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Pneumoconiosis in the Chrome Mining Industry of Rhodesia

BY

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Chromite is the only practical source of the metal chromium. It is ideally a simple oxide of iron and chromium (FeCr_2O_4), but most chromite mined is in fact chrome spinel in which Al and Mg are replaced by Cr and Fe in varying degree.

Chrome ore deposits result from crystal differentiation in ultrabasic magmas. For this reason they always occur as seams, pods or lenses within serpentine and related rocks which are the altered derivatives of dunites, peridotites and pyroxenites.

In Rhodesia the seam type of deposit is represented in the Great Dyke, an ultrabasic body some 300 miles long, which in places has six or more parallel, flat-dipping seams superimposed on one another. Each seldom exceeds a foot in thickness, but extends for thousands of feet along strike and in depth. They are mined in those favourable areas that are close to rail. The pod and lens type of ore bodies are found at Selukwe, Mashaba and Belingwe in serpentines of much greater age than those of the Dyke. The country rocks are consequently much more disturbed and silicified. Usually free silica is not a constituent of serpentine except in very minor amount as secondary opal veining. The pods and lenses may have all dimensions measuring hundreds of feet, so that while being very considerably thicker than the seam type, they are not as extensive laterally or in depth.

MINING

In mining the narrow seams of the Great Dyke, dust generation is minimal. Most of the drilling is done in soft serpentine using rotary coal bits. In stoping the reducing system is followed. Some three feet of serpentine is excavated from above the chrome seam, leaving it exposed on the floor, from which it is later popped off.

Mining at Selukwe is, in respect of dust formation, more akin to standard mining methods as applied in gold and copper mines, because a

much larger proportion of hard rock must be pneumatically drilled and blasted than in the mines situated in the Great Dyke. All drilling is wet and normal dust suppression techniques are employed.

PERMISSIBLE DUSTINESS

The yardstick used in Rhodesia is 300 particles per c.c., but the average is considerably below this.

SOURCES OF DUST AND MEANS OF SUPPRESSION

Along the Great Dyke rotary drilling and minimum dust generation is supplemented by good ventilation both natural and mechanical. At the Selukwe deposits the following means are adopted:

- (a) After blasting, the re-entry time for a worker is four hours to allow for the air to be replaced by fans. The face of the tunnel or excavation is subjected to a fine spray of water for 15 minutes before the re-entry of persons.
- (b) Shovelling also exposes the shovellers to dust, and to counter this the rock pile is wetted down.
- (c) Small mechanical loaders create about three times as much dust as load shovelling; there again the rock is wetted and sometimes an atomising spray is fitted on to the front of the loader.
- (d) In scraping operations, when the rock is removed by a type of steel grab hauled along the ground collecting broken rock, the rule is for the rock to be wetted and for persons to keep away as far as possible.
- (e) When the rock is tipped from trucks into an excavation, which forms a collecting point for the hoister unit, a device for hoisting to the surface, water sprays are used and also doors which enclose the dust after rock has been tipped so that it can be drawn off into flannel bag filters by a fan, thus eliminating the hazard for persons working at the tip.
- (f) Stopers or those excavators underground from where the mineral-bearing rock is removed are subjected to wetting down at the working face and adequate means are taken to disperse the dust from drilling.
- (g) Fans on the surface allow fresh air to be drawn through the workings and the foul air to be exhausted, while small auxiliary fans underground ensure the distribution of air to all working places in need of it.

CLINICAL FINDINGS

In the chrome industry 27 miners who only worked in the chrome mines and exposed to dust were compensated for pneumoconiosis or for tuberculosis with or without pneumoconiosis. Of this group, only six were accepted as having uncomplicated disease of the lungs due to the inhalation of the dust. Four of them were graded Stage I pneumoconiosis, one as Stage II and one as Stage III (Figs. 1 and 2).

Symptoms in the six cases were:

Shortness of breath	.....	.....	.....	.....	.....	5
Cough	.....	.....	.....	.....	.....	3
Pain in chest	.....	.....	.....	.....	.....	1
Haemoptysis	.....	.....	.....	.....	.....	1
Loss of weight	.....	.....	.....	.....	.....	0
Mucopurulent sputum	.....	.....	.....	.....	.....	1

Signs were few, for in these six cases one case is reported as having rhonchi and in another crepitations (Figs. 3 and 4).

In all six cases, however, the expansion of the chest as measured with the measuring tape was reduced.

Number	.....	.....	.....	.....	2	4
Amount of expansion in undress	.....	.....	.....	.....	0.1	1.12

The lesions as determined radiologically were mostly present in the base or towards the middle zones with a tending to spare the upper zones.

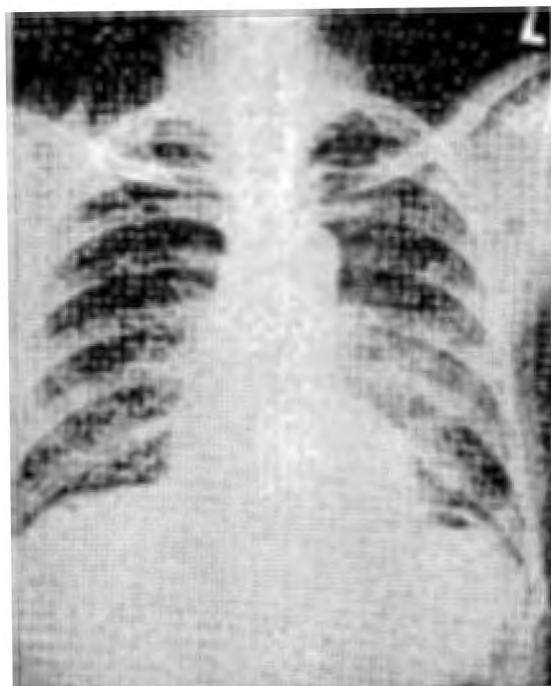


Fig. 1—Chrome: first stage pneumoconiosis lesions basal; service, 120 months.



