

or nervous disorder was present. He inferred that it is a matter of an industrial disease with pathologic changes in the lungs (reticulation) and general poisoning caused by the dust.

In Sweden the condition had previously been mentioned by Rundberg⁸ (1939), who observed, in addition, irritation of the skin.

AN INVESTIGATION OF THE ACTION OF INHALED VANADIUM
PENTOXIDE DUST ON MAN

Since 1946 vanadium pentoxide has been produced in a new factory at the Falun Copperworks in Falun, a mining town in the Swedish province of Dalecarlia. The raw material is iron ore slag from the Domnarfvet Ironworks. It contains about 12 to 17 per cent vanadium. Briefly, the manufacturing process is as follows: The slag is crushed, pulverized and mixed with soda. It is then roasted at 600 to 800 C., a treatment whereby the vanadium is rendered water-soluble. This is followed by warm water extraction, precipitation of vanadium pentoxide and drying of the product. The bulk of the product is delivered for the manufacture of hard steel, while some is used as a catalyzer in the sulfuric acid plant at the copperworks.

In the beginning of the operation, when the dust formation was at its heaviest, tests of the factory dust showed great variation of the dust content of the air in the different parts of the building (0.6 to 86.9 mg. per cubic meter, with a maximum vanadium content of 4.8 to 7.5 per cent). The number of particles also varied (6 to 140 particles per milliliter). Determination of the particle size showed that a considerable part of the dust was made up of fine particles (22 per cent $< 8\mu$, 39 per cent $< 12\mu$), sizes which indicate its ability to pass far down the respiratory tract. Besides the vanadium the soda is the only constituent of the dust that should be considered harmful, in that it may have an irritating effect on the skin and the mucous membranes. This, however, is of no great significance in view of the low content of soda in the dust.

When the new factory opened (toward the end of 1946) little or nothing was known about the dangers attached to the handling of the substance, and at the beginning face masks were not worn. Within a short time, however, illness began to occur. Since the examination of the first patient (in December 1946), I have kept the whole personnel of the vanadium factory—foremen, workers, builders (including repairers)—under constant medical supervision. The material of this report^{12d} consists of a series of 36 workers who were thus observed during the years 1947 to 1950. All of them had symptoms once or repeatedly. The main symptoms were severe irritation of the respiratory tract, with dryness and pain in the throat, a troublesome cough and wheezing sounds over the chest, with or without viscid sputum, shortness of breath and palpitation on exertion, weakness and fatigue. In a few cases bronchopneumonia occurred. Some patients had nasal catarrh or smarting of the eyes. There was also in some cases a skin disease in the form of papular eruptions on the face, the hands and the dorsa of the feet. The symptoms appeared in different combinations and degrees. There were also symptoms of neurasthenia and giddiness, and in one case there was tremor for a short period.

Slight irritation (redness) of the conjunctivas with no or little inconvenience seems to belong to the syndrome in the present series.

8. Rundberg, G.: Moderna yrkessjukdomsproblem i Sverige, Nord. med. 2:1845, 1939.