ABSTRACTS

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ENVIRONMENT


For statistical purposes in this country, accidents in coal mines fall into three classes, generally known as "fatal accidents", "serious non-fatal accidents", and "plus three-day accidents". A fatal accident is one where the person is killed instantaneously or who dies of its effects within one year of having sustained the accident. Serious, non-fatal accidents comprise not only accidents causing fracture of the hand or of any limb or any dislocation of any limb or any other serious personal injury, but also accidents resulting in any personal injury, however slight, which are caused by certain specified happenings such as explosions, shot-firing, electricity, or overwinding of cages. Very often persons are only slightly injured from these causes, and thus it happens that the recorded figures each year for the number of serious, non-fatal accidents comprise an appreciable number in which the injuries are very minor or trivial. Fatal and serious non-fatal accidents must be reported forthwith to the Inspector of Mines. The "plus three-day accidents" comprise all accidents not reported in the two other categories but which disable a person for more than three days. These accidents are reported annually to the Inspector.

Fatal and Serious Non-fatal Accidents

Over the years 1850 to 1930, the average annual death roll remained about, or a little above, 1,000. During the whole of this time the man-power employed was increasing—from about a quarter of a million in 1850 to rather over one million in 1930, so that the death rate fell from about four per 1,000 persons employed in 1850 to just over one per 1,000 in 1930. Since 1940 there has been a more or less continual fall in fatal accidents to 468 in 1948, 460 in 1949 (the lowest figure ever recorded) and 493 in 1950 (despite a disastrous fire at Creswell in Derbyshire involving 80 deaths, and an inrush of liquid peat or moss at Knockshinnoch in Ayrshire involving 13 deaths). The rate per 1,000 persons employed in 1950 was about 0.7. A more significant rate than the number of fatalities per 1,000 persons employed is probably the number per 100,000 man-shifts worked. This rate is only available since 1922. Between that year and 1940, it remained around or above 0.45; in 1941 and 1942 there was a rise to 0.43 and 0.46, respectively; and this was followed by a more or less steady and continuous decline to a record low figure of 0.25 in 1948 and 1949, the 1950 figure being 0.27.

Serious non-fatal accidents have declined steadily since figures were first collected in 1900. The fall in the serious injury rate in the past 50 years was from about 5.5 per 1,000 persons employed in 1900 to just under 3.0 in 1950. On a man-shift basis there were about 165 serious injuries per 100,000 man-shifts worked between 1920 and 1930, while by 1950 this rate had fallen to 1.13.

The "Plus Three-day" Accidents

Most of these accidents are comparatively minor cuts, bruises, abrasions, or similar injuries. Unlike the fatal and serious non-fatal accidents the total number has not decreased in recent years. Indeed, they have increased, and during the year 1950 amounted to as much as one for every three persons employed in the industry. An analysis of these accidents, however, suggests that their number is also influenced by factors other than the general safety conditions of the mine, such as changes in workmen's compensation and industrial injury benefits, the effect of a high rate of income tax and its variation with earnings under the British "Pay-as-you-Earn" system under which a worker can recover over-payments during a period of absence from work, the encouragement given to miners in recent years to report and have all injuries properly treated, however trivial, and to the general trend of social legislation. It is difficult to assess the weight of these extraneous factors but the general view is that the incidence of fatal and serious accidents gives a far more reliable measure of the safety conditions of a mine than the incidence of minor accidents.

Table 1

<table>
<thead>
<tr>
<th>Relation of number of persons employed in mines to number of persons disabled for more than three days</th>
</tr>
</thead>
<tbody>
<tr>
<td>1946</td>
</tr>
<tr>
<td>Persons employed</td>
</tr>
<tr>
<td>Persons disabled for more than three days</td>
</tr>
</tbody>
</table>

* Based on a paper communicated to the British Association, August, 1951.
Table 1 shows the position in respect of the number of persons employed in mines under the Coal Mines Act, 1911, and the number of persons disabled for more than three days for the years 1946–1950 inclusive.

New Lines of Attack

Up to the present time, the attack upon the accident problem in coal mines has been mainly by way of statutory regulation and inspection, assisted by scientific research into specific mining dangers and a raising of the standards of education and training of mining personnel; and, more directly, by improvements in the standards of housing, welfare, and recreational facilities for the mining community as a whole. That these lines of attack have achieved a considerable measure of success over the years is shown by the progressive reduction in the accident rates for fatal and serious non-fatal accidents. But there is still much to be done along these well-established lines and this attack must undoubtedly continue by way of further regulations as new mining methods, machines, safety devices, and practices are proved; by way of higher standards of education and training for mine managers, officials, and workmen; by increased scientific research into mining dangers; by the general adoption of higher standards of engineering practice; and by the expansion of social and welfare activities in all mining communities.

But if the rate of progress in accident reduction is to be accelerated, as (to put the matter on the lowest level) it must be in view of the present serious man-power and production position, then not only must the attacking forces along existing lines be reinforced, but new forces must also be brought to bear on a still broader front or, perhaps, on quite new fronts.

A preliminary study of absenteeism and of the accident rate in one large mining area made it appear that accident rates and absenteeism were related to one another, and that each in turn was related to the size of the pits in which the men, absent or injured, were working. These possible relationships were then traced on a national scale with practically the same result. The trend of absenteeism with size of pit can be seen from the Ministry of Fuel and Power Digest, 1944; there is a highly significant correlation between the average size of the pits in the 25 wages districts and the total absenteeism in those districts.

