

TRACE METALS IN THE ENVIRONMENT

VOLUME 6—Cobalt

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Editors**

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An Appraisal of Environmental Exposure

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PREFACE

In 1972 the National Institute of Environmental Health Sciences (NIEHS) initiated a program with Midwest Research Institute (MRI) to appraise environmental exposure to specific heavy metals in all their chemical forms and to evaluate the potential environmental and human health effects of the resulting exposures.

This book on cobalt is one of a series of comprehensive documents that resulted from this program. It appraises sources of environmental cobalt in all its chemical forms, and evaluates the potential environmental and human health effects of resulting exposure. Specifically, this book identifies natural and anthropogenic sources of cobalt in the environment; evaluates the chemical forms, quantities and modes of transport of cobalt moving through the environment; assesses human exposure to cobalt through inhalation, drinking water, the food chain and dermal contacts; and, finally, assesses the human health hazards expected from these environmental exposures.

Chapters of this book were written by senior- and mid-level staff at MRI with expertise in environmental chemistry (Bonnie L. Carson, Senior Chemist; Dr. Ralph R. Wilkinson, Senior Technology Scientist; and Christopher J. Cole, Assistant Environmental Scientist); pharmacology (Dr. Betty L. Hernon, Senior Physiologist); biochemistry (Dr. Robert A. Jacob, Senior Chemist); analytical chemistry [Dr. Glenn M. Trischan, Associate Analytical Chemist (currently at the Globe Union Division, Johnson Control Corporation, Milwaukee, Wisconsin)]; and agronomy (Joy L. McCann, Assistant Scientist). The technical editors, Bonnie L. Carson and Dr. Ivan C. Smith, have each served as project leader and/or principal investigator on the NIEHS program since its inception. The editors wish to express their appreciation to Dr. Ernest Angino of the University of Kansas for technical editing of Chapters IV and V. Particular thanks are due to Dr. Edward W. Lawless, Head of the Technology Assessment Section, and Ms. Doris Nagel for editorial comments; to the MRI library staff, who helped procure the more than 2000 references cited herein; and to the MRI word processing staff, which is headed by Ms. Audene Cook, especially Ms. Elaine J. Kent and Ms. Barbara Malson.

Finally, we thank Dr. Warren T. Piver (Project Officer) and Dr. Hans Falk of NIEHS for their support, encouragement and patience throughout the many years of our association.



Ivan C. Smith is Director of the Saudi Arabian-United States Program for Cooperation in the Field of Solar Energy at the Solar Energy Research Institute, a division of Midwest Research Institute. Prior to this assignment he was Senior Advisor for Environmental Science at Midwest Research Institute, where he was actively involved in studies of the relationship between the geochemical environment and health and disease for over 15 years. His areas of expertise include identification and control of chemical emissions to the environment, their environmental persistence, routes to the human population, and impact on human health and the environment.

Dr. Smith was co-chairman (1976-1979) of the National Academy of Sciences Subcommittee, Geochemical Environment in Relation to Health and Disease, a charter member and president (1977-1978) of the Society of Environmental Geochemistry and Health, and is a past chairman of the Kansas City Section of the American Chemical Society. He is co-author of seven books, a book chapter and many technical publications and reports. He has served on numerous national panels relating to this field. He is currently Associate Editor of *Science of the Total Environment*.

Dr. Smith received his PhD in Physical Chemistry from Kansas State University in 1961 and his BS from Emporia State University in 1956. He is a member of Sigma Xi, Phi Kappa Phi, Lambda Delta Lambda, Phi Lambda Upsilon and the Scientific Research Society of America.



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Ms. Carson graduated *summa cum laude* from the University of New Hampshire in 1963 with a BA in Chemistry. She received her MS in Organic Chemistry from Oregon State University in 1966. She has been an organic chemistry laboratory instructor at the University of Waterloo in Ontario; an assistant abstractor at Chemical Abstracts Service; and a free-lance Russian translator. She is a member of the American Chemical Society, Iota Sigma Pi, Phi Kappa Phi, the American Institute of Chemists, the Society for Environmental Geochemistry and Health, and the American Association for the Advancement of Science. She has co-authored with Dr. Smith a journal article on osmium and a book chapter on trace metals in new and used petroleum products.

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