

8. REFERENCES

Abbey DE. 1994a. Incidence of respiratory symptoms and chronic disease in a non-smoking population as a function of long-term cumulative exposure to ambient air pollutants (Adventist health study of smog follow-up study). Volume 1. Final Report. California Environmental Protection Agency, Air Resources Board, Research Division, Sacramento, CA.

Abbey DE. 1994b. Incidence of respiratory symptoms and chronic disease in a non-smoking population as a function of long-term cumulative exposure to ambient air pollutants (Adventist health study of smog follow-up study). Volume 2. Final Report. California Environmental Protection Agency, Air Resources Board, Research Division, Sacramento, CA.

Abbey DE, Lebowitz MD, Mills PK, et al. 1995. Long-term ambient concentration of particulates and oxidants and development of chronic disease in a cohort of nonsmoking California residents. *Inhalation Toxicology* 7:19-34.

Abbey DE, Mills P, Beeson L, et al 1990. Incidence of respiratory symptoms and chronic diseases in a non-smoking population as a function of long-term cumulative exposure to ambient air pollutants (AHSMOG follow-up study). Loma Linda University, Center for Health Promotion, CA.

Abbey DE, Petersen F, Mills PK, et al. 1993. Long-term ambient concentrations of total suspended particulates, ozone, and sulfur dioxide and respiratory symptoms in a nonsmoking population. *Arch Environ Health* 48:33-46.

Abeles FB, Craker KE, Forrence LE, et al. 1971. Fate of air pollutants: Removal of ethylene, sulfur dioxide, and nitrogen dioxide by soil. *Science* 173:914-916.

Ackerman-Liebrich U, Leuenberger P, Schwartz J, et al. 1997. Lung function and long term exposure to air pollutants in Switzerland. *Am J Respir Crit Care Med* 155:122-129.

*ACGIH. 199 1. Documentation of the threshold limit values and biological exposure indices. 6th ed. American Conference of Governmental Industrial Hygienists. Cincinnati, OH.

*ACGIH. 1994. Threshold limit values for chemical substances and physical agents and biological exposure indices. American Conference of Governmental Industrial Hygienists. Cincinnati, OH.

Adams JB. 1997. Food additive-additive interactions involving sulphur dioxide and ascorbic and nitrous acids: a review. *Food Chemistry* 59:401-409.

*Adams DF, Appel BR, Dasgupta PK, et al. 1987. Determination of sulfur dioxide emissions in stack gases by pulsed fluorescence (Method 714). In Lodge JP, ed. *Methods of air sampling and analysis*. 3rd ed. Chelsea, MI: Lewis Publishers, Inc. 533-537.

*Adams DF, Falgout D, Frohlinger JO, et al. 197 1. Tentative method of analysis for sulfur dioxide content of the upper atmosphere (manual conductimetric method). *Health Sciences Lab* 8:42-47.

*Cited in text

- *Adinolfi, M. 1985. The development of the human blood-CSF-brain barrier. *Developmental Medicine & Child Neurology* 27:532-537.
- *Agocs MM, White MC, Ursicz G, et al. 1997. A longitudinal study of ambient air pollutants and the lung peak expiratory flow rates among asthmatic children in Hungary. *Int J Epidemiol* 26:1272-1280.
- *Ahlborg G, Hogstedt C, Sundell L, et al. 1981. Laryngeal cancer and pickling house vapors. *Stand J Work Env Health* 7:239-240.
- *Alarie Y, Krumm AA, Busey WM, et al. 1975. Long-term exposure to sulfur dioxide, sulfuric acid mist, fly ash, and their mixtures: Results of studies in monkeys and guinea pigs. *Arch Environ Health* 30:254-263.
- *Alarie Y, Uh-ich CE, WM Busey, et al. 1972. Long-term continuous exposure to sulfur dioxide in Cynomolgus monkeys. *Arch Environ Health* 24: 115-128.
- *Alarie Y, Wakisaka I, Oka S. 1973. Sensory irritation by sulfur dioxide and chlorobenzilidene malononitrile. *Environ Physiol Biochem* 3:53-64.
- *Altman, PK, and Dittmer, DS 1974. In: *Biological Handbooks: Biology Data Book, Volume III, Second Edition*. Bethesda, MD: Federation of American Societies for Experimental Biology, 1987-2008,204lc
- Altshuller AP. 1973. Atmospheric sulfur dioxide and sulfate: distribution of concentrations at urban and non-urban sites in the United States. *Environmental Science & Technology* 7:709-712.
- *Amdur MO. 1959. The physiological response of guinea pigs to atmospheric pollutants. *Int J Air Pollut* 1:170-183.
- *Amdur MO. 1966. Respiratory absorption data and sulfur dioxide dose-response curves. *Arch Environ Health* 12:729-732.
- *Amdur MO. 1969. Toxicologic appraisal of particulate matter, oxides of sulfur, and sulfuric acid. *Journal of the Air Pollution Control Association* 19:638-644.
- *Amdur MO. 1974. 1974 Cummings Memorial Lecture. The long road from Donora. *Am Ind Hyg Assoc J* 35:589-597.
- Amdur MO. 1989. Health effects of air pollutants: Sulfuric acid, the old and the new. *Environ Health Perspect* 81:109-113.
- Amdur MO, Chen LC. 1989. Furnace-generated acid aerosols: Speculation and pulmonary effects. *Environ Health Perspect* 79:147-150.
- *Amdur MO, Doull J, Klaassen C, eds. 1991. *Casarett and Doull's toxicology: The basic sciences of poisons*. 4th ed. New York, NY: Pergamon Press.
- *Amdur MO, Melvin WW, Drinker P. 1953. Effects of inhalation of sulphur dioxide by man. *The Lancet* 2:758-759.

Anderson A. 1950. Possible long term effects of exposure to sulphur dioxide. *Brit J Ind Med* 782-86.

*Andersen ME, Krishnan K. 1994. Relating *in vitro* to *in vivo* exposures with physiologically-based tissue dosimetry and tissue response models. In: Salem H, ed. *Animal test alternatives*. Aberdeen Proving Ground, MD: U.S. Army Chemical Research Development and Engineering Center.

*Anderson HR, Ponce de Leon A, Bland JM, et al. 1996. Air pollution and daily mortality in London: 1987-92. *BMJ* 312:665-669.

*Anderson HR, Spix C, Medina S, et al. 1997. Air pollution and daily admissions for chronic obstructive pulmonary disease in 6 European cities: results from the APHEA project. *Eur Respir J* 10: 1064- 1071.

*Andersen ME, Clewell HJ,III, Gargas ML, et al. 1987. Physiologically based pharmacokinetics and the risk assessment process for methylene chloride. *Toxicol Appl Pharmacol* 87: 185-205.

*Andersen I, Lundqvist GR, Jensen PL, et al. 1974. Human response to controlled levels of sulfur dioxide. *Arch Environ Health* 28:31-39.

*Andersen ME, Krishnan K. 1994. Relating *in vitro* to *in vivo* exposures with physiologically based tissue dosimetry and tissue response models In: Salem H, ed. *Animal test alternatives: Refinement, reduction, replacement*. New York, NY: Marcel Dekker, Inc., 9-25.

*Andersen ME, Clewell HJ III, Gargas ML, et al. 1987. Physiologically based pharmacokinetics and the risk assessment process for methylene chloride. *Toxicol Appl Pharmacol* 87: 185-205.

Anjemo R, Koch B, Runn P, et al. 1994. Toxic clouds: The toxicological properties of seven chemicals and assessment of injuries after an accident. *Foersvarets Forskningsanalt*, Umea (Sweden).

*Anonymous. 1996a. Adsorption process shows promise for simultaneous removal of SO₂ and NO_x. *The Air Pollution Consultant* May/June: 1.6-1 .8.

Anonymous. 1996b. Technical topics of interest: Most criteria pollutants expected to increase slightly after 2000. *The Air Pollution Consultant* May/June: 1.18-1 .2 1.

*Appel BR, Tanner RL, Adams DF, et al. 1987. Semi-continuous determination of atmospheric particulate sulfur, sulfuric acid and ammonium sulfates (Method 7 13). In Lodge JP, ed. *Methods of air sampling and analysis*. 3rd ed. Chelsea, MI: Lewis Publishers, Inc. 529-532.

*Archer VE, Gillam JD. 1978. Chronic sulfur dioxide exposure in a smelter. II. Indices of chest disease. *J Occup Med* 20:88-95.

Arritt RW. 199 1. A numerical modeling technique for estimating sulfur dioxide dry deposition due to local source emissions. *J Air Waste Manage Assoc* 41:1341-1347.

Ash RM, Lynch JR. 1972. The evaluation of gas detector tube systems: Sulfur dioxide. *Am Ind Hyg Assoc J* 32:490-491

*Atkinson DA, Sim TC, Grant JA. 1993. Sodium metabisulfite and sulfur dioxide release: An under-recognized hazard among shrimp fishermen. *Ann Allergy* 7 1:563-566.

- *ATSDR/CDC. 1990. Subcommittee report on biological indicators of organ damage. Agency for Toxic Substances and Disease Registry, Centers for Disease Control and Prevention, Atlanta, GA.
- *ATSDR. 1989. Decision guide for identifying substance-specific data needs related to toxicological profiles. Agency for Toxic Substances and Disease Registry, Division of Toxicology, Atlanta, GA.
- Atzori L, Bannenberg G, Corrigan AM, et al. 1992a. Sulfur dioxide-induced bronchoconstriction in the isolated perfused and ventilated guinea-pig lung. *Respiration* 59:16-21.
- Atzori L, Bannenberg G, Corrigan AM, et al. 1992b. Sulfur dioxide-induced bronchoconstriction via ruthenium red-sensitive activation of sensory nerves. *Respiration* 59:272-278.
- *Bacharova L, Fandakova K, Bratka J, et al. 1996. The association between air pollution and the daily number of deaths: findings from the Slovak Republic contribution to the APHEA project. *J Epidemiol Community Health* 50(Suppl 1):S19-S21.
- *Balchum GJ, Dybicki J, Meneely GR. 1959a. Absorption and distribution of ³⁵sulfur dioxide inhaled through the nose and mouth by dogs. *Am J Physiol* 197: 1317-1321.
- *Balchum GJ, Dybicki J, Meneely R. 1959b. Measurement of pulmonary resistance and compliance with concurrent tissue radioactive sulfur distributions in dogs inhaling a labeled air pollutant-sulfur dioxide [Abstract]. *Fed Proc* 18:6.
- *Balchum OJ, Dybicki J, Meneely GR. 1960a. The dynamics of sulfur dioxide inhalation, absorption, distribution and retention. *Arch Ind Health* 21:564-569.
- *Balchum OJ, Dybicki J, Meneely GR. 1960b. Pulmonary resistance and compliance with concurrent radioactive sulfur distribution in dogs breathing sulfur dioxide. *J Appl Physiol* 15:62-66.
- *Ballester F, Corella D, Perez-Hoyos S, et al. 1996. Air pollution and mortality in Valencia, Spain: a study using the APHEA methodology. *J Epidemiol Community Health* 50:527-533.
- *Balmes JR, Fine JM, Sheppard D. 1987. Symptomatic bronchoconstriction after short-term inhalation of sulfur dioxide. *Am Rev Respir Dis* 136: 1117-1121.
- *Bannenberg G, Atzori L, Xue J, et al. 1994. Sulfur dioxide and sodium metabisulfite induce bronchoconstriction in the isolated perfused and ventilated guinea pig lung via stimulation of capsaicin-sensitive sensory nerves. *Respiration* 61: 130-137.
- Barale R, Barrai I, Sbrana I, et al. 1993. Monitoring human exposure to urban air pollutants. *Environ Health Perspect Suppl* 101:89-95.
- *Barnes DG, Dourson M. 1988. Reference dose (RfD): Description and use in health risk assessments. U.S. Environmental Protection Agency. *Regul Toxicol Pharmacol* 8:471-486.
- Barnes PJ. 1986. Neural control of human airways in health and disease. *Am Rev Respir Dis* 134: 1289-