The trend of the accident rate with increasing size of pit is shown in Table 2 which analyses the distribution of all accidents (fatal, serious non-fatal, and “plus three-day”) in 1948 between 10 size ranges of pits.

The trend of rising total rate with increasing size of pit, averaged over the broad size ranges here used, is evident. The reasons for this need further investigation. At first sight it might seem that it was due to the more difficult geological conditions of the bigger pits which are normally deeper and work thicker seams. But while the accident rate from falls of roof or side at the working face almost doubles from the smallest pits to those employing between 250 and 499 men, from then on it remains practically constant. As the pits employing 500 men or more account for seven-eighths of the total man-power, it is a safe rule to say that while the total accident rate increases steadily with the size of pit, the face accident rate from “falls of ground” remains nearly constant. Thus it is likely that factors other than geological conditions are responsible for this rise.

The South Western Division, which includes the South Wales coalfield, has the highest accident rate in the country. This is shown graphically in Fig. 1, which also shows the national trend of all accidents and of face accidents from “falls of ground.” It is desirable to inquire why the South Western Division, although showing the same trend of accident rate with size of pit is, in absolute terms, so much above the national average.

Here again difficult geological conditions may seem, with perhaps greater justification than elsewhere, to provide the complete answer. But difficult though the geological conditions are, South Wales differs from all other Divisions in one significant respect: it has by far the highest recorded incidence of pneumoconiosis. It is relevant to ask whether this is likely to affect the general accident rate. This it might do in two ways: it might make the men less alert through psychological causes or it might have psychological effects. The fear of contracting the complaint may subconsciously increase the proneness of men to accident and injury. If an accident is partly an expression of a subconscious desire to get out of an unacceptable situation, it is natural to expect the accident rate to be higher in the pits with the larger incidence of the disease.

To test whether pneumoconiosis may be in part responsible for the higher accident rate, the returns for pits of the South Western Division for 1948 were again examined and the pits classified according to the incidence

Table 2

<table>
<thead>
<tr>
<th>No. of Miners on Books</th>
<th>No. of Pits</th>
<th>No. of Man-shifts (Thousands)</th>
<th>Total Accidents</th>
<th>Face Accidents from Falls of Roof or Side</th>
<th>Face Rate</th>
<th>Total Rate</th>
</tr>
</thead>
<tbody>
<tr>
<td>Less than 100</td>
<td>354</td>
<td>1,618</td>
<td>1,228</td>
<td>262</td>
<td>16.2</td>
<td>75.9</td>
</tr>
<tr>
<td>100–249</td>
<td>82</td>
<td>3,692</td>
<td>3,818</td>
<td>726</td>
<td>19.7</td>
<td>103.5</td>
</tr>
<tr>
<td>250–499</td>
<td>124</td>
<td>11,701</td>
<td>15,096</td>
<td>3,335</td>
<td>28.9</td>
<td>129.0</td>
</tr>
<tr>
<td>500–749</td>
<td>102</td>
<td>16,088</td>
<td>21,495</td>
<td>5,344</td>
<td>33.2</td>
<td>133.5</td>
</tr>
<tr>
<td>750–999</td>
<td>112</td>
<td>23,955</td>
<td>32,295</td>
<td>7,287</td>
<td>30.4</td>
<td>134.6</td>
</tr>
<tr>
<td>1,000–1,499</td>
<td>94</td>
<td>32,370</td>
<td>44,719</td>
<td>10,401</td>
<td>32.1</td>
<td>138.2</td>
</tr>
<tr>
<td>1,500–1,999</td>
<td>50</td>
<td>21,246</td>
<td>31,355</td>
<td>6,608</td>
<td>31.6</td>
<td>147.6</td>
</tr>
<tr>
<td>2,000–2,499</td>
<td>14</td>
<td>8,756</td>
<td>14,343</td>
<td>3,140</td>
<td>35.9</td>
<td>162.5</td>
</tr>
<tr>
<td>2,500–2,999</td>
<td>13</td>
<td>8,693</td>
<td>14,170</td>
<td>2,815</td>
<td>32.4</td>
<td>163.0</td>
</tr>
<tr>
<td>3,000 and above</td>
<td>4</td>
<td>3,528</td>
<td>5,882</td>
<td>1,188</td>
<td>33.7</td>
<td>166.6</td>
</tr>
</tbody>
</table>
The North Western Division, which comprises the coal fields of Lancashire and North Wales, is, as a mining proposition, not an attractive one; it is old, large parts are exhausted, and geological and working conditions, even in the best parts of Lancashire, are somewhat difficult and uncomfortable. Yet in 1949 and 1950 the average accident rate was the lowest in the country. It may be that this is partly explained by the relatively high percentage of men in the Division who have passed through statutory training schemes of some kind, either on first entering the industry, or upon upgrading for work at the face. The percentage of men trained in this Division since the training regulations were introduced in 1947 is the highest in the country. Further research seems to be needed to find out whether it is the trained men who are themselves keeping free of accidents, whether their influence makes the other miners more safety-conscious, or whether the department responsible for training is able also to affect for good to a greater extent than in other divisions the safety measures taken in the pits.

Lancashire and North Wales did not always rank first for safety. Among the 25 "wages districts" into which the industry was divided before Vesting Day, the rankings of Lancashire were sixteenth and eighth for underground and surface accidents, respectively, in 1923; and fourteenth and seventh, in 1937.

