlier times that many of them had to be re–discovered in different places at different times. They had a smaller number of

promising theses to work upon, more time to think about them, and the same expert were often capable of dealing with both the fundamental and the applied aspects of some arts and sciences but not, it seems, in this particular field.

More recently, with an equal quality of brain power (we hope), the spread of knowledge has become theoretically more rapid and wider, but the lag between the recognition and establishment of important scientific facts and their general appreciation and application, may be lamentably long. This seems to have been most evident in the field of occupational health and social welfare.

Today, in this competitive age, multitudes of hypotheses, many »jerry–built« are broadcast hurriedly: we are overwhelmed by storms of data of undetermined quality, within which an important observation which may lead to Truth may be lost, or disguised in a quite unjustifiable use of the word »significant«.

Furthermore, today, those who provide fundamental data are rarely those who duties are to interpret and to translate them in terms of law and industrial need and practice. Thus, those of us who are primarily concerned with the application of knowledge are bemused and beset with doubts as to the most profitable lines of attack on the problems of prevention of pneumoconiosis, and have insufficient time to think about priorities and methods.

Not only the nature of the disease but also the attributes of dust, that many–faced malefactor, did much to hamper progress. Dust is ubiquitous, a major curse to man and all his works, and much dust accompanies man in his activities. The ancients had a great deal of experience of dust, but concentrated their attention on poisonous dusts because their effects were spectacular and often, regrettably, irreversible. Such researches were fascinating, and were greatly extended, being profitable, if dangerous on occasion. In fact, it seems our mediaeval ancestors became far too familiar with them.

These were evidently then, the Lords of the Kingdom of Dusts, so why bother about the other dust which seemed to be everywhere and only caused passing inconvenience, if one breathed or swallowed much of it? – and so few people did bother.

Even today this seemingly innocuosness of the most dangerous pneumoconiosis–producing dusts and consequent disregard of its risk, is a serious adverse factor in the control of the disease.

Another factor which militated against evolution of knowledge, was the attitude to labour. Many of the ancient civilisations treated their prisoners, slaves and subjugated peoples, remarkably well on the whole in the light of their knowledge, and made laws to secure their welfare, some of which date back some 4000 years.

The reasons for this were not entirely altruistic, but rather because they were valuable property and also there was no knowing when the masters themselves would become slaves. But, with the break up of

these civilisations, the dark ages began and many a century passed before an altruistic spirit towards labour began to emerge again, later to be crystallised in laws. For long these laws were of an elementary general social welfare character, followed in England with the advent of the industrial revolution of particular laws to prevent the exploitation of the labour and children and women in specific industries. It was the controversies about these laws which focussed public attention on the hazards from accidents in the rapidly extending steam driven industries, and later to hazards from other causes, such as excessive dust.

Again, of the long standing risks, dust and disease of the lungs was one of the last to claim attention, partly because the great excess of deaths in certain expanded and concentrated dusty industries, such as the manufacture of pottery and cutlery, only became clearly demonstrable – after an inevitable lag period – from the data derived from compulsory registration of births and deaths which began in 1837. Thus came about in the last half of the nineteenth century (in 1864) the first requirements to suppress dust in factories in England because of its effects on the lungs. But, except for this proof of the mortality due to the disease which had been surmised for centuries, knowledge of its other characteristics was as vague and inconsequent as before.

Nevertheless, great developments were in the offing. In England a sense of responsibility for labour in industry had grown up and, although it was primarily directed to women and children, men had benefited also. This sense of responsibility had been induced and greatly stimulated, where necessary, for some fifty years (since 1832) through the enforcement of the law, coupled with advice, by the Government Factory Inspectors. Their approach to their duties was at first somewhat ad hoc: events (as accidents) happened which should not happen, therefore they must be prevented. Results of exposures to industrial risks might be reasonably evident, although the causes and how they operated might be obscure, but something had to be done.

This was very true of pneumoconiosis and the lessons we have learned are that while appreciation of the existence of an occupational risk is necessary to start off preventive measures, much can be done usefully while awaiting more precise information as to the cause, the way it works, and the best preventive measures. Also, that in these fast moving times preventive measures to be fully effective must be enforced by law. Moreover, such enforcement is a great stimulus to the adoption of higher standards of prevention, while its absence is a real hindrance to progress at all.