- Barrie LA, Georgii HW. 1976. An experimental investigation of the absorption of sulphur dioxide by water drops containing heavy metal ions. *Atmos Environ* 10:743-749.
- Basbaum C, Gallup M, Gum J, et al. 1990. Modification of mucin gene expression in the airways of rats exposed to sulfur dioxide. In: Puchelle E, ed. *Proceedings-Part I, Seventh International Congress of Biorheology*, Nancy, France, June 18-23, 1989. Symposium: Cellular and Molecular Aspects of Mucus and Cilia. New York: Pergamon Press, 485-489.
- Bascom R, Bromberg PA, Costa DA, et al. 1996. *Am J Respir Crit Care Med* 153:3-50.
- *Baskurt OK. 1988. Acute hematologic and hemorheologic effects of sulfur dioxide inhalation. *Arch Environ Health* 43: 344-348.
- *Baskurt OK, Levi E, Andac SO, et al. 1990. Effect of sulfur dioxide inhalation on erythrocyte deformability. *Clinical Hemorheology* 10:485-490.
- Bates DV, Sizto R. 1987. Air pollution and hospital admissions in Southern Ontario: The acid summer haze effect. *Environ Res* 43:317-331.
- Batterman S, Osak I, Gelman C. 1997. SO₂ sorption characteristics of air sampling filter media using a new laboratory test. *Atmos Environ* 31:1041-1047.
- Beck-Speier I, Kreyling WG, Luippold GB, et al. 1990. Sulfite oxidase activity in rat nasal tissue and pathologic responses to inhalation of sulfur oxides. *J Aerosol Sci* 21:S463-S466.
- Ben-Jebria A, Full AP, DeMaria DD, et al. 1990. Dynamics of sulfur dioxide absorption in excised porcine tracheae. *Environ Res* 53:119-134.
- *Benner WH, Ogorevc B, Novakov T. 1992. Oxidation of sulfur dioxide in thin water containing NH₃. *Atmos Environ* 26A:1713-1723.
- Berry RD, Colls JJ. 1990. Atmospheric carbon dioxide and sulphur dioxide on an urban/rural transect-I. Continuous measurements at the transect ends. *Atmos Environ* 24A:2681-2688.
- Bethel RA, Epstein J, Sheppard D, et al. 1983. Sulfur dioxide-induced bronchoconstriction in freely breathing, exercising, asthmatic subjects. *Am Rev Respir Dis* 128:987-990.
- Bethel RA, Erle DJ, Epstein J, et al. 1983. Effect of exercise rate and route of inhalation on sulfur dioxide-induced bronchoconstriction in asthmatic subjects. *Am Rev Respir Dis* 128:592-596.
- *Bethel RA, Sheppard D, Epstein J, et al. 1984. Interaction of sulfur dioxide and dry cold air in causing bronchoconstriction in asthmatic subjects. *J Appl Physiol: Respir Environ Exercise Physiol* 57:4 19-423.
- *Bethel RA, Sheppard D, Geffroy B, et al. 1985. Effects of 0.25 ppm sulfur dioxide on airway resistance in freely breathing, heavily exercising, asthmatic subjects. *Am Rev Respir Dis* 13 1:659-661.
- Bhopal RS, Phillimore P, Moffatt S, et al. 1994. Is living near a coking works harmful to health? A study of industrial air pollution. *J Epidemiol Community Health* 48:237-247.

- Bond GG, Cook RR, Wight PC, et al. 1983. A case-control study of brain tumor mortality at a Texas chemical plant. *J Occup Med* 25:377-386.
- *Bond GG, Flores GH, Shellenberger RJ, et al. 1986. Nested case-control study of lung cancer among chemical workers. *Am J Epidemiol* 124:53-66.
- *Bourque CP-A, Arp PA. 1996. Simulating sulfur dioxide plume dispersion and subsequent deposition downwind from a stationary point source: a model. *Environmental Pollution* 91:363-380.
- Brook JR, Sirois A, Clarke JF. 1996. Comparison of dry deposition velocities for SO₂, HNO₃, and SO₂⁻⁴ estimated with two inferential models *Water Air Soil Pollut* 87:205-218.
- *Brooks S. 1992. Occupational and Environmental Asthma. In: Rom WR, MD, ed. *Environmental Occupational Medicine*. Boston, MA: Little Brown and Co., 393-446.
- *Brooks SM, Weiss MA, IL Bernstein. 1985. Reactive airways dysfunction syndrome (RADS): Persistent asmata syndrome after high level irritant exposures. *Chest* 88:376-384.
- Brunekreef B, Dockery DW, Krzyzanowski M. 1995. Epidemiological studies on short-term effects of low levels of major ambient air pollution components. *Environ Health Perspect* 103:3- 13.
- *Buchdahl R, Parker A, Stebbings T, et al. 1996. Association between air pollution and acute childhood wheezy episodes: prospective observational study. *BMJ* 312:661-665.
- Buchholtz WF, Crow WL. 1990. Relating SARA Title III emissions to community exposure through ambient air quality measurements [Abstract]. In: *Proceedings of the Annual Meeting of the Air and Waste Management Association*.
- *Bufalini M. 1971. Oxidation of sulfur dioxide in polluted atmospheres-- a review. *Environmental Sciences & Technology* 5:685-703.
- *CA ARB. 1998. Table of Standards. California Air Resources Board. California Code of Regulations, Title 17, Secion 70200.
- *Cabre F, Marin C, Cascante M, et al. 1990. Occurrence and comparison of sulfite oxidase activity in mammalian tissues. *Biochem Med Metab Biol* 43:159-162.
- *CDC. 1996. Physical activity and health: A report of the Surgeon General executive summary. U.S. Department of Health and Human Services, Center for Disease Control and Prevention, National Center for Chronic Disease Prevention and Health Promotion, The President's Council on Physical Fitness and Sports.
- *Charan NB, Myers CG, Lakshminarayan S, et al. 1979. Pulmonary injuries associated with acute sulfur dioxide inhalation. *Am Rev Respir Dis* 119:555-560.
- *Chen Z, Zhang Y, Wang Y, et al. 1990. An estimate of the conversion rates of SO₂, to SO₄²⁻, and NO₂ to HNO₃ + NO₃⁻ for the evaluation air pollution in Beijing. *J Environ Sci (China)*2:4 1-48.
- Ciccone G, Faggiano F, Falasca P. 1995. Sulfur dioxide air pollution and hospital admissions in Ravenna: A case-control study. *Epidemiol Prev (Italy)* 19:99-104.

Cirillo MC, Clerici G, Manzi D. 1990. Atmospheric transport of sulphur dioxide on a local scale: A case study. In: *Developments in Environmental Modelling*, 16. *Modelling in Ecotoxicology*. New York, NY: Elsevier Science Publishing Co., Inc.

*Clewell HJ III, Andersen ME. 1985. Risk assessment extrapolations and physiological modeling. *Toxicol IndHealth* 1:111-131.

*CO DPHE. 1998. Colorado Department of Public Health and Environment, Air Pollution Control Division. 5 Colorado Code of Regulations. 1001 - 14.

*Cohen HJ, Drew RT, Johnson JL, et al. 1973. Molecular basis of the biological function of molybdenum. The relationship between sulfite oxidase and the acute toxicity of bisulfite and SO₂. *Proc Nat Acad Sci* 70:3655-3659.

*Cohen HJ, Johnson JL, Rajagopalan KV. 1974. Molecular basis of the biological function of molybdenum. Developmental patterns of sulfite oxidase and xanthine oxidase in the rat. *Arch Biochem Biophys* 164:440-446.

*Constantin D, Bini A, Meletti E, et al. 1996. Age-related differences in the metabolism of sulphite to sulphate and in the identification of sulphur trioxide radical in human polymorphonuclear leukocytes. *Mech Ageing Dev* 88:95-109.

*Constantin D, Mehrotra K, Rahimtula A, et al. 1994. Stimulatory effects of sulfur and nitrogen oxides on carcinogen activation in human polymorphonuclear leukocytes" *Environ Health Perspect* 102: 161 - 164.

*Cox RA, Penkett SA. 1970. The photo-oxidation of sulfur dioxide in sunlight. *Atmos Environ* 4:425-433.
Cox RA, Penkett SA. 1971. Oxidation of atmospheric sulfur dioxide by products of the ozone-olefin reaction. *Nature* 230:321-322.

*CT DEP. 1998. Connecticut primary and secondary standards. Connecticut Department of Environmental Protection, Bureau of Air Management. 22a-174-24.

*Cureton KJ. 1987. Commentary on "Children and fitness: A public health perspective." *Res Q Exert Sport* 58:315-320.

Dab W, Medina P, QuCnel S, Le Moullec Y, et al. 1996. Short term respiratory health effects of ambient air pollution: results of the APHEA project in Paris. *J Epidemiol Comm-n Health* SO(Supp1 1):S42-S46.

*Dalhamn T, Strandberg L. 1961. Acute effect of sulphur dioxide on the rate of ciliary beat in the trachea of rabbit, in vivo and in vitro, with studies in the absorptional capacity of the nasal cavity. *Int J Air Water Pollut* 4:154-167.

Dalton SM, Toole-O'Neil B, Gullett BK, et al. 1992. Summary of the 1991 EPRI/EPA/DOE sulfur dioxide Control Symposium. *Control Technology* 42:1110-1117.

Davies MH, Ngong JM, Pean A, et al. 1995. Sulphoxidation and sulphation capacity in patients with primary biliary cirrhosis. *Journal of Hepatology* 22:55 1-560.

De Boer KF, Thomas R. 1991. Scenario analyses using the Dutch acidification systems model emission and deposition scenarios sulfur dioxide nitrogen oxides and ammonia. In Heij GJ, Schneider T, eds. *Studies in Environmental Science*, 46. Acidification Research in the Netherlands: Final Report of the Dutch Priority Programme in Acidification, New York, NY: Elsevier Sciences Publishers Co., Inc.

*Department of Labor. 1975. Occupational exposure to sulfur dioxide. *Federal Register* 40:54520-54534.

De Santis F, Allefrini E, Fazio MC, et al. 1997. Development of a passive sampling technique for the determination of nitrogen dioxide and sulphur dioxide in ambient air. *Analytica Chimica Acta* 346:127-134.

*Deshmane V, Lee CM, Sublette KL. 1993. Microbial reduction of sulfur dioxide with pretreated sewage sludge and elemental hydrogen as electron donors. *Applied Biochem Biotechnol* 39/40:739-752.

*Devalia JL, Rusznak C, Herdman MJ, et al. 1994. Effect of nitrogen dioxide and sulfur dioxide on airway response of mild asthmatic patients to allergen inhalation. *Lancet* 344: 1668-71.

*Dikmenoglu N, Baskurt OK, Levi E, et al. 1991. How does sulphur dioxide affect erythrocyte deformability? *Clinical Hemorheology* 11:497-499.

*Dockery DW, Ware JH, Ferris BG, et al. 1982. Change in pulmonary function in children associated with air pollution episodes. *J Air Pollut Control Assoc* 32:937-942.

*Dodge R, Solomon P, Moyers J, et al. 1985. A longitudinal study of children exposed to sulfur oxides. *Am J Epidemiol* 121:730-736.