From the figures quoted it does appear that under existing conditions men are more likely to suffer injury in the larger pits. But a more detailed analysis is called for in order to separate from the "size-factor" the other influences, such as training and safety organization, and the extent of personal supervision by the higher management, on the one hand, and physiological and psychological factors, such as lack of alertness or fear of industrial disease, on the other. Such an analysis would reveal more than the accident patterns themselves. It calls for a study of all the facts of recorded accidents at the pits and places where they occurred, as well as a ready reference to all available statistics, by a special team of trained investigators.

In the meantime, it is interesting to speculate in advance upon the fact that while the accident rate from "falls of ground" at the face seems virtually independent of seam conditions, the total accident rate increases with the size of the pit. This at once suggests that the workers outbye from the coal face grow more prone to accident as the community, into whose achievements their own efforts fit, increases in size. The face worker is—at least in theory—an individual contract; the outbye worker serves the whole pit. The interest, or attentiveness, of the face worker would appear to be something fixed and independent of how many other men work in the pit, while that of the outbye worker would appear to fall off as he feels more and more that he is only one man amid the impersonal multitude. Hence the interest or the attentiveness of the worker is less in the larger pits and his liability to accident increases. Such a hypothesis needs to be checked against other factors that seem to influence accidents. It would appear, for example, that the liability of the haulage

TABLE 3
ACCIDENT RATES IN RELATION TO INCIDENCE OF PNEUMOCONIOSIS (SOUTH WESTERN DIVISION)

<table>
<thead>
<tr>
<th>Incidence of Pneumoconiosis (per 1,000 persons employed)</th>
<th>No. of Pits</th>
<th>No. of Miners</th>
<th>No. of Accidents (All Kinds)</th>
<th>Rate per 1,000 Persons Employed</th>
</tr>
</thead>
<tbody>
<tr>
<td>Less than 100</td>
<td>77</td>
<td>43,577</td>
<td>9,188</td>
<td>211</td>
</tr>
<tr>
<td>100-200</td>
<td>48</td>
<td>32,494</td>
<td>7,966</td>
<td>245</td>
</tr>
<tr>
<td>Above 200</td>
<td>59</td>
<td>41,223</td>
<td>12,113</td>
<td>294</td>
</tr>
<tr>
<td>Division</td>
<td>184</td>
<td>117,294</td>
<td>29,267</td>
<td>247</td>
</tr>
</tbody>
</table>

A simple statistical test shows that the difference between the accident rates at the three classes of pits is highly significant. But more comprehensive data are needed before it is possible to analyse the relative effects of size, on the one hand, and pneumoconiosis, on the other. And it is essential to know, in the pits with the high pneumoconiosis rates, to what extent the men who were subsequently certified contributed to the higher rates. These are all questions for further research, and the analysis, such as it is, does not pretend to show whether the higher rate is due to psychological or physiological causes, or how far factors under the control of the management, such as poor ventilation, aggravate both the accident and pneumoconiosis rate together. But the figures do suggest that if the division were altogether free of the disease (or of the factors that cause the disease), the two curves of Fig. 1 for the South Western Division would be closer to the national curves than they now are.
worker to injury increases as the number of such workers to the mile decreases. In other words, the greater the haulage worker's length of roadway, the greater the risk of injury that he runs. This suggests that as contact between haulage workers becomes more remote, the accident rate goes up. It may be that remote contact increases the errors of signalling, or that it breaks up the working group and hence diminishes interest.

The value of research into observable features of human behaviour, such as the accident rate and its relation to the size of the groups or communities in which men work, may, in the final result, lie in the light it sheds upon the structure of authority in the pit, and the extent to which the men feel themselves to be part of the organization in which they are employed. Whatever the public may think about miners and whatever may be attempted in the way of reconstructing the industry, coal will always be got by small groups of men working in comparative isolation and under remote supervision. The need to understand the extent to which each man feels he is a member of the group, and the extent to which the groups identify themselves with the pit as a whole, is one of the most urgent investigations that confronts the industry today. The recorded facts alone can suggest how the need should be met.

INDUSTRIAL LUNG DISEASES


The investigations described were made in a soot factory in the Rhineland where two types of soot are made, "flame-black" from anthracene residues, and "gas-black" by burning vapourized anthracene oil mixed with an illuminating gas. Neither contained silicic acid but both were of a particle size which enabled large quantities of the dust to enter the lung.

Three hundred and thirty-four soot workers and other employees were examined by miniature mass radiography, and where possible those with suspected or definite abnormalities were further examined with full-size films. The results from the miniature films were as follows:

<table>
<thead>
<tr>
<th>Result</th>
<th>Group I: 180 Soot Workers</th>
<th>Group II: 154 Other Employees</th>
</tr>
</thead>
<tbody>
<tr>
<td>No pathological changes</td>
<td>94</td>
<td>118</td>
</tr>
<tr>
<td>Probably inactive T.B. foci</td>
<td>2</td>
<td>14</td>
</tr>
<tr>
<td>Doubtfully active T.B. foci</td>
<td>2</td>
<td>5</td>
</tr>
<tr>
<td>Doubtful or definite pneumoconiosis</td>
<td>67</td>
<td>5</td>
</tr>
<tr>
<td>Poor technique—no diagnosis</td>
<td>10</td>
<td>12</td>
</tr>
<tr>
<td></td>
<td>180</td>
<td>154</td>
</tr>
</tbody>
</table>

The differences between the two groups were evident. In those working in soot the proportion of normal films was much lower than in the other workers, while the number of doubtful or definite abnormalities was very much higher. Only 54 of the 77 soot workers who should have been re-examined and four others who had not been previously radiographed were examined with full-size films; the results were as follows:

At least 28 out of the 184 soot workers, i.e., more than 15%, had changes in the lungs, and of the 44 workmen who had been employed over 10 years, 17 had some pneumoconiotic change, and in nine of these the changes were quite definite.