I said that great developments were in the offing in the latter decades of the last century. One of these at first sight would seem to have little bearing on progress in the control of occupational diseases. It was a development in an allied science – that of social jurisprudence – towards translating altruistic responsibility of employers into concrete financial liability, which, through successive enactments, was to have an increas-

ing influence on the control of occupational diseases for some years. This development was the Employers' Liability Act of 1880 which, by making the employer liable for certain industrial accidents, initiated workmens' compensation legislation in the United Kingdom, and in so doing, indirectly added a powerful stimulus to the prevention first of accidents and, later, of occupational poisonings and diseases.

People could not know then that they were entering upon a great new era of hope and achievement in the history of pneumoconiosis, and for this Medicine had had to await, as has often happened, advances in collateral or ancillary sciences and skills.

The two discoveries which acted as detonators in blowing away the accumulated stagnant confusion and ushered in the present dynamic period of progress were, of course, that of the tubercle bacillus in 1882 and that of the röntgen rays in 1895. They roughly separate the long dark ages when progress was negligible from the recent half–century during which achievements in the diagnosis, control and prevention of the disease, have been heartening.

The first, by identifying pulmonary tuberculosis as an infective disease made possible concentration on the study of pneumoconiosis as an entity.

It will be remembered that pulmonary tuberculosis is as old, or nearly as old, a disease as pneumoconiosis, and what is now appreciated as the synergistic action between certain dusts and the tubercle bacillus, was the cause of immemorial confusion of the two diseases clinically and etiologically. For long they had been lumped together as »phthisis« or »consumption« and the emphasis from early times was on the influence of a dusty occupation on tuberculosis rather than, as today, the influence of a tuberculous infection on pneumoconiosis. Incidentally, (since the two diseases grew up together), it is interesting, although hardly profitable, to speculate on the influence of this symbiosis on world history – would the tubercle bacillus ever have reached its high peak of virulence but for the influence of silica?

This discovery of the tubercle bacillus did much, therefore, to clarify thought and focus research. Also, without it (and radiography) the late development of measures designed to prevent the importation and spread of tuberculosis in dangerous dusty trades would have been impossible and this, in turn, helped to reduce the spread of tuberculosis generally.

Nevertheless, this fundamental accession to knowledge was very slow in getting about and in being applied and, although efforts were made to distinguish between »tuberculous phthisis« and »dust phthisis«, confusion between the two diseases persisted widely, especially since they so often occurred together in the same case.

In fact, it had the unfortunate effect of adding to the confusion by infusing new life into the old controversy as to whether pneumoconiosis was not merely a manifestation of tuberculosis, modified by exposure

to dust. Most experts now think this is nonsense and, although it was never of any practical importance, it was fiercely argued, and the idea still lingers on.

The other remarkable discovery – one which was to contribute so greatly to the diagnosis, control and prevention of the disease, and yet in so doing to introduce new problems and new difficulties, was that of the röntgen rays, which was launched on an astonished world in 1895.

No discovery has had such a magical appeal to layman and expert alike, few have been of such benefit to mankind and few have been so wastefully and dangerously misused.

Nevertheless, again it was some years before technical advances in radiography allowed of their serious use in the study and control of pneumoconiosis. In fact, some seventeen years were to elapse before radiography of the lungs and its interpretation was sufficiently advanced to permit of its being applied (in South Africa) on the grand scale for the survey of a pneumoconiosis–producing industry.

There is the danger in this feeling of relief at the present sunshine following the long night in the history of this disease lest we descend into another age of obscurity and futility. Today, data coruscate around us in glittering appeal, and theses and hypotheses are as numerous as the leaves in Vallambrosa. There is a risk that the clouds of ideas based on swarms of data may darken our perception of priorities and delay work in eliminating the disease, for that is the vital need.

The pursuit of knowledge is merely selfish enchantment of the mind unless it has also the aim of benefiting mankind – the repository of ethics and reason; and although there is evidence that in some areas and in some industries the severity of the disease has been ameliorated and the mortality lessened, there is no evidence that, and there are grave doubts whether, the world mortality has diminished.

Aristotle is quoted as having said »... The truth in practical matters is discerned from the facts of life; for these are the decisive factor. We must survey what we have already said, bringing it to the test of the facts of life ...«. It was, perhaps, neglect of this fundamental truth which brought the Greek Civilisation to its close.

While it would be impertinent as savouring of a denial of the freedom of research to set out, even if I could, priorities for research in this field, for who would be proved right in the outcome, it is essential I think, first, for everyone whether engaged on pure or applied work, to keep the goal of elimination of the disease constantly in mind, lest time be wasted and talent and money be diffused ineffectively in this great task; secondly, to exert himself to see that existing knowledge is applied to the utmost, and thirdly, to study the deficiencies in knowledge and practice and the extent to which they, and even the ill-disposed advocacy of expedients, are obstacles.

