GENERAL REMARKS ON THE SUBSTANCES CONSIDERED

This eighty-sixth volume of *IARC Monographs* considers cobalt (with or without tungsten carbide) in hard metals and cobalt sulfate, gallium arsenide, indium phosphide and vanadium pentoxide.

Most of the materials evaluated in this volume are poorly soluble solid materials that are deposited in particulate form in the lung, where they may be retained for long periods of time. In this respect, they should be considered as 'particulate toxicants', the toxic effects of which are regulated not only by their chemical composition but also by their particle size and surface properties.

Workers in the hard-metal industry can have significant exposures to metallic cobalt particles in general in the presence but occasionally in the absence of tungsten carbide. Cobalt and cobalt compounds were evaluated in volume 52 (1991) as being *possibly carcinogenic to humans* (*Group 2B*), and the evidence of carcinogenicity in humans was *inadequate*. Since that time, new epidemiological studies of the hard-metal industry have been conducted in Sweden and in France and are evaluated here. Exposure to metallic cobalt is also prevalent in the cobalt production industry, and studies on that industry were also considered in the evaluation of cobalt. Because most data from the hard-metal industry deal with mixtures of cobalt and tungsten carbide, the Working Group also evaluated studies of tungsten miners, especially in China. Although these studies explored an association between exposure to silica and lung cancer and no data on exposure to tungsten were available, risks for lung cancer were nevertheless presented separately for tungsten miners. These were not increased compared with the reference population, but there is major potential for confounding by silica and other carcinogens in these studies.

No new studies in experimental animals were available for cobalt compounds used in the hard-metal industry. Nevertheless, this volume re-evaluates some of the experimental evidence for cobalt that was presented in the previous volume. The Working Group questioned the relevance of the routes of administration used in some of the animal carcinogenesis bioassays for the evaluation of carcinogenicity of cobalt metal and cobalt alloys. These included, for example, intramuscular injection into rats of cobalt metal powder or cobalt–chromium–molybdenum alloy, which produced sarcomas at the site of injection. The bioassays were reviewed again in this volume and the Working Group maintained the same conclusion as that reached in the previous monograph.

The semiconductor industry is a rapidly growing and changing industry that uses several compounds which have been evaluated as being potentially carcinogenic to humans. Inhalation studies by the National Toxicology Program have recently become available on two metal compounds used in this industry — gallium arsenide and indium phosphide. The available human epidemiological evidence from studies of the semiconductor industry is summarized and evaluated, although this is not extensive and is not particularly informative for the monographs on gallium arsenide and indium phosphide. Exposures to gallium arsenide and indium phosphide in the semiconductor industry may be very low, and other potential carcinogens present in this industry include trichloroethylene (*Group 2A*; IARC, 1995) and ultraviolet radiation (*Group 2A*; IARC, 1992).

In addition, there have been indications of adverse reproductive and developmental effects in workers in the semiconductor industry, although it has been suggested that these may be attributed in part to factors that are unrelated to employment in this industry. Therefore, more comprehensive epidemiological investigations of the semiconductor industry are needed.

Although they are not used in either the hard-metal or semiconductor industries, inhalation studies by the National Toxicology Program have recently become available on cobalt sulfate heptahydrate and vanadium pentoxide. Because the Working Group that convened to elaborate this volume had considerable expertise in metal carcinogenicity, it was considered advantageous to evaluate these compounds also. The evaluation of cobalt sulfate heptahydrate in this volume brings up to date the evaluations of cobalt compounds that appear in volume 52.