The general picture of radiological changes was described as follows. The first signs of soot deposits in the lungs consisted of numerous small shadows of unequal distribution. They were most numerous in the upper and middle zones while the lower zones and the apices were less involved. The size of the shadows varied between that of a pinhead and of a mustard seed. The edges of the shadows were characteristically soft and indefinite. The opacities were rather faint, and they were certainly less dense than similar opacities resulting from the inhalation of rock dust. In more advanced cases fine linear opacities were seen originating from the individual foci and giving a net-like picture. The hilar glands were not enlarged. Two enlarged sections of films of two soot workers are given as illustrations. The appearances in the original films

FIG. 1.—Right mid-zone from chest radiograph of a man aged 49 exposed to soot from anthracene from 1938 to 1951.
ABSTRACTS


Out of 1,247 lungs, or portions of lungs, received by the author during the years 1929-49 for examination for the presence of disease attributable to dust, sufficient details of 1,205 were obtained for analysis. Of these 394 came from pottery workers, 302 from coal miners, 132 from asbestos workers, 103 from stonemasons and quarrters, 102 from iron or steel foundry workers, metal grinders, or sandblasters, and 172 from workers in miscellaneous occupations. Silicosis was found in 796 cases, other forms of pneumoconiosis in 240 (mainly asbestos workers and coal miners), and no pneumoconiosis in 169 (mainly workers in miscellaneous occupations).

The mean age at death of asbestos workers was considerably lower than that of any other group in this series. Tuberculosis was present in 58-6% of cases of silicosis, and in 32% of the other forms of pneumoconiosis (43% in the combined groups). Carcinoma of the bronchus was found in 7-7% of cases showing pneumoconiosis and in 8-3% of those without fibrosis due to dust; there may well have been selection in sending cases for examination, and no satisfactory control group was available for comparison. In the group of asbestos workers primary lung tumours were found in 14% (19-6% in males and 9-7% in females), and it seems certain that this is higher than in the general population.

H. E. Harding.


Rhodesian asbestos dust was obtained of two types: with an average fibre length of 2-5 μ ("short fibre") and of 15 μ ("long fibre"). Groups of 30 young male rats were given intratracheal injections of 10 mg. of long-fibre asbestos, of long-fibre asbestos and alumina, of short-fibre asbestos, of short-fibre asbestos and alumina, or of alumina alone. The survival time of each rat was recorded and the survivors (14) killed at the end of 483 days. Short-fibre asbestos produced only moderate peribronchial fibrosis, and in 3 animals slight interstitial fibrosis; long-fibre asbestos produced in most of the animals examined a moderate interstitial fibrosis that appeared to develop from a patchy alveolar collapse. The addition of alumina to the asbestos seemed to increase the interstitial fibrosis, and no evidence was found of any amelioration of the effect of asbestos. Alumina alone produced mild interstitial fibrosis in only one animal.

H. E. Harding.

Among previous investigations, Lochtgether and Teleky (1932) observed radiological abnormalities in soot workers, but Böhme (1936) considered soot to be harmless and Otto (1940) found no lung changes in chimney sweeps.

Brauss and Gärnter found that heavy exposure to soot inhalation may continue for years without ill-effect but radiological changes may develop after 10 or more years' exposure. In occasional cases, massive fibrosis develops. These findings in soot workers are relevant to the problem of whether coal and graphite pneumoconiosis is due to the small amount of silica contained within the coal or graphite or is due to the carbon itself. The authors have demonstrated that pure carbon can cause lung changes on inhalation so it is possible that the carbon fraction of the coal itself plays a major part in the aetiology of coalworkers' pneumoconiosis. On the other hand there may be a silica effect modified by coal whose action, as suggested by Ray, King and Harrison (1951), might be to increase lymphatic blockage so that silica is retained in the lungs to exert its effect instead of being removed to the hilar glands.

Fig. 2.—Right mid-zone from chest radiograph of a man aged 49 exposed to soot from anthracene from 1924 to 1948. From 1948 to 1951 he worked as a glazier and labourer.

are exactly like those seen in simple pneumoconiosis of coalworkers.

Some of the workmen with lung changes suffered from dyspnoea at work. Of the nine men with more than 10 years' employment and definite pneumoconiosis, there were four who were now only capable of light work and three of these were not yet 50 years old.

REFERENCES


Bituminous and anthracite coal dust was introduced intratracheally into two series of rabbits and the ensuing histological changes were studied for a period of 1 year. The silicon content of the dust was estimated and was found to be insignificant in both cases. It was observed that introduction of anthracite dust caused more severe and lasting changes, including the formation of argyrophil fibres in the alveolar walls. The authors do not dispute the deleterious effect of silicon when it is inhaled with coal dust, but believe that the difference which they have observed between the effect of bituminous coal and that of anthracite owes something to the inherent pathogenetic properties of the latter.