These are the priorities of approach which, if studied, will themselves indicate priorities of action.

The two discoveries I have mentioned enabled the identification and attachment of the disease as a risk in certain occupations to be done with a great deal more precision. Naturally enough, these occupations were those with the most obvious and the most serious of the surmised risks and naturelly, also, it soon became evident that in them the cause of the disease was free silica, and the intensity of the risk was dependent on the proportion of free silica in the dust and the amount of the dust.

In terms of numbers exposed, inevitability of the disease, shortness of life and liability to tuberculous infection, the occupations involving exposure to dusts with a high proportion of free silica, are still a long way the most hazardous and should still have first call on our resources. The point I am trying to make here is that »classical« silicosis from »straight« free silica is the oldest and best known, as well as the most serious of the manifestations of pneumoconiosis and is a yardstick to which all others may be related, but because of this and of the variety of occupations and industries affected, they tend to become neglected in the allocation of new effect, particularly in connection with research into preventive methods and their application in relation to the needs and limitations of industrial processes.

For example, some of these occupations (e. g. sandblasting with siliceous abrasives) employ very few people with correspondingly few deaths from silicosis. Because of this such occupations may hardly be noted in a general survey and dismissed as of low priority for attention. Nevertheless, these few deaths indicate an appalling mortality and the devastating impact of silicosis on such occupations has to be measured to be believed. The attraction of the completely new in research is often compelling, but the adage »off with the old love and on with the new« has no application here.

It seems, therefore, that if I am right in my suggestion that if we try to focus effort more on the application of existing knowledge and into research into the solution of the problems which hamper its application, rather than indulge too much in excursions into the ewigkeit (except as a relaxation) we would advance more quickly and easily to our goal, to the easement of our consciences and the saving of many more lives.

In looking backwards, we cannot help being astonished at the power of words in the history of mankind. Speeches and writings may inspire, sadden, devastate, insult, make us angry or merely confuse us, but the nature and extent of our reactions are really only products of our imaginations.

The magic of words is so great that everyone aspires to use it with varying, but sometimes remarkable, results, one way or another.

Now in the height of the confusion in the latter part of the last century, truth being elusive in the realm of pneumoconiosis, great men had time on their hands, but having reputations to maintain, they cast about and made sacrifices to the Goddess »Nomenclature«, escaped into

their imaginations, and made confusion more profound. The magic was there but so was the witchcraft, and the tendency remains today.

Moreower, this deity is vain and acquisitive, with the result that the terminology of pneumoconiosis is so confusing as to hamper the dissemination and application of knowledge.

Not all were guilty, however, in this respect, nor am I the first to utter warnings about the occupation of »word building and word making«. I must be acquitted, for in 1892 (the year I was born) that acute observer, Dr. J. T. Arlidge, wrote as follows:*

> »The ingenuity of some authors ... has enriched our Terminology by not a few words, Greek derivatives, certainly not very euphonious, intended to express the kind of dust which is productive of the lung mischief. The general term for the whole series of dust-produced lung diseases is pneumoconiosis. If coal or charcoal be the offending material, then the result is a pneumokoniosis anthracitica, or briefly, anthracosis. If metallic dust be the offending particle, then there is siderosis pulmonum, or pneumokoniosis siderotica. If stone dust set up the lung lesion, there is chalicosis, and if clay dust, aluminosis pulmonum.
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> This list does not exhaust the category of barbarisms, the fruit of fertile brains which seem to think a new word is the equivalent to the discovery of a new scientific fact.«

For this reason, even in the slight paper, I have been compelled to use the terms »pneumoconiosis« or »this disease« generically, for I have not defined what I understand by these and many other expressions.

The word »pneumokoniosis« was introduced by Zenker to denote *fibrosis* of the lungs due to the inhalation of dusts in various occupations. Now this was a good definition, particularly at that stage of knowledge, because the term »fibrosis« was definitive of the pathological lesion and the primary cause of death. Moreover, it was capable of being used generically, giving a clear picture as to what was meant and also of being subdivided to apply to specific causative occupations when they were under discussion, e. g. in knife grinders as »the pneumoconiosis of knife grinders«. With this definition it was not necessary to specify what dust or dusts were causative, provided the occupation caused fibrosis of the lungs. It was unfortunate, therefore, that the term »pneumoconiosis« as Zenker defined it did not catch on sufficiently rapidly and widely, so the vocabulary sprouted like a wild yeast and the resulting froth and fermentation was spectacular and harmful to orderly progress.

