THE PHYSIOLOGICAL EFFECT OF COBALT CARBONYL VAPOUR.

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THE discovery of cobalt tetra-carbonyl by Dr Hirtz and Mr Cowapp in Dr Ludwig Mond's laboratories offered a further opportunity of studying the toxic action of volatile compounds of the heavy metals. Through the kindness of Dr Mond, a sufficient quantity of cobalt carbonyl was placed at my disposal for physiological experimentation.

Cobalt carbonyl is a crystalline substance of red colour. It is not very volatile and the vapour has not so characteristic a smell as that of the carbonyls of nickel and iron.

The following experiments were conducted for the purpose of obtaining indications of the volatility as well as of the dissociation of cobalt carbonyl in dry air. Air, freed from carbonic acid by washing in solutions of caustic potash and dried by passing over calcium chloride and through sulphuric acid, was conducted through a tube containing crystals of carbonyl of cobalt kept at a constant temperature by means of a water jacket. The air was then passed through a glass chamber guarded by plugs of cotton wool at the outlet and inlet and thence bubbled through bromine water in a wash bottle and a Meyer's apparatus.

The cobalt found in the bromine water added to that deposited in the plugs and on the walls of the glass chamber corresponded to the amount volatilised, but it was found that, with the current of air employed, saturation was not obtained, unless the temperature of the water jacket was some degrees higher than that of the rest of the apparatus. When volatilised at 0° C. the volume percentage of the carbonyl in a current of air not exceeding 2 litres per minute was very small indeed. The maximum obtained was less than 0·001 volume

per cent. At 16° C. the greatest amount of cobalt carbonyl evaporated corresponded to about 0·01 vol. %, but of this 50 % was found as a solid cobalt compound in the wool, etc. It therefore appeared to be unlikely that a mixture of the vapour in air of sufficient concentration to produce acute poisoning in animals would be obtained by such means.

Previous experiments ("The toxicology of nickel carbonyl," *Journ. of Hygiene*, 1907, VII., 4 and 1908, VIII., 5) have shown that at least 15 mgrs. of cobalt per kilogram body weight must be absorbed to kill rabbits. A rabbit weighing two kilograms would therefore require to inhale and absorb approximately 5 c.cm. of cobalt carbonyl vapour. If exposed for two hours at 16° C. to a 0·01 vol. % mixture, 7·2 c.cm. would be contained in the air breathed, but the experiments referred to above show that not less than one half of the quantity of the carbonyl is dissociated, even in the presence of dry air. In the presence of moist air, containing carbonic acid, the amount of dissociation would be greater.

It has been shown that when an animal breathes a mixture of nickel or iron carbonyl and air only part of the vapour breathed is absorbed by the lungs. The expired air, as is the case with other vapour mixtures, contains a certain amount of the vapour. In the case of $Ni(CO)_4$, $Fe(CO)_5$, CO and some other gases, the proportion of vapour absorbed has been found to be about 50 % of the total quantity. It therefore appears that even after two hours' inhalation not more than 1·8 c.cm. of the vapour would be absorbed. Prolongation of the time of exposure to the vapour would favour further dissociation, so that on theoretical considerations, it would seem impossible to produce acute poisoning in an animal with cobalt carbonyl vapour.

In order to test the accuracy of these considerations, rabbits were placed in the glass chamber and allowed to breathe the air mixed with cobalt carbonyl vapour. The temperature of the water jacket was varied in different experiments between 20° and 26° C. The rate of air current was also varied from 0·3 to 2·25 litres per minute. In one experiment, a rabbit was exposed for one hour to the vapour mixture. The cobalt carbonyl was volatilised at 21·5° C. and the air current was kept at 0·3 litre per minute, in order that saturation might be obtained. The temperature of the glass chamber rose from 14·3° to 16° C. during the experiment. After the experiment was over, crystals of cobalt carbonyl were collected from the tube beyond the water jacket, indicating that the air was saturated in the cooler portions of the apparatus. Only 0·175 mgr. of cobalt was recovered from the

bromine flask, while 1·2 mgrs. was recovered from the cotton wool plugs. In this case it was impossible to estimate the quantity of cobalt deposited in the chamber itself, as the rabbit's fur would offer as much surface for deposition as the glass walls. On the basis of the blank experiments, it could be estimated that the rabbit had absorbed not more than 0·14 mgr. of cobalt. As was expected, no symptoms of any description followed. Other experiments of a similar nature also yielded entirely negative results.

A rabbit was enclosed in a wooden box provided with glass windows in which was fixed a stretched piece of linen on which crystals of cobalt carbonyl were spread. The rabbit was allowed to remain in the box for two hours. The temperature inside the box rose from 13·5° to 18° C. A slight alteration in the colour of the visible mucous membranes indicated that some carbon monoxide had been absorbed. The amount of this was small. No symptoms of any kind were noted.

From these experiments the conclusion appears justified that owing to its low vapour tension and ready dissociability, cobalt carbonyl, contrasted with nickel and iron carbonyl, is unlikely to produce acute poisoning.