L. Crome.


This paper is divided into two parts: in the first the literature relating to the prophylactic and therapeutic treatment of silicosis is reviewed; and in the second the author's experiments are described and recommendations for prophylaxis made.

In the experimental section the author describes the preparation of a 2% suspension of aluminium hydroxide in 1% sodium chloride by adding a 2% solution of sodium carbonate to an equal volume of 2% aluminium chloride. This suspension, which consists of particles of about 1 μ diameter, is used to demonstrate the reduction by alumina of the solubility of quartz, and the effect of alumina in accelerating the aggregation and sedimentation of quartz suspended in water, saline, or serum diluted with saline. This suspension, which remains stable for some hours, is used in an apparatus (not fully described) for the production of a prophylactic aerosol.

To prove the innocuous character of the aerosol, 6 guinea-pigs were exposed for 30 minutes daily to an atmosphere containing about 300 mg. of alumina per cubic metre. (This represents about 10 times the daily exposure proposed for the treatment of human subjects.) After a year the 6 animals appeared to be in excellent health; 2 were killed, and their lungs were found to be normal.

A second group of 6 adult guinea-pigs were exposed for 3 hours twice daily to an atmosphere containing quartz particles less than 20 μ in diameter. Of these animals 3 received daily a 15-minute exposure to the aluminium hydroxide aerosol. The powdered quartz was dispersed by compressed air, a quantity being blown into the dusting chamber at hourly intervals. The concentration, as determined by thermal precipitator samples, varied between 200,000 and 10,000 particles per c.cm.

At the end of 10 months 2 of the animals receiving silica only were losing weight, showed accelerated respiration, and one of them refused food; the remainder appeared well. Two of each set of 3 were killed. Macroscopically, the lungs of the 2 pairs showed slight differences—the pair exposed only to silica showed more enlargement of the mediastinal and tracheal lymph nodes and their lungs were firmer to the touch. Chemical analysis of lung tissue revealed approximately twice as much silica in the lungs of those receiving silica only as in the others. This was confirmed by the appearance of sections under the polarizing microscope. Lung sections were stained with haematoxylin-eosin, and with van Gieson stain for connective tissue. Examination of sections showed invasion of the lung by fibrous tissue, and thickening of the alveolar walls leading to disappearance of the alveoli from large areas; occasional necrotic zones were seen in this dense tissue. No typical hyaline nodules were apparent. Under polarized light doubly-refracting particles were seen in the necrotic zones, in the perivascular lymphatics, and especially in giant cells in the neighbourhood of the alveolar ducts. The few remaining alveoli, the alveolar ducts, and the respiratory bronchioles were generally empty. The animals receiving aluminium hydroxide in addition showed changes similar to these, but much less advanced; numerous cellular elements were present in the alveoli and bronchioles, including dust-containing macrophages.

Inhalation of the aluminium hydroxide aerosol was well tolerated by 4 volunteers, who remained for 3 hours in a chamber containing about 60 mg. of alumina per cubic metre. In factories where there is a silicosis risk the following mixture is recommended for dispersion as aerosol in changing-rooms: aluminium hydroxide, 2%; sodium hyposulphite, 0-2%; sodium benzoate, 0-5%; sodium para-aminobenzoate, 0-3%; oil of bergamot, 0-1%; water at pH 7-3 to 7-5. Workmen should be exposed for 10 to 15 minutes at the end of each shift. (The absence of nodulation in both groups of animals and the smaller amount of silica in the animals receiving aluminium hydroxide are noteworthy and in marked contrast to the findings of others [for example, King, Wright, Ray, and Harrison, Brit. J. industr. Med., 1950, 7, 27]. As the author remarks, the experiments should be repeated with larger groups of animals.)

J. W. Roe.


It is suggested that the term "anthracosis" is misleading, since carbon alone does not give rise to any specific lung picture and the appearances seen may occur in other conditions in which carbon is encountered. The author accepts "anthro-silicosis" as a reasonable term; he asserts that dust particles larger than 3 μ in diameter cannot enter the lungs, and maintains that silica, being toxic to the macrophage dust cells, prevents these from performing their normal transportation activities. Hence the lymphatics become blocked and a reactive fibrosis occurs round them with formation of characteristic micronodules. If these coalesce they form macronodules and have a typical appearance.

The Belgian Institute of Hygiene for Mines has suggested a classification for the radiological appearances which is similar to that of the French authors Hanot and Heck. These are as follows: (1) Normal films.
(2) Subnormal films; some increased opacity and slight hilar hypertrophy. (3) The micronodular stage; this is divided into three sections according to degree. (4) The macronodular stage; this also has three subdivisions according to the degree of observed changes. (5) Cumulative lesions of irregular outline and considerable extent formed by aggregation of numerous micro- and macro-nodules. (6) Pseudo-tumours or large areas of fibrosis of marked opacity and with irregular outline, some still active and others arrested. It is noted that sharp divisions between these six stages are not observed, since they merge gradually, and also that emphysema is a necessary corollary of silicosis.

By reason of the varying nature of the soil or rock in which coal is found the lesions in miners' lungs must vary enormously between one district and another. There is some evidence of increased or reduced susceptibility, and the author observes in this connexion that among a group of heavy drinkers it is impossible to point in advance to those who will have cirrhosis of the liver at the age of 40. He also suggests that previous healed tuberculous lesions probably explain the frequency of dust lesions in the subclavicular zones, especially the right. Presumably deposit of dust particles here is favoured by antecedent scarring. It is stated that in a silicotic lung showing only minor changes there may, many years later, be found advanced fibrosis and emphysema, though the subject has not worked in a mine since he first came for examination. Indeed it might seem unwise to ask a miner with early lesions to cease work, as he may develop a psychosis, and in any case such development is inevitable. The advice to continue must necessarily take account of the presence or absence of symptoms, which are not always in line with the radiological findings.