The word itself implies, of course, no pathology and no disability, and therefore without further definition is taken to mean merely any respiratory condition which may be ascribed to dust. Thus, it is applied

* J. T. Arlidge: »The Hygiene, Diseases and Mortality of Occupations«: 1892; page 258.

to anything from an abnormal x-ray picture as seen in welders, or silver finishers, or iron-oxide workers, due to diffraction of the rays by minute particles of metal dust which causes no symptoms, no disease, and no disability, to gross fibrosis of the lungs with extreme shortness of breath, compensatory emphysema, pneumothorax, bronchiectasis, and gross pleural, pericardial, and diaphragmatic adhesions and with death on the doorstep, as in advanced asbestosis. It may include cancer of the lung due to radioactive dusts, beryllium granulomatosis, and all the curious affections associated with workers handling grain, bagasse, mouldy cotton and hay.

Clearly, an expression which implies both trivialities and most serious diseases is of no practical use and is liable to mislead.

Let us consider further the expression »siderosis«, which Arlidge mentioned. It was coined first, I think, as a respectable name for »Grinders' Rot« – which, at least, told us something – to describe an interstitial fibrosis of the lungs then thought to be caused by fine metal particles: a quarter of a century later, some people used it as a name for silicosis in haematite miners, and now, after another quarter of a century, it is used to describe both the killing fibrosis of haematite miners and the harmless spotting of the lungs by fine metal particles, discernible only by radiography.

Then if, in desperation, we turn to the dictionaries, what do we find? Taking one at random, after stating the derivation of pneumokoniosis to be from the Greek, meaning lung plus dust, it goes on: »A lung condition due to the inhalation of minute particles. It is attended by fibroid induration and pigmentation. See aluminosis, anthracosis, asbestosis, byssinosis, chalicosis, ptilosis, siderosis, silicosis, and tabacosis.« As you will observe, some of these expressions are merely alternative appellations, some may not exist and a number are not necessarily attended by and are certainly not associated with fibroid induration of the lungs.

But, let us not give up: on turning to »ptilosis« we are told it is »A form of pneumokoniosis caused by inhaling the dust from ostrich feathers«. What this definition really means, only the bird knows. I will not weary you further except to remind you that compound names are used, as for instance, silico-anthracosis, and I have seen several cases with both silicosis and asbestosis, to which, fortunately. as yet no special name has been applied.

These coined words ending in »-osis« implying a disease of the lungs, have achieved (and not without reason) as malignant a connotation amongst workers in dusty occupations as »consumption«, »cancer« or the expression »malignant disease« itself, amongst the general population, and should never be used lightly or as a label for pulmonary abnormalities (usually only discovered radiographically) which cause no disability and never will cause disability, simply because of some slight points of similarity with true pneumoconiosis. It is not widely

enough appreciated that the higher the atomic weight of an insoluble dust inhaled, the more likely will the radiograph indicate some departure from the range of normality, irrespective of whether the dust has a specific effect on the lungs or not, or whether there is contemporaneous or previous exposure to another dust which has such a specific effect. This is particularly the case with metal dusts, exposure to which may be of no consequence.

Thus is confusion made worse confounded: no wonder we mislead and are misled, and when the experts collide in the fog the courts of law flee to the dictionaries – and what a paradise for our friends the lawyers. We simple-minded and, of necessity, practically disposed persons, must really avoid being hypnotised by the theoreticians and shackled by the lexicographers, and tidy up this nomenclature.

Thus, in the period of confusion, a variety of names implying distinct diseases and related to the alleged causative dusts, were coined. Some have gone out of use, others have changed their meaning: others have more than one meaning, and attempts have been made since to introduce additional varietal names.

It is most desirable, therefore, that the exceedingly loose and irresponsible use of the word »pneumoconiosis« so often encountered today – which causes despondency in workers labelled unnecessarily as suffering from a deadly disease and also many other difficulties and waste of effort – should be firmly discouraged.

The risk of perpetuating confusion, and even increasing it, was appreciated by the Third International Conference on Pneumoconiosis of the International Labour Organisation in Australia in 1950, the definition of pneumoconiosis being an item on the Agenda. It will be remembered that the subject of the first of these Conferences in 1930 was Silicosis – described there as a fibrosis of the lungs – which showed its preference for Zenker's approach.

