GENERAL REMARKS ON THE AGENTS CONSIDERED

This fifty-eighth volume of *IARC Monographs* covers some metals and their compounds —beryllium and beryllium compounds, cadmium and cadmium compounds, mercury and inorganic and methylmercury compounds. Exposures in the glass manufacturing industry are also addressed, as several metallic salts and pigments may be used in manufacture and colouring of crystal and art glass and in the production of glass containers.

Beryllium compounds were used extensively in the past as phosphors in fluorescent lighting tubes; they are now widely used in solid-state computer and communication systems and in the aircraft and aerospace industries. Beryllium also occurs in coal, the burning of which results in some environmental exposure. Occupational exposure to beryllium and beryllium compounds has been reduced over the last 40 years, and low permissible exposure limits have been set in some countries. Beryllium and beryllium compounds were evaluated previously in the *Monographs* (IARC, 1972, 1980, 1987a). Extended analyses have been reported of mortality among cohorts of workers in beryllium plants and of those entered into the US Beryllium Case Registry, and it is mainly on the basis of those new studies that a re-evaluation was made.

Cadmium and cadmium compounds were also evaluated previously (IARC, 1973, 1976, 1987b). Occupational exposure to cadmium can occur in zinc smelting and cadmium refining, in cadmium alloy production, in nickel–cadmium battery manufacture and through the production and use of cadmium pigments. Environmental exposures to cadmium may occur owing to its presence as a pollutant in food and water. Exposure to cadmium can occur also through the smoking of tobacco. New analyses of epidemiological cohorts and the results of new studies of carcinogenicity in experimental animals were considered by the Working Group in making the re-evaluation reported here.

Mercury and mercury compounds are considered for the first time in the *IARC Monographs*. Metallic mercury and inorganic salts as well as some organomercury compounds are included. Organomercury salts and those used in organomercury fungicides and bactericides are mentioned, but commercial biocidal products are not included. Human exposure to mercury can occur *via* many sources, including mercury mining, chloralkali plants, manufacture of thermometers, maintenance of mercury-containing instruments and from dental amalgams. Exposure to methylmercury compounds has occurred from the consumption of mercury-contaminated fish, and mercury poisoning has resulted from eating bread accidentally made from seed treated with organomercury fungicides and intended for sowing.

The environmental occurrence of and exposures to cadmium and mercury compounds were reviewed within the International Programme on Chemical Safety (WHO, 1990, 1991, 1992a,b), and reference is made to those reviews throughout this volume. Cadmium and

mercury were included by the International Register of Potentially Toxic Chemicals of the United Nations Environment Programme (UNEP, 1984, 1992) in its listing of dangerous chemical substances and processes of global significance.

A monograph on exposures in the glass manufacturing industry was prepared, as several epidemiological studies reported in the recent literature suggested an increased risk for cancer, mainly of the lung. Some of the studies were conducted in areas of northern Europe where crystal and art glass are made; in some studies, however, the type of glass industry involved is poorly defined. In particular, no epidemiological data were available that specifically addressed risks for workers employed in the automated manufacture of flat glass (Pilkington process), the most widely used process in the modern glass industry. A basic ingredient in the making of glass is silica, and exposures to lead, arsenic and several metallic pigments may occur, including cadmium and mercury salts. Cross-reference is made to relevant volumes of *IARC Monographs* in which evaluations of these components can be found. Occupational exposures in the production of glass fibres are not considered in this volume, because they have been evaluated previously (IARC, 1988)[1]: there is *sufficient evidence* for the carcinogenicity of glasswool in experimental animals; there is *inadequate evidence* for the carcinogenicity of glass filaments in experimental animals; there is *inadequate evidence* for the carcinogenicity of glasswool and of glass filaments in humans. **Overall evaluation**: glasswool is *possibly carcinogenic to humans (Group 2B)*; and glass filaments are *not classifiable as to their carcinogenicity to humans (Group 3)*.

Traditional analytical methods for determining exposure to metals, in particular to mercury and cadmium, provide only total concentrations of metal, and specific chemical compounds of the elements cannot be identified. Exposure limit values often refer to total concentrations of an element. Marked differences exist, however, in the deposition, absorption and distribution of the different compounds of each element, and particle size determines uptake through the lungs. Bioavailability and solubility in physiological fluids may also differ for different compounds.

Biological monitoring, by analysis of blood and urine, is often useful in determining exposure or body burden. The toxicological data available on cadmium and mercury are extensive; as the *Monographs* are not intended to provide a complete review of such information, unless it has a direct bearing on the evaluation of potential carcinogenicity, a selection of illustrative original references were summarized to provide an outline of the available evidence. Information on the toxicokinetics of beryllium in humans is very limited, and few data are available on concentrations of beryllium in biological fluids obtained from occupationally exposed and control populations. For agents that induce cancer at the site of entry, e.g., in the respiratory system, however, biological monitoring may not be predictive of individual risk in the absence of knowledge about toxicokinetic behaviour.

Although much research has been conducted on the metals covered in this volume, the molecular mechanisms of action that may lead to carcinogenic effects are still not completely understood. Involvement of the immune system in beryllium- and mercury-induced chronic diseases may complicate the dose–response patterns; it also raises the possibility of the

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[1]For definition of the italicized terms, see Preamble, pp. 26–30.

existence of subpopulations who are susceptible to effects that may be related to carcinogenicity.

References

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