But in benign but very early cases, discovered after 4 or 5 rather than 8 or 10 years' employment, it may be reasonable to suggest that mining be abandoned. Any decisions made must depend not only on the radiological picture, but on all the other evidence available.

The development of silicosis is not inevitable in miners, and many escape it though working for 25 to 30 years. In a group of 3,302 miners with an average of 13 years' work 550 had various lung lesions. The author does not discuss tuberculosis as a complication, though this occurred in some cases in his series. In the mines investigated every miner is examined radiologically at 2-yearly intervals. Apart from the use of water when drilling, it has been found useful to inject water into the soft coal before this is brought down; this procedure greatly reduces the amount of dust. G. C. Pether.


The dread of silicosis among workers in the Aberdeen granite industry has created a real social problem in the region for many years. During the last 2 years the author has conducted an extensive survey of the extent and severity of silicosis in this region in an effort to clarify the position. Practically all workers in the monumental side of the industry, totalling 510 men, were examined radiologically, and a supplementary examination of 33 retired stonemasons was also carried out. Clinical examination was omitted in most of these cases. The extent of disease was defined radiologically as: (1) early reticulation, (2) reticulation, (3) nodulation, or (4) massive shadows. The different stages are briefly described and illustrated (but little comparison is made with the appearances of silicosis as it occurs in other industries).

About 10% of the stoneworkers had radiological silicosis, but in only about 2.5% was it severe enough to entitle the patient to compensation. It was found that, on the average, 32 years' exposure to dust was required to produce the first stage of early reticulation, and the corresponding periods for the other 3 stages were 38, 40, and 42 years respectively. Silicosis in this industry appears, therefore, to be essentially a disease of old age in its symptomatic stages. The incidence of tuberculosis in the stoneworkers was no higher than in dust-free occupations where individuals work together in groups indoors. D. E. Fletcher.


The experiments reported are a continuation of previous work, at the Johns Hopkins School of Hygiene and Public Health, Baltimore, on the effect of certain dusts on the susceptibility of rats to lobar pneumonia. Rats were exposed in a dust chamber to high concentrations of coal dust or smoke. After various periods they were inoculated intrabronchially with pneumococci type 1, and the results were compared with control animals similarly inoculated. Some groups of animals were given pneumococci in mucin, which in control animals led to a lobar pneumonia. Others were given pneumococci in broth, which usually leads to a pneumococcal septicaemia with or without lobar consolidation. In addition to the incidence of mortality, the incidence of infection was estimated in the mucin experiments from the number of survivors showing evidence of healing lesions in the lung. In the broth experiments, the incidence of lobar consolidation of the lungs was similarly estimated.

No significant differences were found between the animals exposed to smoke and the controls in either the mucin or the broth experiments. In the mucin experiment the animals exposed to coal dust for 14 or more days showed a lower mortality and infection rate compared with controls; no such difference was found in the broth experiments. The results are thus similar to those previously obtained with quartz and feldspar dusts. It is suggested that the dusts may act by affecting the protective action of the mucin so that the organisms are more liable to attack by the body defences, or another possibility is that local mobilization of macrophages is stimulated in response to the dust. C. M. Fletcher.
Pulmonary Tuberculosis in Dockers (Grainworkers).

During the course of 9½ years the authors examined 192 grain-workers who were exposed to the inhalation of a variety of mixed dusts for longer or shorter periods. Of these, 75 were found to be suffering from pulmonary tuberculosis; 54 patients had positive and 21 negative sputum. The length of time the patient had been working on grain ships before the disease was detected varied between 1 and 48 years in the positive group and between 1 and 23 years among the negative cases. Of the patients in whom tuberculosis was discovered there was a preponderance in the age group 50 to 60; 20 of the 54 with positive sputum and 11 of the 21 with negative sputum were older than 50. One in every 6 patients who were sent to the chest clinic during the same time was found to be tuberculous.

The authors are of the opinion that the high incidence of tuberculosis among grain-workers is due to working conditions rather than to socio-economic status.
Franz Heimann.


The authors show in their survey that the increase in tuberculosis mortality among shoemakers was due to the change from working at home to working in factories, which introduced the possibility of cross-infection at work. That this does occur was confirmed by mass radiography, which revealed a positive correlation between the number of workers and the incidence of overt tuberculosis. Among printers the death rate from pulmonary tuberculosis was over twice that for all males of working age, but in the last 50 years has steadily declined. The death rate from all other causes remained low in both trades.
Franz Heimann.

INDUSTRIAL TOXICOLOGY


In this investigation into the cause of industrial bladder carcinoma the carcinogenicity of β-naphthylamine, a dye intermediate which has previously been tested by other workers, who fed it to various species of animals, was again assessed. The results confirmed the outstanding sensitivity of dogs, and in these animals alteration of the pH or urine from acid to alkaline made no difference to the rate of induction of tumours. In mice no bladder tumours developed; in rats and rabbits benign bladder tumours appeared only after prolonged administration of the chemical. Urinary estimations of 2-amino-1-naphthol conjugates during these experiments showed that there are species differences in the excretion of β-naphthylamine. An approximate correlation exists between susceptibility to tumour formation and the amount of these conjugates excreted. In bitches the concentration of the conjugate in urine compared with plasma was about 200 to 1. The carcinogenic activity of 2-amino-1-naphthol hydrochloride on bladder epithelium was tested in mice by inserting into the bladder a wax pellet impregnated with reagent. A carcinogenic potency comparable with that of 20-methylcholanthrene was observed.