After considerable discussion, the 1950 Conference adopted the following Resolution:

> »While in a wide sense the term »pneumoconiosis« connoted any condition of the lungs resulting from the inhalation of dust that might or might not be of clinical significance, for the purpose of the International Labour Organisation the Conference accepted the following definition:
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> > Pneumoconiosis is a diagnosable disease of the lungs produced by the inhalation of dust, the term »dust« being understood to refer to particulate matter in the solid phase, but excluding living organisms.
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> Moreover, the Conference deprecated the further extension of terms, beyond those already in common use, and suggested that for the future the terminology of pneumoconiosis should take the form of naming the dust to which the worker is exposed, or alternatively the industry or process concerned.«

Previously, as I have indicated, the International Labour Organisation had adhered to definitions based on fibrosis of the lungs, and the substitution in 1950 of fibrosis by »diagnosable disease of the lungs« in the new definition (of pneumoconiosis), and further, the insertion of a definition of dust, is noteworthy.

The definition was thus expanded specifically so as to include diseases which are demonstrably caused by dust but are not fibrosis of the lung, and to exclude infections of the lungs in the production of which inhaled dust has no part, unless as a carrier of the infection as, for example, in pulmonary anthrax.

This definition is a considerable advance in consonance with modern thought, and should be accepted generally. It is wide enough and specific enough for international purposes – which was the aim of the Conference in drafting it – and also for general use, since it concentrates attention on diagnosable diseases caused by the inhalation of dust, excludes trivialities and fancies and symptoms unless based on an identifiable pathological state. Moreover, the recommendation on terminology associated with the definition should (we hope) dispose of any extension of the »word-building game« referred to above.

So much for a definition of pneumoconiosis for international and general purposes but, as is evident from the Resolution, it is contemplated that sub–definitions will be required operationally.

At the present time, as has been mentioned, the word »pneumoconiosis« is interpreted more or less widely and less or more specifically in relation to the circumstances or the purposes for which the word is being used and it is clear that this practice must continue.

But it seems essential that when the word »pneumoconiosis« is used generally it should be used with the meaning set out in the International Labour Organisation definition, and if it is necessary to particularise further, then the addition of limiting words identifying the occupation or the dust concerned as is suggested in the International Labour Organisation Resolution, or with reference to the particular purpose for which it is being used. Thus, »pneumoconiosis of coal miners« or »Talc pneumoconiosis« or pneumoconiosis meaning disease of the lungs due to dust as defined in the legislation of a particular country or state as attracting Workmen's Compensation.

The operational use of the latter word is, of course, most important and must be retained. The meaning to be attached to it may be wider or more restricted than the International Labour Organisation definition.

Some countries and states, for example, have the widest possible general prescription of injuries, disease and poisoning claimed to be occupational: others prefer general prescription particularising the disease and poisonings to be covered, and yet others, compensation for accidents arising out of and in the course of employment with pre-

scription of particular diseases and poisonings in relation to particular occupations, adding to the list as necessary in the light of new knowledge.

It is not the place here to consider the merits of different methods of applying compensation, but rather to illustrate different meanings of the word »pneumoconiosis«.

In any case, it would be a somewhat academic exercise to try to do so, since the choice of method by a particular country must so much depend on its needs, resources, environmental conditions and its particular kind of administrative techniques.

In England, our method of attaching compensation (or Industrial Injuries Benefit, as we call it) is a variety of the last type given above, and this leads necessarily to a definition of »pneumoconiosis«.

This by law is defined as:

> »Fibrosis of the lungs due to silica dust, asbestos dust, or other dust, and includes the condition of the lungs known as dust reticulation.«

It will be seen that this definition falls within the International Labour Organisation definition, but is limited in comparison with the latter. Other provision is made, however, to compensate for »diagnosable disease of the lungs produced by the inhalation of dust« which is not covered by the above definition, such as byssinosis or beryllium granulomatosis.

I have spoken about some of the difficulties which for so long impeded and almost halted progress in the study and control of pneumoconiosis; of the bursting of the shackles on progress as the result of certain discoveries just over half a century ago, and of the gradual emergence of a consciousness of social responsibility for pneumoconiosis expressing itself in national and international concern and consequential legislation.

The latter factor, that is the public conscience expressed in law in many ways, has now become the most powerful influence not only in the control of the disease but also in stimulating research and ensuring the backing for it.

Thus, in the United Kingdom the Government not only enforces laws designed to ensure safe working conditions but has powers to secure the closure of dangerous places of work and has wide powers of prohibiting, limiting or controlling the use of any material or process in the interests of occupational health. The law embraces also comprehensive measures for initial and periodical medical examination of workers exposed to risk of the disease, the medical treatment, rehabilitation, retraining for placement in other work, and compensation of those suffering from the disease. Places in special factories are also available for them. Moreover, the Government provides money for cognate research and industry is not backward in this direction.

