Part V
Airborne Particulate Matter Exposures and Health Risks

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Various methods have been developed and applied over the years to document human exposures to particulate matter (PM) in both indoor and outdoor environments for the assessment of risk. Generally, there are several ways through which exposure routes and levels and related health impacts can be determined. This includes the direct measurement of ambient PM levels using stationary or mobile sampling equipment, equipping human subjects with personal air quality monitors to more thoroughly assess exposures as a consequence of time-activity patterns in various microenvironments, using environmental indicators such as plants to measure and monitor air quality and collecting human biological materials such as urine and blood to measure chemical constituents or the metabolic by-products of PM exposures. This information, combined with epidemiological, occupational and clinical investigations, is critical in furthering our ability to fully assess the human and environmental health risks associated with airborne PM. This part contains six contributions that discuss exposures to PM and its constituents in both humans and environmental media and their health risks. These are described as follows.

In the first chapter, Walker discusses the use of snow, soil and lichens to monitor contaminant levels in airborne PM in North-Eastern European Russia. As part of this, Walker provides evidence for the particle-bound transport of metals via the deposition of coal fly-ash from power generating stations, an important source of airborne emissions in this region. The use of biomonitoring to assess exposures of toxic constituents in ambient PM in urban and industrialized areas is discussed by Klumpp and Ro-Poulsen in the second chapter. Specifically, they present two widely applied biomonitoring procedures in Europe: the standardised ryegrass exposure method for monitoring trace metals and the standardised exposure of curly kale for monitoring polycyclic aromatic hydrocarbons (PAHs). In presenting the results of a Europe-wide biomonitoring study undertaken in eleven cities using these two procedures, they highlight the value of biomonitoring to assess trace metal and PAH pollution in urban areas. The third chapter, authored by Sabaliauskas and Evans address the outdoor and indoor exposures to ultrafine PM in cities, which have a diameter of less than

100 nm. Although they contribute little to the overall PM mass found in urban air, they are the most prevalent in terms of particle number and may pose the greatest health risk due to their size. Sabaliauskas and Evans discuss the various sources and processes which influence ultrafine concentrations and the important factors to be considered in the design of human exposure studies in urbanized areas. In the fourth chapter, Iavicoli et al. provide a comprehensive overview of current knowledge regarding the environmental monitoring of subjects occupationally exposed to urban PM such as traffic police and taxi and bus drivers. As they discuss, studies have provided clear evidence for an association between occupational exposures to urban PM, especially that derived from traffic, and adverse health effects. Among other things, their discussion emphasizes the need to directly monitor exposures among those occupationally exposed, as air quality data derived fixed monitoring stations are not likely reflective of the actual exposures which occur in roadside environments. Kappos provides an overview of the results of epidemiological and clinical investigations which have linked ambient PM exposures to a variety of negative human health outcomes in the fifth chapter. Effects which are particularly relevant to public health policy are the focus of discussion, including the body of evidence linking short-term exposures to cardiovascular and respiratory morbidity and mortality and that relating long-term exposures to respiratory health in children and the development of cancer. Finally, Wiseman and Zereini review current knowledge regarding platinum group element (PGE) levels measured in airborne PM of biological concern and discuss their possible health effects in humans. As they argue, recent studies on PGE in biologically relevant media such as airborne fine and ultrafine PM suggest that exposures to these metals are indeed a human health concern due to their mobility and solubility in the environment, their potential to be transformed into more toxic species upon uptake by humans and by the very fact that the contribute to a suite of metals found in fine PM that have been associated with various negative health effects.