Hydroxy derivatives of an aromatic amine have not previously been shown to be locally carcinogenic. The authors do not claim that a 2-amino-1-naphthol conjugate is the only carcinogenic metabolite of β-naphthylamine, but that it seems to be the one which is present in the greatest quantity in dogs' urine. They suggest that the species differences depend on variations in metabolism rather than on tissue susceptibility.
J. N. Agate.

Therapeutic Possibilities in ‘‘Parathion’’ Poisoning.

The toxic potentialities of the insecticide ‘‘parathion’’ are reviewed. Those using it may complain of headache and lassitude. In severe poisoning, symptoms of excessive parasympathetic stimulation are seen, including sweat rash, lacrimation, salivation, nausea, vomiting, diarrhoea, intestinal colic, dyspnoea due to bronchospasm, myosis, and paralysis of accommodation, with a fall in body temperature. Muscular tremors and convulsions may precede coma and cardiovascular collapse. At necropsy oedema of lungs and brain is seen, together with generalized capillary dilatation.

The experiments reported in this paper were carried out on mice to test the effectiveness of various substances which might be expected to be therapeutically useful. These included eserine, ‘‘artane’’ (benzhexol), ‘‘trasentin’’, phenobarbital, morphone, phenytoin, tubocurarine, ‘‘diparcol’’ (diethazine), ‘‘phenergan’’ (promethazine), and sympathol. Of these only artane gave significant protection. Atropine and ‘‘parpanit’’ were more effective than any of the above drugs; they were more effective against poisoning by intravenous than by oral parathion. Parpanit was most effective against intravenous parathion. Parpanit, 10 to 20 mg. per kg. injected intraperitoneally, reduced mortality due to intravenous parathion from 5 in 10 to 0 in 10. When the parathion was administered orally the antidotes were only effective if given repeatedly.

The results emphasize the need for early treatment and indicate that the prevention of further absorption of parathion from skin, mucous membranes, or stomach is most important. Injection of atropine sulphate is recommended. Parpanit, with its wider activity (against the nicotine-like actions of acetylcholine as well), should also be given, especially if atropine is not well tolerated. At present it can be given only orally or rectally in the form of crushed tablets.

(As potential antidotes, other ‘‘ganglionic blocking agents’’ which also possess atropine-like activity, such as ‘‘banthine’, should be investigated.)

Derek R. Wood.
Electrocardiograms were obtained in 10 of 13 cases of arsine poisoning, the clinical details of which were described previously (Arch. ind. Hyg. occup. Med., 1950, 1, 437). The first records were made 36 to 48 hours after exposure to arsine, and recordings were repeated at intervals for periods up to 18 months. In all cases except one high-peaked T waves occurred, particularly in the precordial leads near the sternum (CF₂), becoming less at CF₄ and least marked at CF₆. The T-wave elevation was present in the limb leads, though not to such a high degree. Maximum elevation occurred between 48 and 96 hours after exposure in 7 cases, while in the remainder it appeared after 5, 7, and 12 days respectively. In 8 out of 10 cases the maximum elevation of the T wave in CF₂ and CF₄ occurred on the same day. In 7 cases the S-T segment had an elevated take-off in the precordial leads, which was maximal at 36 to 48 hours, and returned to normal in 96 hours, after exposure. In one man the records did not conform with the pattern common to the others, in that the T wave showed late inversion in all records. This change persisted for 18 months, though the degree of inversion decreased. It is postulated that this was due to changes in the myocardium immediately beneath, or extending into, the pericardium.

Hyperpotassaemia is discussed as a possible cause of the electrocardiographic changes. Potassium is released from the erythrocytes as a result of haemolysis, and although serum potassium determinations were not made, it is suggested that the occurrence of haemoglobinuria would be an indication of possible hyperpotassaemia. The results show that the typical electrocardiographic changes appear whether or not there was clinical haemoglobinuria. In addition to this argument, it is pointed out that no widening of the QRS complex or narrowing of the base of the T wave was seen, as would be expected in potassium intoxication.

In the 4 cases that ended fatally death was due clinically to acute myocardial failure, while necropsy in 2 of these cases revealed extensive myocardial degenerative changes. These changes are considered to be due either to the direct action of arsine on the tissues or to the action of arsine metabolites derived from haemolyzing erythrocytes. In conclusion, it is suggested that these electrocardiographic changes are the most sensitive means of diagnosing arsine poisoning yet discovered.

W. K. S. Moore.


The intraperitoneal injection of beryllium chloride in rats and guinea-pigs, with subsequent observation for 30 days, showed that, calculated as beryllium it has an LD₅₀ of 0.56 mg. per kg. of body weight for rats and 6.3 mg. per kg. for guinea-pigs. In view of this marked difference between these two species in susceptibility to beryllium, tissues from both were used to ascertain whether a correlation between species susceptibility and phosphatase inhibition existed. The normal alkaline phosphatase activity of the various homogenized tissues was measured and the concentration of beryllium required to produce 50% inhibition of hydrolysis of β-glycerophosphate determined. The tissues examined were: serum, liver, duodenum, kidney, thyroid gland, adrenal cortex, and adrenal medulla. With the exception of the adrenal cortex and medulla, the tissues of the rat had a higher alkaline phosphatase activity than those of the guinea-pig and, with some exceptions, the enzyme was more sensitive to beryllium poisoning.