The combined effects of public conscience, opportunity and sanctions for backsliders, has a reciprocal beneficial action in bringing to light deficiencies in preventive measures themselves or in their application to particular industrial processes.

These may be found to be due to defects in the Science and Art of Management or that safeguards cannot be developed or fully applied because essential scientific, engineering or medical data are non-existent – which point urgently to further applied research.

Industry to live must exist and in this connection, as well as in relation to the control of an occupational disease, I would emphasise that the usefulness and efficacy of a theoretically sound preventive measure varies directly with its suitability for an industrial process, its ease of application thereto, and of its enforcement. The milieu of industry provides the acid test here – in industry are to be found the »facts of life from which Truth is discerned« in Aristotle's phrase. The moral is obvious – closer study by those concerned of industrial processes from this aspect whether they are engaged in industrial research, occupational health research, or in devising and applying appropriate preventive measures. The economics of industry are intertwined nowadays in all these activities, and the more those engaged in them get together the better.

With lessons from the past and hopes for the future in our minds, we may well pause to consider where we are today and how best to go forward.

We have seen how that by the turn of the last century Law and Order in the control of pneumoconiosis had emerged, as the result of great medical and scientific discoveries and the growth of social responsibility.

This stimulated a period of intense activity during the first quarter of this century directed to applying the new knowledge towards the prevention of the disease in the main fibrosis-producing industries, and to devising new and better ways of doing so. To this, physics, chemistry, and engineering as well as medicine and the law, all contributed, and much new knowledge was gained.

Further knowledge about dust clouds, their evolution, composition, behaviour and control in industrial processes was evidently essential, and its pursuit received a great stimulus. Research, both pure and applied, laid foundations for exact study and produced ingenious technical devices of great value during this period.

Advances in morbid anatomy and experimental pathology, in radiological technique and interpretation, also contributed basic data essential for occupational health surveys of the modern kind, and the net result in this first quarter of this century in some countries where the risks of pneumoconiosis were urgent and considerable, was special legislation directed to preventing the disease arising out of work in the known risky processes surveyed, and to providing for compensation for those

disabled by »fibroid phthisis or silicosis of the lungs or from that disease accompanied by tuberculosis«, as the disease was then described.

Remarkable progress was achieved therefore in this period, towards effective control of the disease because of the great advances in knowledge in many fields and their specific application to this problem as studied in industrial processes. Of these influences, the advances in the science of ventilating engineering and particularly in the application of localised exhaust ventilation to dusty processes, were to have salutary and enduring effects.

Effects were, of course, neither immediately nor easily demonstrable, because of the nature of the disease. During the last 25 years, however, it has become increasingly evident that the measures introduced in the first quarter of this century and extended and improved since, have materially lessened the impact of the disease in the older causative processes.

Evidence of this rests mainly on the non-occurrence nowadays of so-called »acute« cases so common in those processes 50 years ago, and the slow but steady increase during the last 25 years in the mean length of employment in the processes of those who ultimately die of the disease. Statistical proof is slow in emerging, since for this not only is accuracy of diagnosis essential – which, as we have seen, was late in evolution – but also to obtain reasonably exact data auxiliary machinery for nothing, investigating, analysing and recording cases had to be devised.

So was ushered in the second quarter of the present century with such great promise. Observers taking stock then might well be pardoned for thinking that the demon dust as a cause of occupational pulmonary disease had been exorcised. They had much reason for thinking that full control and even the virtual extinction of the disease – meaning by that suppression of the disease by the application of known preventive measures to the extent that it would cause neither disablement during an average working life-time nor any shortening of the expectation of life – was merely a matter of time.

But this was not so, since the very success obtained by concentrating on the disease and its cause, free silica, as encountered in certain industries where the risk was most serious, engendered a curious limitation in appraisal of the disease and its causation and in the outlook concerning pneumoconiosis generally.

In fact, what had happened was that the disease which had been evaluated and attacked with such vigour was only the particular type of pneumoconiosis encountered where the dust was wholly or substantially free silica – in other words, basically »classical« silicosis.

Moreover, the recognition in an occupation of this type of disease with its nodular fibrosis, distinguishable radiographically and clearly related in incidence and severity to the proportion of free silica in the dust encountered therein, had proved to be a navigational aid of the

greatest value: also, pulmonary disease with these features and easily determinable to be occupational in origin, did not seem to occur in other dusty trades.

How attractive, therefore, to separate off the dusty occupations with substantial exposure to free silica dust together with evidence of accompanying fibrosis of the lungs from the others, regarding the latter as of little importance.