*DOE. 1996. Assessing historical global sulfur emission patterns for the period 1850-1990. Washington, DC: Office of Planning and Analysis, Department of Energy. NTIS no. DE96-014790.

*DOT. 1995. U.S. Department of Transportation Code of Federal Regulations 49 CFR 171.77/49 CFR 171.2.

*DOT. 1998. U.S. Department of Transportation. Code of Federal Regulations 49 CFR 172.101. Table of Hazardous Materials and Special Provisions.

Douglas GJ, Price JF, Page CP. 1994. A method for the long-term exposure of rabbits to environmental pollutant gases. *Eur Respir J* 7:1516-1526.

Dunn S. 1997a. Atmospheric trends: Carbon emissions set new record. In: O'Meara M, ed. *Worldwatch Institute Report: Vital Signs*. New York, NY: W.W. Norton & Company, Inc., 58-59.

Dunn S. 1997b. Atmospheric trends: Global temperature down slightly. In: O'Meara M, ed. *Worldwatch Institute Report: Vital Signs*. New York, NY: W.W. Norton & Company, Inc., 62-63.

Dzubay TG, Stevens RK. 1975. Ambient air analysis with dichotomous sampler and x-ray fluorescence spectrometer. *Environ Sci Technol* 9:663-668.

*Ellenhorn MJ, Barceloux DG. 1988. *Medical toxicology: diagnosis and treatment of human poisoning*. New York, NY: Elsevier Science Publishing Co., Inc, 874-875.

Ellison JM. 1965. The nature of air pollution and the methods available for measuring it. *Bull World Health Organ* 32:399-409.

Endecott BR, Sanders DC, Chaturvedi AK. 1996. Simultaneous gas chromatographic determination of four toxic gases generally present in combustion atmospheres. *J Anal Toxicol* 20: 189-194.

Engi D, Boozer DD, Church HW, et al. 1992. Toxicological effects of Kuwaiti oil fires. Sandia National Labs, Albuquerque, NM.

Enterline PE, Marsh GM. 1982. Cancer among workers exposed to arsenic and other substances in a copper smelter. *Am J Epidemiol* 116:895-911.

*Enterline PE, Marsh GM, Esmen NA, et al. 1987. Some effects of cigarette smoking, arsenic and sulfur dioxide on mortality among US copper smelter workers. *J Occup Med* 29:831-838.

EPA. 1984. Health effects assessment for sulfuric acid. Cincinnati, OH: U.S. Environmental Protection Agency, Environmental Criteria and Assessment Office. EPA/540/1-86/031.

*EPA. 1986a. Method 9035: Sulfate (calorimetric, automated, chloranilate). In: Test methods for evaluating solid waste-physical/chemical methods. September 1986. 9035-1-9035-6.

*EPA. 1986b. Method 9036: Sulfate (calorimetric, automated, methylthymol blue, AA II). In: Test methods for evaluating solid waste-physical/chemical methods. September 1986. 9036-1-9036-7.

*EPA. 1986c. Method 9038: Sulfate (turbidimetric). In: Test methods for evaluating solid wastephysical/chemical methods. September 1986. 9038-1-9038-6.

*EPA. 1986d. Second addendum to air quality criteria for particulate matter and sulfur oxides (1982): Assessment of newly available health effects information. Environmental Criteria and Assessment (MD-22), Office of Health and Environmental Assessment (ORD), U.S. Environmental Protection Agency, Research Triangle Park, NC. December 1986. EPA document number PB87-176574.

EPA. 1990. Acid aerosol deposition in the developing human lung. Research Triangle Park, NC: U.S. Environmental Protection Agency, Health Effects Research Lab. EPA/600/D-90/132.

EPA. 1990. Emission Factors for Iron Foundries: Criteria and Toxic Pollutants. Research Triangle Park, NC: Environmental Protection Agency, Air and Engineering Research Lab.

*EPA. 1990. Interim methods for development of inhalation reference doses. U.S. Environmental Protection Agency. EPA 600/8-90-066A.

EPA. 1991. Air/Superfund National Technical Guidance Study Series. Emission Factors for Superfund Remediation Technologies. Washington, DC: Environmental Protection Agency, Office of Emergency and Remedial Response.

EPA. 1993. Guidance on the application of refined dispersion models for hazardous/toxic air releases (Final Report). Research Triangle Park, NC: Environmental Protection Agency, Office of Air Quality Planning and Standards.

- EPA. 1993. National air pollutant emission trends, 1900-1992. Research Triangle Park, NC: Environmental Protection Agency, Office of Air Quality Planning and Standards.
- *EPA. 1994a. National Air Pollutant Emission Trends, 1900-1993. Research Triangle Park, NC: Environmental Protection Agency, Office of Air Quality Planning and Standards.
- *EPA. 1994b. Review of the National Ambient Air Quality Standards for Sulfur Oxides: Assessment of Scientific and Technical Information. Supplement to the 1986 OAQPS Staff Paper Addendum (Final Report). Research Triangle Park, NC: Environmental Protection Agency, Office of Air Quality Planning and Standards.
- EPA. 1994c. Supplement to the second addendum (1986) to air quality criteria for particulate matter and sulfur oxides (1982): Assessment of new findings on sulfur dioxide acute exposure health effects in asthmatic individuals. Washington, DC: Environmental Protection Agency, Office of Health and Environmental Assessment.
- *EPA. 1995a. U.S. Environmental Protection Agency. Code of Federal Regulations 40 CFR 180.444.
- *EPA. 1995b. U.S. Environmental Protection Agency. Code of Federal Regulations 40 CFR 302.4.
- *EPA. 1995c. U.S. Environmental Protection Agency. Code of Federal Regulations 40 CFR 60, Appendix A.
- EPA. 1996. U.S. Environmental Protection Agency. National air quality and emissions trends report, 1995. Research Triangle Park, NC: Office of Air Quality Planning and Standards, Emissions Monitoring and Analysis Division, Air Quality Trends Analysis Group. EPA 454/R-96-005.
- *EPA. 1997. EPA's proposed implementation requirements for SO₂ reduction. U.S. Environmental Protection Agency. Code of Federal Regulations 40 CFR 51.
- *EPA. 1998a. U.S. Environmental Protection Agency. Code of Federal Regulations 40 CFR 50.4. National primary ambient air quality standards for sulfur oxides (sulfur dioxide).
- *EPA. 1998b. U.S. Environmental Protection Agency. Code of Federal Regulations 40 CFR 50.5. National secondary ambient air quality standard for sulfur oxides (sulfur dioxide).
- *EPA. 1998c. U.S. Environmental Protection Agency. Code of Federal Regulations 40 CFR 116.4. Designation of hazardous substances.
- *EPA. 1998d. U.S. Environmental Protection Agency. Code of Federal Regulations 40 CFR 180.444. Sulfur dioxide; tolerances for residues.
- *EPA. 1998e. U.S. Environmental Protection Agency. Code of Federal Regulations 40 CFR 180.1013. Sulfur dioxide from use in fumigants for stored grains; exemption from the requirement of a tolerance.
- *EPA. 1998f. U.S. Environmental Protection Agency. Code of Federal Regulations 40 CFR 355. Appendix A to Part 355: The list of extremely hazardous substances and their threshold planning quantities.

- *EPA. 1998. U.S. Environmental Protection Agency. Code of Federal Regulations 40 CFR 372.65. Toxic chemical release reporting: community right-to-know. Chemicals and chemical categories to which this part applies.
- Erismann JW, Versluis AH, Verplanke TA, et al. 1993. Monitoring the dry deposition of sulfur dioxide in the Netherlands: Results for grassland and heather vegetation. *Atmos Environ* 27A:1153-1161.
- *Esmen NA, Marsh GM, Stone RA, et al. 1997. Quantifying individual residential exposure to smelter emissions in four Arizona copper smelter communities: exposure estimation procedures and results. *Toxicol Ind Health* 13(2/3):247-258.
- *Etlik O, Tomur A, Tuncer M, et al. 1997. Protective effect of antioxidant vitamins on red blood cell lipoperoxidation induced by SO₂ inhalation. *J Basic Clin Physiol Pharmacol* 8(1-2):31-43.
- Farley JM. 1992. Inhaled toxicants and airway hyperresponsiveness. *Annu Rev Pharmacol Toxicol* 32:67-88.
- *Farone A, Huang S, Paulauskis J, et al. 1995. Airway neutrophilia and chemokine mRNA expression in sulfur dioxide-induced bronchitis. *Am J Respir Cell Mol Biol* 12:345-350.
- *FDA. 1996. U.S. Food and Drug Administration Code of Federal Regulations 21 CFR 582.3862. [Retrieval in Progress]
- Federspiel CF, Layne JT, Auer C, et al. 1980. Lung function among employees of a copper mine smelter: Lack of effect of chronic sulfur dioxide exposure. *J Occup Med* 22:438-444.
- Ferris BG, Chen H, Puleo S, et al. 1978. Chronic nonspecific respiratory disease in Berlin, New Hampshire, 1967-1973.
- Feichter J, Kjellström E, Rodhe H, et al. 1996. Simulation of the tropospheric sulfur cycle in a global climate model. *Atmos Environ* 30: 1693-1707.
- *Field PI, Simmler R, Bell SC, et al. 1996. Evidence for opioid modulation and generation of prostaglandins in sulphur dioxide (SO₂)-induced bronchoconstriction. *Thorax* 51:159-163.
- Fine JM, Gordon T, Sheppard D. 1987. The roles of pH and ionic species in sulfur dioxide- and sulfite-induced bronchoconstriction. *Am Rev Respir Dis* 136: 1122- 1126.
- Fine JM, Gordon T, Thompson JE, et al. 1987. The role of titratable acidity in acid aerosol-induced bronchoconstriction. *Am Rev Respir Dis* 135:826-830.
- *Flato S, Hemminki K, Thunberg E, et al. 1996. DNA adduct formation in the human nasal mucosa as a biomarker of exposure to environmental mutagens and carcinogens. *Environ Health Perspect* 104:471-473.
- *FL DEP. 1998. Ambient air quality standards. Florida Department of Environmental Protection, Bureau of Air Regulation. 62-204.240.
- Folinsbee LJ. 1992. Human Health Effects of Air Pollution *Environmental Health Perspectives* 100:45-56.