Fig. 2—Chrome: first stage pneumoconiosis; service, 108 months.



Fig. 3—Chrome: hard nodules plus ground glass. Second stage service, 204 months.

Table I
DISTRIBUTION OF LESIONS

R	L
3	2
3	3
4	4

The months of service of these six cases showed a varying influence of time before they retired because of symptoms.

Table II

Number	1	3	0	1	1	0
Months of service	1-100	101-200	201-300	31-400	401-500	500+

Of the 27 cases, 21 were considered to have tuberculosis, but it was difficult to state definitely how many had only tuberculosis and those who were also affected by chrome fibrosis.

The symptoms mentioned by these 21 cases were:

Cough	.....	.....	.....	.....	.....	20
Pain in chest	.....	.....	.....	.....	.....	8
Shortness of breath	.....	.....	.....	.....	.....	9
Loss of weight	.....	.....	.....	.....	.....	12
Haemoptysis	.....	.....	.....	.....	.....	5
Sputum positive for tubercle bacilli	.....	.....	.....	.....	.....	16
Mucopurulent sputum	.....	.....	.....	.....	.....	13

The degree of expansion of the chest wall was restricted in all cases as shown in table.

Table III

RANGE OF EXPANSION IN 21 CASES OF CHROME CASES WITH TUBERCULOSIS

Number of cases	5	14	2	0
Expansion in inches	0.1	1.1-2	2.2-3	3+

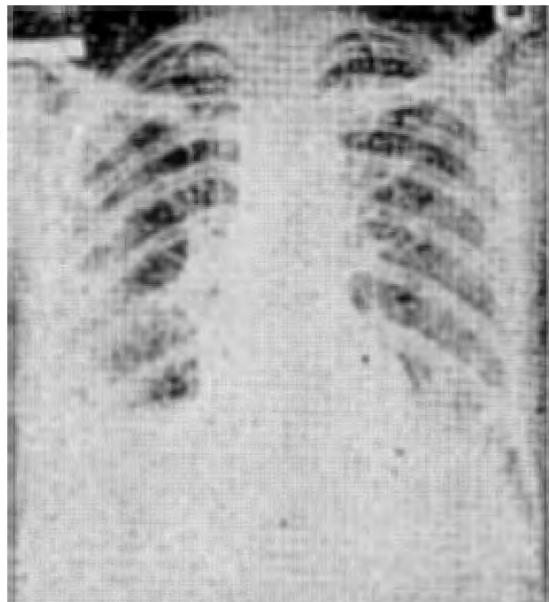


Fig. 4—Chrome: third stage pneumoconiosis; service, 24 months.

The lesions when tuberculosis was present were mostly found in the upper zones.

Table IV
DISTRIBUTION OF LESIONS IN 21 CASES WITH
TUBERCULOSIS

R	L
14	11
12	15
8	10

X-RAY FINDINGS

The X-ray findings in pneumoconiosis in chrome miners has recently been described by Sluis-Cremer and Du Toit (1968). In our six cases there did not seem to be any pattern that would distinguish a chrome pneumoconiosis from the usual appearance of silicosis with nodules, infiltrates, "ground glass" areas and increased lung markings. The nodules were perhaps a little finer and harder than in the other dusts, but there was no distinctive pattern in the lungs. The hilar areas were not involved. The degree of pneumoconiosis did not exceed Stage II and there was no pleural thickening or calcification. Dr. J. C. Gilson, Head of the Pneumoconiosis Research Unit of the Medical Research Council of Great Britain, who kindly commented on these six films, classified the lesions as:

1958 I.C.O. CLASSIFICATION	
3/3t	2/2t
2/2t	2/1m
3/4N	1/2m

COMMENTS

One of the earlier references to involvement of the lung by chromium was Mancuso and Huefer (1951). They described a spotty but not nodular pneumoconiosis. On X-ray the changes in the lungs consisted largely of an ill-defined mottling.

Sluis-Cremer and Du Toit (1968) have demonstrated that miners working in chrome mines in South Africa develop radiological changes which consisted of nodulations and is typically of a very fine type and that it usually appears first in the right upper zone, but may be very diffuse.

Besides the fine nodulation, sparse, short, linear opacities of similar density to the nodules may be seen, and when the changes are marked the extreme lung fields are apparent, although there is a tendency for the apices to be spared. It is suggested that the nodulation is more radiologically opaque than in simple coal miners' pneumoconiosis. Occasionally the nodules may be somewhat larger, reaching up to 2 to 3 mm. in size.

The hilar shadows do not usually show any change radiologically, but in others the hilar

shadows may be increased, although not as striking as occurs in silicosis.

Pleural thickening is also an uncommon manifestation of this form of pneumoconiosis.

In none of the cases described by Sluis-Cremer and Du Toit was shortness of breath complained of, and physical signs were few. In our cases preliminary symptoms were mentioned, but physical signs appear to be minimal, except restricted expansion of the chest.

SUMMARY

(1) Inhalation of chrome dust can lead to pneumoconiosis and six cases are described of miners who had worked only in this industry.

(2) Symptoms include shortness of breath.

(3) The radiological changes include fine nodulations, increased lung markings.

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