How easy, then, to go a step further and evolve the general proposition that only dusts containing free silica were inherently dangerous to life as causing the only true pneumoconiosis, this being a diffuse nodular fibrosis of the lungs.

This proposition circumscribed for a time the general outlook on the disease in respect both of its manifestations and of their causation, and obscured the importance of some observations made a number of years earlier as, for example, on the injuriousness of asbestos dust.

It was the coming of knowledge about asbestosis about 25 years ago which completely upset the proposition that only free silica dusts were inherently dangerous; for here was a class of silicate minerals, shown to be at least as dangerous to the individual as free silica and probably more so, and which also caused a diffuse fibrosis of the lungs but which is not nodular and is quite different from that of silicosis.

Obviously, the field of study was thrown wide open again. It was no longer possible to dismiss those dusty trades where the dusts contained no free silica, or only minimal amounts, as solely engineering problems – although admittedly sometimes of the greatest difficulty – of suppressing dust from »insulting« (to use Leroy Gardiner's illuminating expression) concentrations to a reasonable level which the lungs could scavenge quickly and without permanent harm, since the dust had no specific action on living cells.

Asbestosis is a fibrous silicate – what about other fibrous silicates like sillimanite? what about the plate silicates like mica? what about other mineral dusts? what about dusts in mixture and with possible inhibiting (as Haldane had suggested years previously) or accelerating effects?

Asbestosis is also far more difficult to diagnose and to assess in degree radiographically than silicosis, because the fibrosis is so fine and so diffuse that the picture does not give the impression of serious disease to the extent that radiographs of silicosis do, and in its earlier stages may easily be regarded as within normal limits: differences in x-ray technique confuse the issues more than in silicosis, as also the supervention of tuberculosis.

Radiologists as well as pathologists have, therefore, much to discover about mineral dusts in the lungs.

Silicosis and pulmonary tuberculosis are well known to have an affinity for each other: recent figures of ours show that out of 2407 deaths from silicosis, pulmonary tuberculosis was a complicating factor

in 1169 or 48.6%. Similarly with deaths from asbestosis, out of 277 deaths, 80 or 28.9% were complicated with pulmonary tuberculosis, a lesser proportion but it may well be significant for human beings. Such an increased susceptibility to tuberculosis has not been shown experimentally in animals, but it does not follow that is not the case in man.

The association between inhalation of dusts and pulmonary tuberculosis is still far from clear.

The seeming increase in cancer of the lungs in recent times causes concern: how far this is real or a reflection of better methods of diagnosis and of a greater proportion of the population living into the cancer-occurring age groups, is a matter of much interest and debate. That carcinogenic agents are present in the atmosphere of great towns and industrialised areas is well known – but what about the possible influence of inhaled mineral dusts.

With regard to silica, analysis of our figures show that of 6884 cases of silicosis at post-mortem, 91 (or 1.32%) had cancer of the lungs or pleura.

Similarly with cases of asbestosis, of 296 deaths, 48 (or 16.2%) were found at post-mortem to be complicated with cancer of the lungs.

Our silicosis figures do not indicate, I suggest, any relationship between silicosis and cancer of the lungs, and in this we are fortified by the South African experience.

But what about the asbestosis data?

Unfortunately, I know of no other figures with which to compare ours. The small numbers certainly dictate caution: nevertheless, they represent the great majority of the deaths from asbestosis which have occurred in the United Kingdom during the past quarter of a century. Nowadays, in my country it is likely that very few deaths from asbestosis escape notice. This is because of the greatly increased awareness of workers, doctors and others in the neighbourhood of asbestos plants, of the disease; of the duty of coroners to investigate with autopsy and to report ot my Department deaths suspected to be due to occupational disease; because of the compensation benefits accruing to cases of pneumoconiosis, our system of factory inspection and our periodical check-up of death certificates with investigation from the occupational angle of deaths from fibrosis of the lungs.

This high proportion of deaths with a complicating primary cancer of the lungs does point at any rate to the necessity for the collection of similar data from other communities with a risk of asbestosis. so that by statistical examination of the global figures so obtained, we can settle the question whether cancer of the lungs is an additional risk of exposure to asbestos dust.

In this connection, there are indications from our records that our preventive regulations which came into full operation in 1932, are

having an effect, and this may be an explanation of why the incidence of complicating cancer of the lung in fatal cases of asbestosis appears to be rising.