- *Fornan SJ. 1966. Body composition of the infant. Part I: The male reference infant. In: Falkner F, ed. Human development. Philadelphia, PA: WB Saunders, 239-246.
- *Fornan, SJ, Has&e, F, Ziegler, EE, and Nelson, SE. 1982. Body composition of reference children from birth to age 10 years. American Journal of Clinical Nutrition 35: 1169-1175.
- *Forastiere F, Valesini S, Salimei E, et al. 1987. Respiratory cancer among soap production workers. *Stand J Work Environ Health* 13:258-260
- *Fowlie AJ, Grasso P, Benford DJ. 1990. The short-term effects of carcinogens and sulphur dioxide on the nuclear size of rat nasal epithelial cells. *J Applied Toxicology* 10:29-38.
- Frank NR, Amdur MO, Whittenberger JL. 1964. A comparison of the acute effects of SO₂ administered alone or in combination with NaCl particles on the respiratory mechanics of healthy adults. *Int J Air Wat Poll* 8:125-133.
- *Frank NR, Amdur MO, Worcester J, et al. 1962. Effects of acute controlled exposure to sulfur dioxide on respiratory mechanics in healthy male adults. *J Appl Physiol* 17:252-258.
- *Frank NR, Yoder RE, Brain JD, et al. 1969. Sulfur dioxide (35 S-labeled) absorption by the nose and mouth under conditions of varying concentration and flow. *Arch Environ Health* 18:3 15-322.
- *Frank NR, Yoder RE, Yokoyama E, et al. 1967. The diffusion of 35sulfur dioxide from tissue fluids into the lungs following exposure of dogs to 35sulfur dioxide I *Health Phys* 13:31-38.
- Franks AP, Harper PJ, Bilo M. 1996. The relationship between risk of death and risk of dangerous dose for toxic substances. *Journal of Hazardous Materials* 5: 11-34.
- *French JG, Lowrimore G, Nelson WC, et al. 1973. The effect of sulfur dioxide and suspended sulfates on acute respiratory disease. *Arch Environ Health* 27: 129- 133.
- *Fung CS, Misra PK, Bloxam R, et al. 1991. A numerical experiment on the relative importance of H₂O₂ and O₃ in aqueous conversion of sulfur dioxide to SO₄²⁻. *Atmos Environ* 25A:411-423.
- Furia T, ed. 1972. Handbook of food additives. 2nd ed. Cleveland, OH: CRC Press, 142-147.
- Garland JA, Atkins DHF, Readings CJ, et al. 1974. Deposition of gaseous sulfur dioxide to the ground. *Atmos Environ* 8:75-79.
- *Garland JA, Clough WS, Fowler D. 1973. Deposition of sulfur dioxide on grass. *Nature* 242:256-257.
- Gimeno L, Rua A, Hernandez E. 1997. Relationship between air pollutants emission patterns and concentrations. *Toxicol Environ Chem* 59: 189-197.
- Glasser M, Greenburg L. 1971. Air pollution, mortality, and weather, New York City. 1960-1964. *Arch Environ Health* 22:334-343.
- *Goldring IP, Greenburg L, Park SS. 1970. Pulmonary effects of sulfur dioxide exposure in the Syrian hamster: combined with emphysema. *Arch Environ Health* 21: 32-37.

Goldstein IF, Weinstein AL. 1986. Air pollution and asthma: Effects of exposures to short-term sulfur dioxide peaks. *Environ Res* 40:332-345.

*Goldstein E, Lippert W, Chang DPY, et al. 1979. Effect of near ambient exposures to sulfur dioxide and ferrous sulfate particles on murine pulmonary defense mechanisms. *Arch Environ Health* 34:424-43 1.

Gong H Jr, Linn MA, Shamo DA, et al. 1996. Effect of inhaled salmeterol on sulfur dioxide-induced bronchoconstriction in asthmatic subjects. *Chest* 110: 1229-1235.

Gorriz A, Llacuna S, Riera M, et al. 1996. Effects of air pollution on hematological and plasma parameters in *Apodemus sylvaticus* and *Mus musculus*. *Arch Environ Contam Toxicol* 31:153-158.

Graham JA, Grant LD, Folinsbee LJ, et al. 1990. Acidic Deposition: State of Science and Technology. Report 22. Direct Health Effect of Air Pollutants Associated with Acidic Precursor Emissions. (Final Report). Washington, DC: Council on Environmental Quality, National Acid Precipitation Assessment Program.

*Grant WM. 1974. Toxicology of the Eye. 2nd ed. Springfield, IL:Charles C. Thomas, 952-959.

Griffiths R, ed. 1996. Sulphur trioxide oleum and sulphuric acid mist. Rugby, Warwickshire, UK: Institution of Chemical Engineers.

Grunstein MM, Hazucha M, Sorli J, et al. 1977. Effect of SO₂ on control of breathing in anesthetized cats. *J Appl Physiol* 43:844-85 1.

*Grzesiak P, Schroeder G, Hopke W. 1997. Degradation of the natural environment resulting from the presence of sulphur compounds in the atmosphere. *Polish Journal of Environmental Studies* 6(4):45-48

*Guerra D, Roman0 P, Zambonelli C. 198 1. Mutagenic effects of sulfur dioxide on *Saccharomyces cerevisiae* dipliod strains. *Experientia* 37: 691-693.

*Gumuslu S, Akbas H, Aliciguzel Y, et al. 1998. Effects of sulfur dioxide inhalation on antioxidant enzyme activities in rat erythrocytes. *Ind Health* 36:70-73.

*Gunnison AF, Benton AW. 1971. Sulfur dioxide: Sulfite. Interaction with mammalian serum and plasma. *Arch Environ Health* 22:381-388.

*Gunnison AF, Palmes ED. 1974. S-sulfonates in human plasma following inhalation of sulfur dioxide. *Am Ind Hyg Assoc J* 35:288-291.

*Gunnison AF, Palmes ED. 1976. A model for the metabolism of sulfite in mammals. *Toxicol Appl Pharmacol* 38:111-126.

Gunnison AF, Palmes ED. 1978. Species variability in plasma S-sulfonate levels during and following sulfite administration. *Chem Biol Interact* 21:3 15-329.

*Gunnison AF, Bresnahan CA, Palmes ED. 1977. Comparative sulfite metabolism in the rat, rabbit, and rhesus monkey. *Toxicol Appl Pharmacol* 42:99-109.

*Gunnison AF, Sellakumar A, Currie D, et al. 1987. Distribution, metabolism and toxicity of inhaled sulfur dioxide and endogenously generated sulfite in the respiratory tract of normal and sulfite oxidase-deficient rats. *J Toxicol Environ Health* 21:141-162.

Gunnison AF, Sellakumar A, Snyder EA, et al. 1988. The effect of inhaled sulfur dioxide and systemic sulfite on the induction of lung carcinoma in rats by benzo(a)pyrene. *Environ Res* 46:59-73.

*Guzelian, P.S, Henry, C.J., Olin, S.S. 1992. Similarities and Differences Between Children and Adults: Implications for Risk Assessment. International Life Sciences Institute Press, Washington, D.C.

Hackney JD, Linn WS, Bailey RM, et al. 1984. Time course of exercise-induced bronchoconstriction in asthmatics exposed to sulfur dioxide. *Environ Res* 34:321-327.

*Haider SS. 1985. Effects of exhaust pollutant sulfur dioxide on lipid metabolism of guinea pig organs. *Ind Health* 23:81-87.

*Haider SS, Hasan M, Khan NH. 1982. Air pollutant sulfur dioxide-induced alterations on the levels of lipids, lipid peroxidation and lipase activity in various regions of the rat brain. *Acta Pharmacol Toxicol* 51:45-50.

*Hajj AM, Nausherwan KB, Lee L. 1996. Role of tachykinins in sulfur dioxide-induced bronchoconstriction in anesthetized guinea pigs. *J Appl Physiol* 80:2044-2050.

*Hanacek J. 1987. Influence of sulphur dioxide breathing on defensive reflexes of the airways. *Acta Physiol Hunga* 70:227-233.

*Hanacek J, Adamicova K, Briestenska J, et al. 1991. Cough reflex in rabbits 24-h and 48-h after sulphur dioxide breathing. *Acta Physiologica Hungarica* 77: 179-185.

Hanna SD, Rydbrink K, Vlahovic M, et al. 1992. California SARA Title III Section 313 data for reporting years 1987 and 1988. *Journal of Hazardous Materials* 31:277-296.

Hannemann AU, Mitra SK, Pruppacher HR. 1996. On the scavenging of gaseous nitrogen compounds by large and small rain drops: II. Wind tunnel and theoretical studies of the simultaneous uptake of NH₃, SO₂, and CO₂ by water drops. *J Atmos Chem* 24:271-284.

*Harkonen H, Nordman H, Korhonen, et al. 1983. Long-term effects of exposure to sulfur dioxide: Lung function after a pyrite dust explosion. *Am Rev Respir Dis* 128:890-893.

*HAZDAT. 1996. Agency for Toxic Substances and Disease Registry (ATSDR), Atlanta, GA.
Hazucha MJ, Kehrl HR, Roger LJ, et al. 1984. Airway responsiveness to methacholine of asthmatics exposed to 0.025, 0.5, and 1.0 ppm sulfur dioxide. *Am Rev Respir Dis* 129:A145 [Abstract].

Health SK, Koenig JQ, Morgan MS, et al. 1994. Effects of sulfur dioxide exposure on African-American and Caucasian asthmatics. *Environ Res* 66:1-11.

- Heinrich I-J, Mohr U, Fuhst R, et al. 1990. Investigation of a potential cotumorogenic effect of the dioxides of nitrogen and sulfur, and of diesel-engine exhaust, on the respiratory tract of Syrian golden hamsters. Fraunhofer-Inst fuer Toxikologie und Aerosolforschung, Hanover, FRG.
- *Helrich K, ed. 1990. Official methods of analysis of the Association of Official Analytical Chemists. Method 963.11. Arlington, VA: Association of Official Analytical Chemists, Inc., 718.
- *Hemminki K, Niemi ML. 1982. Community study of spontaneous abortions: Relation to occupation and air pollution by sulfur dioxide, hydrogen sulfide, and carbon disulfide. *Arch Occup Environ Health* 51:55-63.
- *Hilado CJ, Machado AM. 1977. Effect of sulfur dioxide on Swiss albino mice. *Journal of Combustion Toxicology* 4:236-245.
- *Hill AC. 1971. Vegetation: a sink for atmospheric pollutants. *J Air Pollut Control Assoc* 21:341-346.
- Hoheneder SD, Parrish BR, Jacobs BW, et al. 1993. Federal facility compliance demonstration with state air toxics regulations Proc., Annu. Meet. - Air Waste Manage Assoc [Abstract]
- *Hollowell CD, Gee GY, McLaughlin RD. 1973. Current instrumentation for continuous monitoring for sulfur dioxide. *Anal Chem* 45:63A-72A.
- *Holma B. 1985. Influence of buffer capacity and pH-dependent rheotological properties of respiratory mucus on health effects due to acidic pollution *Sci Total Environ* 41: 101 - 123.
- *Horstman D, Roger LJ, Kehrl H, et al. 1986. Airway sensitivity of asthmatics to sulfur dioxide. *Toxicol Ind Health* 2:289-298.
- *Horstman DH, Seal E, Folinsbee LJ, et al. 1988. The relationship between exposure duration and sulfur dioxide-induced bronchoconstriction in asthmatic subjects. *Am Ind Hyg Assoc J* 49:38-47.
- Horvath H, Charlson RJ. 1969. The direct optical measurement of atmospheric air pollution. *Am Ind Hyg Assoc J* 30:500-509.
- *HSDB. 1996. Hazardous Substances Data Bank. National Library of Medicine, National Toxicology Information Program, Bethesda, MD.
- *HSDB. 1998. Hazardous Substances Data Bank. National Library of Medicine, National Toxicology Information Program, Bethesda, MD. February 1998.
- Huang JL, Wang SY, Hsieh KH. 1991. Effect of short-term exposure to low levels of sulfur dioxide and NO_x on pulmonary function and methacholine and allergen bronchial sensitivities in asthmatic children. *Arch Environ Health* 46:296-299.
- *Huang P, Turpin B. 1996. Reduction of sampling and analytical errors for electron microscopic analysis of atmospheric aerosols. *Atmos Environ* 30:4137-4148.
- *Huber AL, Loving TJ. 1991. Fatal asthma attack after inhaling sulfur fumes. *JAMA* 266(16): 2225.

*IARC. 1992. IARC monographs on the evaluation of the carcinogenic risk of chemicals to man: Occupational exposures to mists and vapours from strong inorganic acids, and other industrial chemicals. Vol. 54. Lyon, France: World Health Organization, International Agency for Research on Cancer.

Imai M, Katsumi Y, Kitagawa M. 1986. Mortality from asthma and chronic bronchitis associated with changes in sulfur oxides air pollution. *Arch Environ Health* 41:29-35.

