INTRODUCTION

The Inland Transport Committee of the International Labour Organisation adopted at its Fourth Session (Nervi, Genoa, December 1951) a Resolution (No. 49) concerning the protection of dock workers against dust associated with the handling of grain cargoes. At its 118th Session (Geneva, March 1952), the Governing Body decided to communicate the resolutions adopted on that occasion to Governments. The resolution recommended the carrying out of studies based on the medical examination of dock workers especially exposed to dust, with a view to gathering adequate medical data and to practical measures to eliminate the dust and to protect dock workers against it.

This Report summarises the information concerning such studies available to the International Labour Office.

REFERENCES IN MEDICAL LITERATURE

During the last 40 years or so, references to the effects of grain dust on the lungs of workers in contact with cereals - dockers, threshers, grain weighers, warehousemen, workers at grain silos and flour millers - have recurred in medical literature. Nevertheless, the aetiology of the affections encountered still awaits further elucidation. Thus, Middleton, in concluding his address on the subject to the Third International Conference on Pneumoconiosis, Sydney, February-March 1950, stated "there is a strong presumption of traumatic irritation and some evidence of allergic reaction".

THE DUST HAZARD

Dockers handling grain are often exposed to excessive amounts of grain dust and such dust may exert an irritant effect, which has been found to vary greatly in severity for different classes of cargo. Wheat is believed by the dockers to cause somewhat more severe irritation than other grains, and this view would seem to be borne out by tests taken of the dust in the air. Nevertheless, with the exception of maize, believed by certain investigators to be practically harmless, the extent of risk varies less in accordance with the grain handled than with the place of origin and the methods of handling. A scientific study of the botanical variety of the grain concerned in relation to its harmfulness is thus not of particular relevance and would in any case meet with
serious obstacles, since the trade description of the grain is not made on this basis and, moreover, cargoes are at times composed of mixed varieties. Investigators too have warned against appraisal of the risk based on visual evidence of the presence of dust, since atmospheric tests have, for instance, revealed distinctly fewer dangerous components in the excessive dust coming from the bottom of the hold towards the end of unloading, which caused discomfort but no intense irritation, than in the dust liberated during other apparently much less dusty operations. This was explained by the fact that the grain hair count was in the former case never high, though there was abundant mineral and vegetable dust.

Content and Properties of the Dust

Analysis of the dust encountered has revealed two main hazards, the first due to physical or possibly chemical properties of the actual grain dust and the other to an allergic reaction to its components or to certain extraneous agents present in the dust.

The first hazard derives from the hard, sharp, spiked hairs of the grain, of dimensions liable on inhalation to become more or less deeply embedded in the bronchial tree. The length of hairs found as a result of sampling and analysis of dust in the air ranged, according to Middleton's estimation, from over 1 mm. to 0.1 mm. for wheat, barley, oats and rye and a maximum of 3,680 hairs were found in 500 cc. of air, with an average for 23 counts of 932 hairs. Another investigator found fragments of 30-35 microns in length and 3.5 microns in breadth in the lungs of guinea pigs dusted with cereal dust. In addition to this element of grain debris, the dust has a mineral content which may vary greatly, but has been estimated at about 5 per cent. (Middleton). Certain experts have found a varying proportion of silica in the cereal dust. Thus, in the French investigation referred to, free silica was found to be present to the extent of 0.19-1.35 per cent., while in another investigation the total silica content revealed varied between 1.1-9.1 per cent. and the soluble silica from 0.92-2.80 per cent.


A medical report on a case of silicosis gives percentages of silica as high as 19.96 for dust from a railroad car and 9.96 for dust in a wheat conveyor tunnel, and adds that the proportion of free silica rose in inverse ratio to the size of the dust particles.

Other constituents found in cereal dust are foreign proteins, acaridiae, starch, bacteria and moulds, yet for most research workers the most harmful factor is the presence of the hard, sharp fragments of vegetable detritus.

Pathological Effects

Middleton told the Sydney Conference that "wheat hairs may penetrate delicate structures in the respiratory tract and cause foreign body reactions as well as sensitisation in susceptible persons, leading to debility and emphysema". Duke has reported on wheat hairs as a cause of asthma in flour millers in the United States, ascribed by him to a two-fold foreign body and allergic reaction. Inflammatory changes in the respiratory passages of workers and transient symptoms of acute irritation experienced in personal experiment by investigators are related to the action of these hairs.

A recent study based on chemical and microscopic examination of wheat, barley and oats dust, animal experiment and clinical and radiological examination of 84 dockers and baggers of grain employed at the port of Marseilles relates the pathological findings, both animal and human, to this vegetable detritus. The lungs of 21 of the men showed abnormal shadows and all of these sooner or later suffered to a varying extent from attacks of grain fever lasting two to three days, accompanied by vertigo, asthenia, intense dyspnoea, coughing with expectoration and nausea, and were subject to recurrence over a period of five to 20 years. These affections evolve, giving a picture of chronic tracheobronchitis and effort dyspnoea, designated Stage I, which affected nine of the 21 cases. The investigators distinguished a second stage in 11 of the 21 cases studied, characterised by intense cyanosis and permanent dyspnoea, not definitely or rapidly amenable to treatment and rest. In guinea pigs subjected to dust, a third stage showing peribronchial fibrosis, atelectasis and involvement of the alveolar walls developed, but only one third-stage case showing pseudo-tumoral formation was found among the dockers examined.