To correlate these results with experiments in vivo, intraperitoneal injections of beryllium were given at various dose levels and the alkaline phosphatase activity of different tissues was estimated at various times after the injections. The activity of the enzyme in rat serum was markedly inhibited, and the inhibition persisted throughout the survival time after lethal doses, but was reversible after sublethal doses. The phosphatase activity of kidney and duodenum was also inhibited in vivo, while the activity of other tissues was not appreciably inhibited. Manganese, cobalt, nickel, zinc, yttrium, and lanthanum afforded some protection against the inhibition of phosphatase in vitro, but failed to afford any protection in experiments in vivo. The adenosine triphosphatase activity of tissues was inhibited by beryllium in vivo, but the activity of glucose-6-phosphatase and 5-nucleotidase was unaffected. Phosphoglucomutase activity of liver and skeletal muscle was inhibited in vivo and in vitro, and this effect was antagonized by magnesium. The liver and kidney of beryllium-poisoned rats showed a decrease in content of phosphocreatine and adenosine triphosphate and a marked increase in inorganic phosphorus content. Glucose-1-phosphate content was increased and glucose-6-phosphate content decreased.

P. A. Nasmyth.


The clinical details are given of 12 cases of dermatitis, 5 of thermal burns, 1 of chronic headache, and 3 of asthma following exposure in a plant producing ethylene amines. The exact constitution of the manufactured ethylene amines was uncertain because the product consisted of a mixture of various homologues with the general formula NH₂-R-NH₂-R-NH₂. The dermatitis resulted from the splashes of liquid or from exposure to high concentrations of vapour. At first the lesions usually consisted of papulo-macular or vesicular eruptions with erythema at the site of contact, but with recurrent exposures the rash took on a more chronic form with scaling, fissuring, and thickening of the skin. One man developed urticarial lesions after exposure to vapour. If the skin was washed well after being splashed lesions either did not appear or were less severe. A
number of the men who had had rashes were able to continue working in the plant without any recurrence of dermatitis provided they took proper precautions.

Altogether 35 men operated the plant and so were exposed daily to the amines. Of the 12 who developed dermatitis, 6 did so during the first year of exposure. The incidence of cases in the plant was the same for each of the 4 years it had been in operation; the majority of cases occurred during the hot months of the year, when only light clothing could be worn and gloves were discarded.

All the thermal burns due to liquid amines healed without incident except in one case, that of a man who was burned twice and, when the second burn healed, developed dermatitis on the site. Of the 3 patients with asthma, 1 began having attacks on exposure to amines after an upper respiratory infection; the second developed asthmatic attacks after handling acetic anhydride and this reaction later occurred when he was exposed to amines; the third man developed asthma while he was exposed to ethylene amines alone. All 3 lost their asthma when they were transferred to other work.

It is suggested that the ethylene amines have an allergic effect in addition to the obvious irritant action due to their alkalinity. (No skin tests were carried out, however, and no information is given about the degree of atmospheric contamination. The fact that several susceptible men were able to continue working in the plant if simple precautions were observed does not support the suggestion of allergic action by these amines.)

W. K. S. Moore.


Polymerization of tetrafluorethylene produces an inert plastic which is unusually thermostable. This polytetrafluorethylene ("teflon" or "fluon") gives off an invisible toxic fume when heated above 300° C., when extruded hot, or when heated by friction with cutting tools. After a few hours' latent period, exposed workers may experience an influenza-like illness, with retrosternal oppression, dry cough, and malaise, followed by fever up to 104° F. (40° C.), rigors, and sweating. There are sometimes transient signs in the chest. Spontaneous recovery takes place in about 2 days.

Experiments on rats showed that exposure to fluon heated to between 140° and 325° C. produced respiratory irritation and death from pulmonary oedema and haemorrhage, especially in experiments at over 300° C. An unidentified mineral acid was evolved, and also, at the latter temperature, a sublimate. Decomposition at 600° to 700° C. produces C2F6, C3F8, and C4F8, but these are not toxic.

The exact nature of the toxic substance in this case is not yet known; a parallel is drawn with metal-fume fever, but only very small quantities of metals were found in the polymer ash. Prevention is by local exhaust ventilation. Treatment is symptomatic, and oxygen is recommended. Some doubt exists whether symptoms can arise from inhaling cold polymer dust.

Full details are given of 2 cases in men exposed to the fume, both of whom had had several attacks.

J. N. Agate.

THE APRIL (1952) ISSUE

The April (1952) issue contains the following papers:—


Pneumoconiosis of Coal Miners in North East England with Special Reference to the Durham Coalfield. By R. I. McCallum.


Dust Sampling and Lung Disease. By C. N. Davies.

The Incidence of Bladder Tumours in a Dyestuffs Factory. By T. S. Scott.

Urinary Coproporphyrins in Lead Poisoning. By J. E. Kench, R. E. Lane, and H. Varley.


A number of copies are still available and may be obtained from the Publishing Manager, British Medical Association, Tavistock Square, W.C.1, price 12s. 6d.