*Islam MS, Neuhann HF, Grzegowski E, et al. 1992. Bronchomotoric effect of low concentration of sulfur dioxide in young healthy volunteers. *Fresenius Euvir Bull* II:54 1-546.

Islam MS, Oberbamscheidt J. 1994. The effect of a short-term sulfur dioxide exposure on the respiratory function of sensitized non-anesthetized rabbits. *Zentralbl Hyg Umweltmed (Germany)* 196: 104-113.

Islam MS, Oberbamscheidt J, Schlipkoeter. 1994. Non-specific airway responsiveness to hyperventilation of low doses of sulfur dioxide and cold air of non-smoking healthy volunteers of different ages. *Zentralblatt Fuer Hygiene Und Umweltmedizin* 195:556-566.

Ito K, Thurston GD, Hayes C, et al. 1993. Associations of London, England, daily mortality with particulate matter, sulfur dioxide, and acidic aerosol pollution. *Arch Environ Health* 48:213-220.

Iwase, N, Sasaki T, Shimura S, et al. 1997. Signature current of SO₂-induced bronchitis in rabbit. *J Clin Invest* 99:1651-1661.

*Jagiello GM, Lin JS, Ducayen MB. 1975. SO₂, and its metabolite: Effects of mammalian egg chromosomes. *Environ Res* 9:84-93.

*Jakab GJ, Clarke RW, Hemenway DR, et al. 1996. Inhalation of acid coated carbon black particles impairs alveolar macrophage phagocytosis. *Toxicol Lett* 88:243-248.

Janak J, Vecera Z. 1990. A monitor for atmospheric sulphur dioxide, based on enrichment of sulfur dioxide by a polydispersive water aerosol. *Mikrochimica Acta* 3-29-34.

Jeffery PK and Reid LM. 1977. The respiratory mucous membrane. In: Brain JD, Proctor DF, Reid LM, eds. *Respiratory Defense Mechanisms, Part 1*. Dekker, NY:Basel. 193-245.

*Jensen FP, Fenger J. 1994. The air quality in Danish urban areas. *Environ Health Perspect* 102:55-60.

*Johanson, CE 1980 Permeability and vascularity of the developing brain: cerebellum vs cerebral cortex. *Brain Research* 190:3-16

Jones W, Gamble J. 1984. Epidemiological-environmental study of lead acid battery workers: I. Environmental study of five lead acid battery plants. *Environ Res* 35:1-10.

*Jorres R, Magnussen H. 1990. Airway response of asthmatics after a 30 min exposure at resting ventilation, to 0.25 ppm NO, or 0.5 ppm sulfur dioxide. *Eur Respir J* 3:132-137.

*Kagedal B, Kϕillberg M, Sorbo B. 1986. A possible involvement of glutathione in the detoxification of sulfite. *Biochem Biophys Res Commun* 136: 1036-1041.

Karakas D, Tuncel SG. 1997. Optimization and field application of a filter pack system for the simultaneous sampling of atmospheric HNO₃, NH₃, and SO₂. *Atmos Environ* 31: 1657-1666.

Kato N, Akimoto H. 1992. Anthropogenic emissions of sulfur dioxide and NO_x in Asia: Emission inventories. *Atmos Environ* 26A:2997-3017.

*Katsouyanni K, Touloumi G, Spix C et al. 1997. Short term effects of ambient sulphur dioxide and particulate matter on mortality in 12 European cities: Results from time series data from the APHEA project. *BMJ* 314:1658-1663.

Kawai T, Endo R, Ohya K, et al. 1990. Effects of combined exposure of low level nitrogen dioxide and sulfur dioxide on respiratory system. *Tokyo-to Kankyo Kagaku Kenkyusho Nenpo* 175-185.

*Kehoe IRA, Willard FM, Kitzmiller K, et al. 1932. On the effects of prolonged exposure to sulphur dioxide. *Journal of Industrial Hygiene* 14: 159- 173.

*Kehrl HR, Roger LJ, Hazucha MJ, et al. 1987. Differing response of asthmatics to sulfur dioxide exposure with continuous and intermittent exercise. *Am Rev Respir Dis* 135:350-355.

*Kellogg WW, Cadel RD, Allen ER. 1972. The sulfur cycle: Man's contributions are compared to natural sources of sulfur compounds in the atmosphere and oceans. *Science* 175:587-596.

*Kennedy SM. 1992. Acquired airway hyperresponsiveness from nonimmunogenic irritant exposure. *Occup Med* 7:287-300.

Kienast K, Knorst M, Riechelmann H, et al. 1993. *In vitro* studies of the beat frequency of ciliary cell cultures after short-term exposures to sulfur dioxide and NO₂. *Pneumologie* 88:520-524.

Kienast K, Muller-Quernheim J, Knorst M, et al. 1993. Reality-related *in vitro* study on reactive oxygen-intermediates release by alveolar macrophages and peripheral blood mononuclear cells after short-term exposures with sulfur dioxide. *Pneumologie* 47:60-65.

Kienast K, Muller-Quernheim J, Knorst M, et al. 1994. *In vitro* study of human alveolar macrophage and peripheral blood mononuclear cell reactive oxygen-intermediates release induced by sulfur dioxide at different concentrations. *Lung* 172:335-345.

Kienast K, Riechelmann H, Knorst M, et al. 1992. Dose dependent effects of sulfur dioxide on mucociliary activity and frequency of ciliary beating in the guinea-pig [Abstract]. *Am Rev Respir Dis* 145:A87.

Kienast K, Riechelmann H, Knorst M, et al. 1994. An experimental model for the exposure of human ciliated cells to sulfur dioxide at different concentrations. *Clinical Investig* 72:215-219.

Kim J-C, Allen ER. 1997. Effects of filter pack sampling conditions on observed ambient concentrations of dry acid deposition species. *Chemosphere* 34(3):587-610.

*Kim HJ, Conca KR, Richardson MJ. 1990. Determination of sulfur dioxide in grapes: Comparison of the Monier-Williams method and two ion exclusion chromatographic methods. *J Assoc Off Anal Chem* 73:983-989.

- *Kirk-Othmer. 1978 to Present. Encyc Chem Tech. 3rd ed. 22(83): 146.
- *Kitabatake M, Yamamoto H, Yuan PF, et al. 1995. Effects of exposure to NO₂ or sulfur dioxide on bronchopulmonary reaction induced by candida albicans in guinea pigs. J Toxicol Environ Health 45:75-82.
- Kitagawa T. 1984. Cause analysis of the Yokkaichi asthma episode in Japan. JAPCA 34:743-746.
- Klein RG, Janowsky I, Schmezer P, et al. 1990. Carcinogenic effect of long-term inhalation of n-nitrosodimethylamine and sulfur dioxide/NO_x in rats [Abstract]. J Cancer Res Clin Oncol 116(Suppl):85.
- Kleinman LI, Daum PH. 1991. Oxidant limitation to the formation of H₂SO₄ near a sulfur dioxide source region. Atmos Environ 25A:2023-2028.
- Kleinman MT, Bailey RM, Chang YT, et al. 1981. Exposures of human volunteers to a controlled atmospheric mixture of ozone, sulfur dioxide and sulfuric acid. Am Ind Hyg Assoc J 42:61-69.
- *Kleinman MT. 1984. Sulfur dioxide and exercise: Relationships between response and absorption in upper airways. J Air Pollut Control Assoc 34:32-37.
- Klemm O, Talbot RW, Klemm KI. 1992. Sulfur dioxide in coastal New England fog. Atmos Environ 26A:2063-2075.
- *Knapp KT, Pierson WR, Dasgupta PK, et al. 1987. Determination of gaseous sulfuric acid and sulfur dioxide in stack gases. In Lodge JP, ed. Methods of air sampling and analysis (Method 711). 3rd ed. Chelsea, MI: Lewis Publishers, Inc. 523-528.
- Knorst MM, Kienast K, Grob S, et al. 1996. Chemotactic response of human alveolar macrophages and blood monocytes elicited by exposure to sulfur dioxide. Res Exp Med 196: 127-135.
- Knorst MM, Kienast K, Mtiller-Quernheim J, et al. 1993. Alveolar macrophages and mononuclear cells of peripheral blood exposed to sulfur dioxide and chrysotil B: An *In vitro* test approximating actual practical conditions for the liberation of oxygen radicals Pneumologie 47:353-356.
- Knorst MM, Kienast K, Mtiller-Quernheim J, et al. 1996. Effect of sulfur dioxide on cytokine production of human alveolar macrophages *in vitro*. Arch Environ Health 51(2): 150- 156.
- Knorst MM, Kienast K, Riechelmann H, et al. 1990. Effect of sulfur dioxide on mucociliary activity and ciliary beat frequency in guinea pig trachea. Int Arch Occup Environ Health 65:325-328.
- Knorst MM, Kienast K, Riechelmann H, et al. 1994. *In vitro* evaluation of alterations in mucociliary clearance of guinea-pig tracheas induced by sulfur dioxide or nitrogen dioxide. Pneumologie 48:443-447.
- *Koenig JQ, Covert DS, Hanley QS, et al. 1990. Prior exposure to ozone potentiates subsequent responses to sulfur dioxide in adolescent asthmatic subjects. Am Rev Respir Dis 141:377-380.
- *Koenig JQ, Covert DS, Pierson WE. 1989. Effects of inhalation of acidic compounds on pulmonary function in allergic adolescent subjects. Environ Health Perspect 79:173-178.

- Koenig JQ, Marshall SG, Horike M, et al. 1987. The effects of albuterol on sulfur dioxide-induced bronchoconstriction in allergic adolescents. *J Allergy Clin Immunol* 79:54-58.
- *Koenig JQ, Morgan MS, Horike M, et al. 1985. The effects of sulfur oxides on nasal and lung function in adolescents with extrinsic asthma. *J Allergy Clin Immunol* 76:813-818.
- Koenig JQ, Pierson WE, Frank R. 1980. Acute effects of inhaled SO₂ plus NaCl droplet aerosol on pulmonary function in asthmatic adolescents. *Environ Res* 22:145-153.
- Koenig JQ, Pierson WE, Horike M, et al. 1981. Effects of sulfur dioxide plus NaCl aerosol combined with moderate exercise on pulmonary function in asthmatic adolescents. *Environ Res* 25:340-348.
- *Koenig JQ, Pierson WE, Horike M, et al. 1982a. Bronchoconstrictor responses to sulfur dioxide or sulfur dioxide plus sodium chloride droplets in allergic, nonasthmatic adolescents. *J Allergy Clin Immunol* 69:339-344.
- *Koenig JQ, Pierson WE, Horike M, et al. 1982b. Effects of inhaled sulfur dioxide (SO₂) on pulmonary function in healthy adolescents: Exposure to SO₂ + sodium chloride droplet aerosol during rest and exercise. *Arch Environ Health* 37:5-9.
- *Koenig JQ, Pierson WE, Horike M, et al. 1983. A comparison of the pulmonary effects of 0.5 ppm versus 1.0 ppm sulfur dioxide plus sodium chloride droplets in asthmatic adolescents. *J Toxicol Environ Health* 11:129-139.
- *Kok GL, Dasgupta PK, Adams DF, et al. 1987a. Determination of sulfur dioxide content of the atmosphere (tetrachloromercurate absorber/para-rosaniline method) (Method 704a). In Lodge JP, ed. 1987. *Methods of air sampling and analysis*. 3rd ed. Chelsea, MI: Lewis Publishers, Inc. 493-498.
- *Kok GL, Dasgupta PK, Adams DF, et al. 1987b. Determination of sulfur dioxide content of the atmosphere (formaldehyde absorber/pars-rosaniline method) (Method 704a). In Lodge JP, ed. 1987. *Methods of air sampling and analysis*. 3rd ed. Chelsea, MI: Lewis Publishers, Inc. 499-502.
- *Kok GL, Pierson WR, Adams DF, et al. 1987c. Continuous monitoring of atmospheric sulfur dioxide with amperometric instruments. In Lodge JP, ed. *Methods of air sampling and analysis*. 3rd ed. Chelsea, MI: Lewis Publishers, Inc. 506-510.
- *Komori, M., Nishio, K, Kitada, M, Shiramatsu, K, Muroya, K, Soma, M, Hagashima, K, and Kamataki, T. 1990. Fetus-specific expression of a form of cytochrome P-450 in human liver. *Biochemistry* 29:4430-4433.
- *Krasnowska M, Kwasniewski A, Rabczyński J, et al. 1998. Effect of heparin on the course of sulfur dioxide induced bronchitis in rats. *Arch Immunol Ther Exp* 46: 17-24.
- Kremer AM, Pal TM, Boleij JSM, et al. 1994. Airway hyperresponsiveness, prevalence of chronic respiratory symptoms, and lung function in workers exposed to irritants. *Occup Environ Med* 51:3-13.
- *Krishnan K, Andersen ME. 1994. Physiologically-based pharmacokinetic modeling in toxicology. In: Hayes W, ed. *Principles and methods of toxicology*. 3rd edition. New York, NY: Raven Press, Ltd.