2 Stephanopoli de Commène, J., and Besson, J., loc. cit.
An American case report describes a definite case of silicosis which developed in a healthy railway worker after eight years' work unloading trucks of wheat and work in a tunnel conveyor where the dust reduced visibility to a few feet. He was finally obliged to give up work on account of acute dyspnoea and seven years later he was completely incapacitated. The percentages of silica present in the dust were those quoted above (see p. 4 above). Of the dust particles from the car and tunnel, 20.25 and 31.55 per cent. respectively were, in the first case, between 1 - 44 microns in size and, in the second case, under 44 microns.

Dunner and his co-authors (1948) examined 55 dockers who complained of dyspnoea, cough and chest pain, and found 14 negative and 11 with fibrosis indicating pneumoconiosis. These results suggest that possible explanation may be found in the fine hairs and fragments of grain husks revealed by microscopic examination of the dust. Moulds were also revealed in the dust but not in the sputum of the workers. In another investigation, Dunner found that 22 out of 100 dockers who had handled grains and seeds showed radiographic signs of pneumoconiotic lesions, while 43 were tubercular. This investigation, however, revealed that the grain workers had also at times been exposed to chemical dusts from bauxite, iron and manganese.

Acaridae present in the dust may set up prurigenous dermatitis and harmful action of endo-toxines secreted by bacteria has been reported. Thresher's fever has been ascribed to moulds present in grain dust and isolated from the sputum of threshers. Tornelle refers to eight cases of mycotic affections, with meningitis in the sputum, affecting threshers, with regression, apart from one case of residual asthma and one of chronic fibrosis.

An American investigation dated 1948 deals with sensitisation to cereal dusts containing fungi, insects and acaridae. In a later

1 Heatley et al., loc. cit.
2 Dunner, L., et al., loc. cit.
study by Stephanopoli de Comnène, who conducted the Marseilles enquiry, there is reference to prurigenous general effects or pruritis (cereal itch, gale de céréale) in addition to feverish bronchial and pulmonary attacks and dyspnoea; the author insists, however, on "the essentially harmful element" being "the omnipresent sharp vegetable detritus" with possible superimposition of the action of moulds.

Prevention

Technical Devices and Personal Protective Equipment

At the Sydney Conference, Middleton stated that the best solution of the problem lay in the removal of dust at the earliest possible stage in the movement of grain from the grower to the manufacturer, adding that, in practice, the dust is now retained at each stage of the journey, by putting back dust separated in transit. The loss of dust has, of course, certain economic aspects and might constitute a point to be taken into account in sales contracts and trade agreements.

Respirators have the disadvantage that the workers may not wear them when they ought to do so, and may not keep them in good order. Nevertheless, the use of respirators is, in many cases, the only immediately practical measure. Conditions for the wearing of respirators are somewhat more favourable than in many other occupations, because the work is in general not carried out in hot conditions and is mostly interrupted by rest breaks and because the dust is, with the exception perhaps of excessive concentrations, easily arrested by a filter in the mask.

One author, referring to the thick clouds of dust raised by the older method of hand-shovelling of grain, records that transport by suction methods has now diminished the risk, though the process of blowing the grain into warehouses still involves danger for those inside. Air ducts and exhaust fans in ships' holds offer some protection, though they work at a disadvantage on account of apertures and consequent short-circuiting of the air current. Exhaust fans near elevators and ploughs have been proposed. Pneumatic elevators are said to provide, at least apparently, less dusty conditions than bucket elevators, but no comparative data are available. The pneumatic elevator offers the advantage of reducing the number of workers exposed to the risk.

Medical Prevention

Dunner and his co-authors stress the need for systematic mass radiography to indicate the frequency of respiratory diseases. Tomnelle emphasises the importance in mycotic infections of anamnesis, characteristic radiographs and the presence of fungi in the sputum.
The authors of the Marseilles report recommend selection of workers based on exclusion of those whose bronchial, pulmonary state would favour the development of pneumoconiosis, which implies compulsory pre-employment radiographic examination and even subsequent re-examination, which it is suggested should be half-yearly (radioscopic plus radiographical as required) and withdrawal from work of those having reached Stage I, because they believe that Stage II cases tend to be progressive even after cessation of work. They also recommend temporary suspension of work for a varying period in cases of intercurrent broncho-pulmonary attacks.

Conclusion

The suggestions for medical supervision made in the Marseilles report go much further than those proposed by any other investigator and are probably related to the special conditions there. The authors said in fact that the grain delivered in Marseilles is very dirty, as much as 3-4 per cent. consisting of dust, and that this is likely to cause more rapid evolution of disease and, at the same time, to render masks, when worn, ineffective by blocking.

It would seem that, failing dust removal at an early stage of the journey, mechanical preventive measures (transport by suction with cyclones in the aspirators as far as possible and exhaust ventilation where removal is manual) may achieve considerable reduction of risks and avoid, at least to a large extent, the difficult problem of providing alternative work for the grain loaders.

The divergences in the findings recorded testify to the need for further investigation and more accurate assessment of the risk. There is much reason to presume that the extent of risk varies greatly at different ports and that the measures to be adopted must take account of local conditions; less drastic medical and other precautions may perhaps be required in certain places in accordance with the port of origin of the grain and the methods of handling in use.