Today we do not encounter cases with extreme fibrosis and gross bronchiectasis and even anasarca and a nutmeg liver, with death (uncomplicated with tuberculosis or cancer of the lung) at an early age within 5 to 7 years from the commencement of exposure to asbestos dust. The duration of exposure which results in death from asbestosis has lengthened, the age at death has increased and the degree of fibrosis found at autopsy has lessened.

That means that more cases of asbestosis are living to the cancer–occuring age period and *if*, and I say *if*, there is a relationship between asbestosis and cancer of the lung and *if* let us surmise, irritation from the asbestos fibre is a co–carcinogen with a long lag period – then we would expect an increased incidence of cancer of the lung over that found in the general population to become evident.

Regarding these complicating cancer cases which I have mentioned, the mean age at death was 53.4 years and the range 32 to 77 years: the mean duration of exposure was 19 years and the range 2 to 42 years.

What is the etiological factor, if any, here?

Physical irritation as a direct carcinogenic agent is rather discounted, I understand, by the cancer experts, but I recollect that Dr. Oppenheimer in the United States has recently done experimental work with cellophane wrapped round the kidney which may be a pointer.

In the foregoing pages I have dipped into the long and confused history of pneumoconiosis hoping to glean something from the past to guide us in the future. We have glanced at certain factors which seem to have greatly hampered or aided progress in knowledge and control of the disease, and in so doing have touched upon their influence on earlier workers in this field. From this it appears that the quality of human thought and the generality of type of human reactions to these problems have been much the same throughout the ages, and progress has been the result more of accident than desing and of intense application than of genius. One would like to think that the ratio of achievement to failure has improved in this generation, but evidence is lacking, although there is, of course, vastly greater activity in this field.

I must confess I shared the optimistic outlook of 25 years ago that we had broken the back of the problem because of the great achievements of our predecessors, but I am afraid that is not so and we are still a long way from securing satisfactory control of pneumoconiosis.

The increase in knowledge about pneumoconiosis and its causation and in its effective application in preventive measures has been most striking, but this has been paralleled by similar advances in industrial research which have brought many new problems and intensified old risks from the introduction of new, highly efficient, but most dusty, production methods.

New diseases, some not strictly within the present definitions of pneumoconiosis, like Shaver's disease and berylliosis, have appeared and with cancer of the lung associated with exposure to dusts, mists and fumes, have complicated the position.

We see then that we are in an era when knowledge still escapes us and the battle must go on.

It seems that benefiting from the lessons of history it behoves us to modify our approach to the problem of control, and concentrate much more on investigation and research on the applied non–medical aspects which are predominantly engineering, physical and chemical, and include the planning of a chemical engineering character specifically orientated to the prevention of the disease. In addition, industrial research should give prior attention to the discovery of substitutes of a non–injurious or less harmful character in hazardous processes where control of the dust and the associated risk is very difficult. Sandblasting with siliceous abrasives, as also grinding on sandstone, are good examples of the latter type of risk and process, for which siliceous material entirely adequate substitutes are available.

In thanking you most sincerely, I would finish by reminding you that St. Paul, that most practical and courageous warrior, said –

»Let us not weary in well doing, for in due season we shall reap, if we faint not.«

Ministry of Labour and National Service,
London

SADRŽAJ

POGLED NA PROBLEM PNEUMOKONIOZA

Prikazan je problem i historijski razvoj pneumokonioza. Medicina je dugo čekala na neka otkrića, koja su bila potrebna, da se razjasni pitanje nastanka pneumokonioza. Jedno od tih je otkriće bacila tuberkuloze. Pneumokonioze predstavljaju teški ekonomski problem. Godine 1951. umrlo je u Engleskoj oko 1.300 radnika oboljelih od pneumokonioza. Iste je godine u prometnim nesrećama nastradalo 5.250 ljudi, a od tuberkuloze je umrla 11.631 osoba. Kad se te brojke usporede s brojem pučanstva, koje je izvrgnuto opasnosti od pneumokonioza, nesreća u prometu i tuberkulozi, onda dobivamo mnogo teže rezultate, iz kojih se vidi, da su pneumokonioze naročito opasna i teška bolest. Tuberkuloza nije jedina bolest, koja prati pneumokonioze. Od 300 radnika umrlih od azbestoze bolovalo je 16% od primarnog karcinoma pluća. Istovremeno je od 6.000 umrlih od silikoze bolovalo od primarnog karcinoma pluća 1,3%. To je zanimljiva pojava, koju treba dalje pažljivo pratiti. U budućnosti treba što veću pažnju obratiti na prevenciju silikoze i ostalih pneumokonioza. Vjerojatno je, da će se u budućih 25 godina problem pneumokonioza u Engleskoj potpuno riješiti.

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