- *Krishnan K, Andersen ME, Clewell HJ, III, et al. 1994. Physiologically-based pharmacokinetic modeling of chemical mixtures. In: Yang RSA, ed. Toxicology of chemical mixtures. New York, NY: Academic Press.
- Krochmal D, Kalina A. 1997. Measurements of nitrogen dioxide and sulfur dioxide concentrations in urban and rural areas of Poland using a passive sampling method. *Environ Poll* 96:401-407.
- Kumar BS, Balasubramanian N. 1992. Extractive spectrophotometric determination of trace amounts of sulfur dioxide in air. *J AOAC Int* 75:1006-1010.
- Kuratli M, Pretsch E. 1994. Sulfur dioxide-selective optodes. *Anal Chem* 66:85-91.
- Laj P, Fuzzi S, Facchini MC, et al. 1997a. Cloud processing of soluble gases. *Atmospheric Environment* 31:2589-2598.
- Laj P, Fuzzi S, Facchini MC, et al. 1997b. Experimental evidence for in-cloud production of aerosol sulphate. *Atmospheric Environment* 31(16):2503-2514.
- *Lamb D, Reid L. 1968. Mitotic rates, goblet cell increase and histochemical changes in mucus in rat bronchial epithelium during exposure to sulphur dioxide. *J Pathol Bacteriol* 96:97-111.
- *Langley-Evans SC, Phillips GJ, Jackson AA. 1996. Sulfur dioxide: a potent glutathione depleting agent. *Comp Biochem Physiol* 114C(2):89-98.
- *Langley-Evans SC, Phillips GJ, Jackson AA. 1997. Fetal exposure to low protein maternal diet alters the susceptibility of young adult rats to sulfur dioxide-induced lung injury. *J Nutr* 127(2):202-209.
- *Lawther PJ, Macfarlane AJ, Waller RE, et al. 1975. Pulmonary function and sulfur dioxide, some preliminary findings. *Environ Res* 10:355-367.
- *Lazarus SC, Wong HH, Watts MJ, et al. 1997. The leukotriene receptor antagonist zafirlukast inhibits sulfur dioxide-induced bronchoconstriction in patients with asthma. *Am J Respir Crit Care Med* 156:1725-1730.
- *Lebowitz MD, Burton A, Kaltenbom W. 1979. Pulmonary function in smelter workers. *J Occup Med* 21:255-259.
- *Lee DS, Longhurst JWS. 1993. Estimates of emissions of sulfur dioxide, NO_x, HCl and NH₃ from a densely populated region of the UK. *Environmental Pollution* 79:37-44.
- *Leeder JS, Keams GL. 1997. Pharmacogenetics in pediatrics: Implications for practice. *Pediatr Clin North Am* 44:55-77.
- *Lefohn AS, Shadwick DS. 1991. Ozone, sulfur dioxide and nitrogen dioxide trends at rural sites located in the United States. *Atmos Environ* 25A:491-501.
- Leigh MW, Carson JL, Gambling TM, et al. 1992. Loss of cilia and altered phenotypic expression of ciliated cells after acute sulfur dioxide exposure. *Chest* 101: 16S.

Lemos M, Lichtenfels AJ, Amaro E, et al. 1994. Quantitative pathology of nasal passages in rats exposed to urban levels of air pollution. *Environ Res* 66:87-95.

*Lentner C, ed. 1981. *Geigy Scientific Tables*. Vol 1: Units of measurement, body fluids, composition of the body, nutrition. West Caldwell, NJ: Medical Education Division, Ciba-Geigy Corporation, 57-62.

*Leung H-W. 1993. Physiologically-based pharmacokinetic modeling. In: Ballantyne B, Marrs T, Turner P, eds. *General and applied toxicology*. New York, NY: Stockton Press, 1:153-164.

Lewis TR, Campbell KI, Vaughan TR. 1969. Effects on canine pulmonary function. Via induced NO₂ impairment, particulate interaction, and subsequent SO_x. *Arch Environ Health* 18:596-601.

Lewis TR, Moorman WJ, Ludmann WF, et al. 1973. Toxicity of long-term exposure to oxides of sulfur. *Arch Environ Health* 26: 16-21.

Li H, Jin S, Shi S. 1994. The trend of mortality of lung cancer and its association with air pollution. *Chung Hua Liu Hsing Ping Hsueh Tsa Chih (China)* 15:38-41

*Lide DR, Frederikse HPR, eds. 1993. *CRC handbook of chemistry and physics*. 74th ed. Boca Raton, FL: CRC Press

*Linn WS, Avol EL, Peng RC, et al. 1987. Replicated dose-response study of sulfur dioxide effects in normal, atopic, and asthmatic volunteers. *Am Rev Respir Dis* 136:1127-1 134.

*Linn WS, Avol EL, Shamoo DA, et al. 1984a. Asthmatics' responses to 6-hr sulfur dioxide exposures on two successive days. *Arch Environ Health* 39:313-319.

Linn WS, Avol EL, Shamoo DA, et al. 1988. Effect of metaproterenol sulfate on mild asthmatics' response to sulfur dioxide exposure and exercise. *Arch Environ Health* 43:399-406.

Linn WS, Gong HG Jr., Shamoo DA, et al. 1997. Chamber exposures of children to mixed ozone, sulfur dioxide, and sulfuric acid. *Arch Environ Health* 52: 179- 187.

Linn WS, Shamoo DA, Anderson KR, et al. 1985. Effects of heat and humidity on the responses of exercising asthmatics to sulfur dioxide exposure. *Am Rev Respir Dis* 131:221-225.

*Linn WS, Shamoo DA, Peng RC, et al. 1990. Responses to sulfur dioxide and exercise by medication-dependent asthmatics: Effect of varying medication levels. *Arch Environ Health* 45:24-30.

*Linn WS, Shamoo DA, Spier CE, et al. 1983a. Respiratory effects of 0.75 ppm sulfur dioxide in exercising asthmatics: Influence of upper respiratory defenses. *Environ Res* 30:340-348.

*Linn WS, Shamoo DA, Venet TG, et al. 1984b. Comparative effects of sulfur dioxide exposures at 5°C and 22°C in exercising asthmatics. *Am Rev Respir Dis* 129:234-239.

*Linn WS, Shamoo DA, Venet TG, et al. 1984c. Combined effect of sulfur dioxide and cold in exercising asthmatics. *Arch Environ Health* 39:339-346.

*Linn WS, Venet TG, Shamoo DA, et al. 1983b. Respiratory effects of sulfur dioxide in heavily exercising asthmatics: A dose-response study. *Am Rev Respir Dis* 127:278-283.

Lippmann M. 1985. Airborne acidity: Estimates of exposure and human health effects. *Environ Health Perspect.* 63:63-70.

Liss PS. 1971. Exchange of sulfur dioxide between the atmosphere and natural waters. *Nature* 233:327-329.

Lokesh KV, Ranganna G. 1993. On variation of levels of carcinogenic organic matter and other pollutants with meteorological elements in ambient air at normal human inhaling heights: Hazardous effects of pollutants and mitigative measures thereof. *Air Pollution 1st Int Conf Proc* 413-422.

*Long NC, Martin JG, Pantano R, et al. 1997. Airway hyperresponsiveness in a rat model of chronic bronchitis: role of C fibers. *Am J Respir Crit Care Med* 155:1222-1229.

*Loomis DP, Borja-Aburto VH, Bangdiwala SI, et al. 1996. Ozone exposure and daily mortality in Mexico City: a time-series analysis. *Res Rep Health Eff Inst* 75:1-37; discussion 39-45.

*Lovati MR, Manzoni C, Daldossi M, et al. 1996. Effects of sub-chronic exposure to SO₂, on lipid and carbohydrate metabolism in rats. *Arch Toxicol* 70: 164- 173.

*Lowe CR, Campbell H, Khosla T. 1970. Bronchitis in two integrated steel works, III. Respiratory symptoms and ventilator-y capacity related to atmospheric pollution. *Br J Ind Med* 27: 121-129.

Lu ZQ. 1990. An observation of the effect of sulfur dioxide on rat nasal mucosa. *Chung Hua Erh Pi Yen Hou Ko Tsa Chih (China)* 25:23-24.

*Lubin JH, Pottern LM, Blot WJ, et al. 198 1. Respiratory cancer among copper smelter workers: recent mortality statistics. *J Occup Med* 23:779-784.

Luria M, Van Valin CC, Gunter RL, et al. 1990. Sulfur dioxide over the western North Atlantic Ocean during GCF/CASF/WATOX. *Global Biogeochem Cycles* 4:38 1-394.

*Ma TH, Harris MM, Anderson VA, et al. 1984. Tradescantia-micronucleus (Trad-MCN) test on 140 health-related agents. *Mutat Res* 138:157-167.

*Ma TH, Isbandi D, Khan SH, et al. 1973. Low level of sulfur dioxide enhanced chromatid aberrations in Tradescantia pollen tubes and seasonal variation of the aberration rates. *Mutat Res* 21:93-100.

Mackenbach JP, Looman CW, Kunst AE. 1993. Air pollution, lagged effects of temperature, and mortality: The Netherlands 1979-87. *J Epidemiol Community Health* 47:121-126.

Magnussen H, Jorres R, Wagner HM, et al. 1990. Relationship between the airway response to inhaled sulfur dioxide, isocapnic hyperventilation, and histamine in asthmatic subjects. *Int Arch Occup Environ Health* 62:485-491.

Mahlum DD, Sasser LB. 1990. Evaluation of Exposure Limits to Toxic Gases for Nuclear Reactor Control Room Operators. Washington, DC: Nuclear Regulatory Commission, Division of Safety Issue Resolution.

- Makkonen U, Juntto S. 1997. Field comparison of measurement methods for sulphur dioxide and aerosol sulphate. *Atmos Environ* 31:983-990.
- Mamatsashvili MI. 1970. On the detrimental effect of carbon monoxide and sulfur dioxide on fertility of female rats. *Hygiene and Sanitation* 36:277-279.
- *Mazumdar S, Schimmel H, Higgins ITT. 1982. Relation of daily mortality to air pollution: An analysis of 14 London winters, 1958/59-1971/72. *Arch Environ Health* 37:213-220.
- *McKay HAC. 1971. The atmospheric oxidation of sulfur dioxide in water droplets in presence of NH₃. *Atmos Environ* 5:7-14.
- *ME DEP. 1998. Sulfur dioxide ambient air standards. Maine Department of Environmental Protection, Bureau of Air Quality Control. Maine R. Chapter 110.
- *Meng Z, Zhang L. 1990a. Chromosomal aberrations and sister-chromatid exchanges in lymphocytes of workers exposed to sulphur dioxide. *Mutat Res* 241: 15-20.
- *Meng Z, Zhang L. 1990b. Observation of frequencies of lymphocytes with micronuclei in human peripheral blood cultures from workers in a sulphuric acid factory. *Environmental and Molecular Mutagenesis* 15:2 18-220.
- Michejda CJ, Kroeger Koepke MB. 1994. Carcinogen activation by sulfate conjugate formation. *Advances in Pharmacology* 27:331-363.
- Miller DF, Flores M. 1992. Sulfur dioxide concentrations in western USA. *Atmos Environ* 26A:345-347.
- *Min Y, Rhee C, Choo M, et al. 1994. Histopathologic changes in the olfactory epithelium in mice after exposure to sulfur dioxide. *Acta Otolaryngol (Stockh)* 114:447-452.
- Mitchell WJ, Hines AP, Bowen JA, et al. 1992. Simple systems for calibrating and auditing sulfur dioxide monitors at remote sites. *Atmos Environ* 26A: 19 1-1 94.
- *Miyata T, Ishii T, Sugiyama N, et al. 1990. Effect of n-acetylneuraminic acid on respiratory tract secretion and inflammation in the bronchitic rabbit. *Arch Int Pharmacodyn* 304:277-289.
- Miyata T, Oda Y, Kai H, et al. 1990. Increased production and secretion of pulmonary surfactant in type II pneumocytes by long term exposure to sulfur dioxide. *Arch Int Pharmacodyn Ther* 288: 147.
- *MN PCA. 1998. State ambient air quality standards. Minnesota Pollution Control Agency, Division of Air Quality. 7009.0080.
- Monastersky R. 1991. Pinatubo's impact spreads around the globe. *Sci News* 140: 132.
- *Moolgavkar SH, Luebeck EG. 1996. A critical review of the evidence on particulate air pollution and mortality. *Epidemiology* 7:420-428.
- Moolgavkar SH, Luebeck EG, Anderson EL. 1997. Air pollution and hospital admissions for respiratory causes in Minneapolis-St. Paul and Birmingham. *Epidemiology* 8:364-370.

- *Moolgavkar SH, Luebeck EG, Hall TA, et al. 1995a. Air pollution and daily mortality in Philadelphia. *Epidemiology* 6:476-484.
- *Moolgavkar SH, Luebeck EG, Hall TA, et al. 1995b. Particulate air pollution, sulfur dioxide, and daily mortality: A reanalysis of the Steubenville data. *Inhalation Toxicology* 7:35-44.
- *Morselli PL, France-Morselli R, and Bossi L. 1980. Clinical pharmacokinetics in newborns and infants. *Clin Pharmacokinet* 5:485-527.
- Moseholm L, Taudorf E, Frosig A. 1993. Pulmonary function changes in asthmatics associated with low-level sulfur dioxide and NO₂ air pollution, weather, and medicine intake: An 8-month prospective study analyzed by neural networks. *Allergy* 48:334-344.
- *MT DHES. 1998. Ambient air quality standards for sulfur dioxide. Montana Department of Health and Environmental Sciences, Air Quality Division. 17.8.210.
- *Murray FJ, Schwetz BA, Crawford AA, et al. 1977. Teratogenic potential of sulfur dioxide and carbon monoxide in mice and rabbits. 469-478.
- *Murray FJ, Schwetz BA, Crawford AA, et al. 1979. Embryotoxicity of inhaled sulfur dioxide and carbon monoxide in mice and rabbits. *J Environ Sci Health C* 13(3):233-250.
- *Myers DJ, Bigby BG, Boushey HA. 1986a. The inhibition of sulfur dioxide-induced bronchoconstriction in asthmatic subjects by cromolyn is dose dependent. *Am Rev Respir Dis* 133:1150-1153.
- *Myers DJ, Bigby BG, Calvayrac P, et al. 1986b. Interaction of cromolyn and a muscarinic antagonist in inhibiting bronchial reactivity to sulfur dioxide and to eucapnic hyperpnea alone. *Am Rev Respir Dis* 133:1154-1158.
- Mylona S. 1996. Sulphur dioxide emissions in Europe 1880-1991 and their effect on sulphur concentrations and depositions. *Tellus* 48B:662-689.
- Nadel JA. 1983. Regulation of bronchial secretions In: Newball HH, ed. *Lung Biology in Health and Disease*. New York, NY: Marcel Dekker, 19:109-139.
- *Nadel JA, Salem H, Tamplin B, et al. 1965. Mechanism of bronchoconstriction during inhalation of sulfur dioxide. *J Appl Physiol* 20:164-167.
- *NAS/NRC. 1989. Biologic markers in reproductive toxicology. National Academy of Sciences/National Research Council. Washington, DC: National Academy Press, 15-35.
- NATICH. 1992. National Toxics Information Clearinghouse. U.S. Environmental Protection Agency, Office of Air Quality Planning and Standards, Research Triangle Park, NC, and State and Territorial Air Pollution Program Administrators/Association of Local Air Pollution Control Officials.
- *NATICH. 1995. National Air Toxics Information Clearinghouse Database. Environmental Protection Agency, Research Triangle Park, NC. October 1995.

*ND SDHCL. 1998. Ambient air quality standards. North Dakota State Department of Health and Consolidated Laboratory. 33-15-02.

Newhouse MT, Dolovich M, Obminski G, et al. 1978. Effect of TLV levels of sulfur dioxide and H₂S₀₄ on bronchial clearance in exercising man. Arch Environ Health 33:24-32.

NIOSH. 1977. Public hearing on occupational standards for sulfur dioxide: Statement of Edward Baier, National Institute for Occupational Safety and Health, before the Department of Labor. Cincinnati, OH: U.S. National Institute for Occupational Safety and Health.

NIOSH. 1990. Hazard Evaluation and Technical Assistance Report HETA 90-092-L2083, Bethlehem Steel, Chesterton, Indiana. Cincinnati, OH: National Institute for Occupational Safety and Health, Hazard Evaluation and Technical Assistance Branch.

NIOSH. 1990. NIOSH comments to DOE on the mine safety and health administration's proposed rule on air quality, chemical substances, and respiratory protection standards by J. D. Millar, March 1, 1990. National Institute for Occupational Safety and Health, Cincinnati, OH.

*NIOSH. 1991. Health Hazard Evaluation Report HETA 90-2000-2158, Hawaii State Health Department. Cincinnati, OH: National Institute for Occupational Safety and Health, Hazard Evaluation and Technical Assistance Branch.

*NIOSH. 1992a. Health Hazard Evaluation Report HETA 90- 179-2 172, National Park Service, Hawaii Volcanoes National Park, Hilo, Hawaii. Cincinnati, OH: National Institute for Occupational Safety and Health, Hazard Evaluation and Technical Assistance Branch.

*NIOSH. 1992b. Health Hazard Evaluation Report HETA 9 1-3 12-2 185, US Department of the Interior, National Park Service, Gallatin National Forest, Montana. Cincinnati, OH: National Institute for Occupational Safety and Health, Centers for Disease Control and Prevention.

*NIOSH. 1992c. Health Hazard Evaluation Report HETA 92-045-2260, US Department of the Interior, National Park Service, New River, West Virginia. Cincinnati, OH: National Institute for Occupational Safety and Health, Centers for Disease Control and Prevention.

NIOSH. 1992d. Health hazard evaluation report HETA 90-174-2231 Modern Materials Incorporated, Rochester, Indiana. Cincinnati, OH: National Institute for Occupational Safety and Health, Centers for Disease Control and Prevention.

NIOSH. 1992e. Health Hazard Evaluation Report HETA 91-261 -224 Metropolitan Sewer District Mill Creek Facility, Cincinnati, Ohio. Cincinnati, OH: National Institute for Occupational Safety and Health, Hazard Evaluation and Technical Assistance Branch.

*NIOSH. 1994a. Manual of Analytical Methods. 4th ed. Cincinnati, OH: U.S. Department of Health and Human Services, Public Health Service, Centers for Disease Control, National Institute for Occupational Safety and Health.

NIOSH. 1994b. Health Hazard Evaluation Report HETA 90-0249-2381, Blaw Knox Rolls, Inc., Wheeling, West Virginia. Cincinnati, OH: National Institute for Occupational Safety and Health, Centers for Disease Control and Prevention.

NIOSH. 1994c. Health Hazard Evaluation Report HETA 90-0365-2415, US Department of the Interior, National Parks Service, Yosemite National Park, California. Cincinnati, OH: National Institute for Occupational Safety and Health, Centers for Disease Control and Prevention.

NIOSH. 1994d. Health Hazard Evaluation Report HETA 91-0142-2434, Dee Zee Manufacturing, Des Moines, Iowa. Cincinnati, OH: National Institute for Occupational Safety and Health, Centers for Disease Control and Prevention.

*NIOSH. 1997. Pocket guide to chemical hazards. Cincinnati, OH: National Institute for Occupational Safety and Health.

*NM ED. 1998. Sulfur compounds. New Mexico Environment Department, Air Quality Bureau. New Mexico Admin. Code 20-2-3-110.

*NOES. 1990. National Occupational Exposure Survey 1981-83. U.S. Department of Health and Human Services, National Institute for Occupational Safety and Health, Cincinnati, OH. July 1, 1990.

*Nordenson I, Beckman G, Beckman L, et al. 1980. Is exposure to sulphur dioxide clastogenic? Chromosomal aberrations among workers at a sulphite pulp factory. *Hereditas* 93: 161-164.

Nowak D, Jirres R, Berger J, et al. 1997. Airway responsiveness to sulfur dioxide in an adult population sample. *AmJRespirCritCareMed* 156:1151-1156.

NRC 1977. National Research Council of Canada, NRC Associate Committee on Scientific Criteria for Environmental Quality, Ad Hoc Panel of Experts, Management Subcommittee. Sulphur and its inorganic derivatives in the Canadian environment. Ottawa, Canada: Environmental Secretariat, 294-307.

*NRC. 1993. Pesticides in the Diets of Infants and Children. National Research Council. Washington D.C., National Academy Press.

*NTDB. 1996. National Trades Data Bank.

*NV DCNR. 1998. Standards of quality for ambient air. Nevada Department of Conservation and Natural Resources, Division of Environmental Protection, Bureau of Air Quality. 445B.391.

*NY DEC. 1998. Air quality standards-sulfur dioxide. New York Department of Environmental Conservation, Division of Air Resources. 257-2.3.

Oda Y, Kai H, Takahama K, et al. 1990. Changes in lipid peroxides content and antioxidant enzyme activities on airway surface in sulfur dioxide-induced bronchitic rats. *Yakugaku Zasshi (Japan)* 110:612-616.

Ohyama K. 1993. Studies on lung tumorigenesis in F344 rats intratracheally instilled airborne particle extracts and exposed to nitrogen dioxide and sulfur dioxide. *J Japan Soc Air Pollut* 28:210-219. (foreign)

Okita T, Hara H, Fukuzaki N. 1996. Measurements of atmospheric SO₂ and SO₄²⁻, and determination of the wet scavenging coefficient of sulfate aerosols for the winter monsoon season over the Sea of Japan. *Atmos Environ* 30:3733-3739.

- *O'Meara M. 1997. Sulfur and nitrogen emissions unchanged. In: O'Meara M, ed. Worldwatch Institute Report: Vital Signs. New York, NY: W.W. Norton & Company, Inc., 60-61.
- *OR DEQ. 1998. Ambient air quality standards. Sulfur dioxide. Oregon Department of Environmental Quality. 340-031-0010.
- *OSHA. 1995b. U.S. Department of Labor. Occupational Safety and Health Administration. Code of Federal Regulations 29 CFR 19 10.20.
- *OSHA. 1998. Occupational Safety and Health Administration. Code of Federal Regulations 29 CFR 1910.1000.
- *OTA. 1990. Neurotoxicology: Identifying and controlling poisons of the nervous system. Washington, DC: Office of Technology Assessment, OTB-BA-438.
- OTS. 1992. Initial submission: Basic toxicity study with diethanolamine sulfur dioxide solution in male rats with cover letter dated 07/31/92. Washington, DC: Environmental Protection Agency, Office of Toxic Substances.
- *Owen GM, Brozek J. 1966. Influence of age, sex, and nutrition on body composition during childhood and adolescence. In: Falkner, ed. Human development. Philadelphia, PA: Saunders, 222-238.
- Padro J, Neumann HH, Den Hartog G. 1993. Dry deposition velocity estimates of sulfur dioxide from models and measurements over a deciduous forest in winter. *Water, Air and Soil Pollution* 68:325-339.
- *Parmeggiani L. 1983. Encyclopedia of Occupational Health and Safety. 3rd rev. ed. Geneva: International Labour Office, 2 122-2126.
- Pauluhn J, Thyssen J, Althoff J, et al. 1985. Long-term inhalation study with benzo(a)pyrene and sulfur dioxide in Syrian golden hamsters. *Exp Pathol* 28:3 1. [Abstract]
- *Peacock PR, Spence JB. 1967. Incidence of lung tumours in LX mice exposed to (1) free radicals; (2) SO₂. *Br J Cancer* 21:606-618.
- Peden DB. 1997. Mechanisms of pollution-induced airway disease: *In vivo* studies. *Allergy* 52(Supp 38):37-44.
- Peters A, Dockery DW, Heinrich J, et al. 1997. Medication use modifies the health effects of particulate sulfate air pollution in children with asthma. *Environ Health Perspect* 105:430-435.
- *Petruzzi S, Dell'Omo G, Fiore M, et al. 1996. Behavioral disturbances in adult CD-1 mice and absence of effects on their offspring upon SO₂ exposure. *Arch Toxicol* 70:757-766.
- Petruzzi S, Musi B, Bignami G. 1994. Acute and chronic sulfur dioxide (sulfur dioxide) exposure: An overview of its effects on humans and laboratory animals. *Ann. Ist. Super. Sanita* 30: 151-156.
- *Pierson WR, Dasgupta PK, Adams DF, et al. 1987. Determination of airborne sulfates. In Lodge JP, ed. *Methods of air sampling and analysis*. 3rd ed. Chelsea, MI: Lewis Publishers, Inc. 639-644.

- Pirilä PL, Nordman H, Korhonen OS, et al. 1996. A thirteen-year follow-up of respiratory effects of acute exposure to sulfur dioxide. *Stand J Work Environ Health* 22: 191-196.
- Poli P, Buschini A, Campanini N, et al. 1992. Urban air pollution: Use of different mutagenicity assays to evaluate environmental genetic hazard. *Mutat Res* 298: 113- 123.
- Ponce de Leon A, Anderson HR, Bland JM, et al. 1996. Effects of air pollution on daily hospital admissions for respiratory disease in London between 1987-88 and 1991-92. *J Epidemiol Community Health* 33(Suppl 1):S63-S70.
- *Ponka A, Pukkala E, Hakulinen T. 1993. Lung cancer and ambient air pollution in Helsinki. *Environment International* 19:221-23 1.
- Pool-Zobel BL, Schmezer P, Zeller WJ, et. al. 1990. *In vitro* and *ex vivo* effects of the air pollutants sulfur dioxide and NO_x on benzo(a)pyrene activating enzymes of the rat liver. *Exp Pathol* 39:207-212.
- Prasad SB, Rao VS, Mannix RC, et al. 1988. Effects of pollutant atmospheres on surface receptors of pulmonary macrophages. *J Toxicol Environ Health* 24:385-402.
- Putilina ON, Kaspruk LV. 199 1. Improved method for determining sulfur dioxide concentration in the atmosphere. *Gig Tr Prof Zabol*35(9):38-40.
- Qin YH, Zhang XM, Liu YQ, et al. 1991. Indoor air pollution in four cities in China. *Biomed Environ Sci* 4:366-372.
- Raabe OG, Wilson DW, Al-Bayati MA, et al. 1994. Biological effects of inhaled pollutant aerosols. *Ann Occup Hyg* 38:323-330.
- Raaschou-Nielsen O, Nielsen ML, Gehl J. 1995. Traffic-related air pollution: Exposure and health effects in Copenhagen street cleaners and cemetery workers. *Arch Environ Health* 50:207-213.
- *Rabinovitch S, Greyson ND, Weiser W, et al. 1989. Clinical and laboratory features of acute sulfur dioxide inhalation poisoning: Two-year follow-up. *Am Rev Respir Dis* 139:556-558.
- *Radojevic M. 1992. Sulfur dioxide and nitrogen oxides oxidation mechanism in the atmosphere. In Radojevic M, Harrison RM, eds. *Environmental management series: Atmospheric acidity: Sources, consequences and abatement*. New York, NY: Elsevier Sciences Publishers LTD, 73-137.
- Rao ST, Ku JY, Rao KS. 1991. Sampling strategies for toxic air contaminants. *Risk Analysis* 11:441-45 1.
- Reid LM. 1974. Histopathological aspects of bronchial secretion. In: *Experimental studies on bronchial secretion and therapeutical aspects of pathological bronchial secretion*, March 9-10, 1973. Stockholm. *Stand J Resp Dis (Suppl)* 90:9-15.
- Reisch M. 1993. Plastics, synthetic fibers output increases. *Chem Eng News* 7 1: 13, 16.
- Reisch M. 1994. Top 50 chemicals production rose modestly last year. *Chem Eng News* 72: 12- 16.

- *Reist M, Jenner P, Halliwell B. 1998. Sulphite enhances peroxynitrate-dependent α_1 -antitrypsinase inactivation. A mechanism of lung injury by sulphur dioxide? *FEBS Lett* 423:231-234.
- Rencher AC, Carter MW, McKee DW. 1977. A retrospective epidemiological study of mortality at a large western copper smelter. *J Occup Med* 19:754-758.
- Reuterwall C, Aringer L, Elinder CG, et al. 1991. Assessment genotoxic exposure in Swedish coke-oven work by different methods of biological monitoring. *Scand J Work Environ Health* 17:123-32.
- Riechelmann H, Maurer J, Kienast K, et al. 1995. Respiratory epithelium exposed to sulfur dioxide: functional and ultrastructural alterations. *Laryngoscope* 105:295-299.
- *Riedel F, Naujokat S, Ruschoff J, et al. 1992. Sulfur dioxide-induced enhancement of inhalative allergic sensitization: Inhibition by anti-inflammatory treatment *Int Arch Allergy Immunol* 98:386-391.
- *Rigas ML, Ben-Jebria A, Ultman JS. 1997. Longitudinal distribution of ozone absorption in the lung: effects of nitrogen dioxide, sulfur dioxide, and ozone exposures. *Arch Environ Health* 52:173-178.
- *Roberts AM, Hahn HL, Schultz JA. 1982. Afferent vagal C-fibers are responsible for the reflex airway constriction and secretion evoked by pulmonary administration of SO_2 in dogs [Abstract]. *Physiologist* 25:226.
- *Roger LJ, Kehrl HR, Hazucha M, et al. 1985. Bronchoconstriction in asthmatics exposed to sulfur dioxide during repeated exercise. *J Appl Physiol* 59:784-791.
- *Rondinelli RCA, Koenig J, Marshall SG. 1987. The effects of sulfur dioxide on pulmonary function in healthy nonsmoking male subjects aged 55 years and older. *Am Ind Hyg Assoc J* 48:299-303.
- Rubinstein I, Bigby BG, Reiss TF, et al. 1990. Short-term exposure to 0.3 ppm nitrogen dioxide does not potentiate airway responsiveness to sulfur dioxide in asthmatic subjects. *Am Rev Respir Dis* 141:381-385.
- *Russel WL and Kelly EM. 1975. Results from a specific-locus test of the mutagenicity of sulfur dioxide in mice. In: Annual Progress Report for period ending June 30, 1975. Oak Ridge, TN: Biology Division, Oak Ridge National Laboratory, 119-120.
- Rusznak C, Devalia JL, Davies RJ. 1996. Airway response of asthmatic subjects to inhaled allergen after exposure to pollutants. *Thorax* 51:1105-1108.
- *Ruth JH. 1986. Odor thresholds and irritation levels of several chemical substances: A review. *Am Ind Hyg Assoc J* 47:A142-A151.
- Ryan NJ, Hogan GR, Hayes AW, et al. 1980. Abstracts and comments. *Food Cosmet Toxicol* 18:743-749.
- Sabbak OA. 1993. Distribution of sulfur dioxide in the atmosphere of Jiddah, Saudi Arabia. *J Air Waste Manage Assoc* 43:208-212.
- Saldiva PH, King M, Delmonte VLC, et al. 1992. Respiratory alterations due to urban air pollution: An experimental study in rats. *Environ Res* 57:19-33.

- *Sandstrom T, Stjernberg N, Andersson M, et al. 1989a. Cell response in bronchioalveolar lavage fluid after exposure to sulfur dioxide: A time-response study. *Am Rev Respir Dis* 140: 1828-1831.
- *Sandstrom T, Stjernberg N, Andersson MC, et al. 1989b. Is the short term limit value for sulphur dioxide exposure safe? Effects of controlled chamber exposure investigated with bronchoalveolar lavage. *Br J Ind Med* 46:200-203.
- Sasaki K, Tanaka N, Watanabe M, et al. 1991. Comparison of cytotoxic effects of chemicals in four different cell types. *Toxic in Vitro* 5:403-406.
- *Savic M, Siriski-Sasic J, Djulizibaric D. 1987. Discomforts and laboratory findings in workers exposed to sulfur dioxide. *Int Arch Occup Environ Health* 59:1519-1518.
- Sax NI, Lewis RJ. 1987. *Hawley's condensed chemical dictionary*. 11th ed. New York, NY: Van Nostrand Reinhold Company.
- Scaringelli FB, Saltzman BE, Freg SA. 1967. Spectrophotometric determination of atmospheric sulfur dioxide. *Anal Chem* 39:1709-1719.
- *Schachter EN, Witek TJ, Beck GJ, et al. 1984. Airway effects of low concentrations of sulfur dioxide: Dose-response characteristics. *Arch Environ Health* 39:34-42.
- Schlesinger RB. 1990b. The interaction of inhaled toxicants with respiratory tract clearance mechanisms. *Crit Rev Toxicol* 20:257-286.
- Schlesinger RB, Chen LC, Finkelstein I, et al. 1990a. Comparative potency of inhaled acidic sulfates: Speciation and the role of hydrogen ion. *Environ Res* 52:210-224.
- *Schneider LK, Calkins CA. 1970. Sulfur dioxide-induced lymphocyte defects in human peripheral blood cultures. *Environ Res* 3:473-483.
- Schmid S. 1992. An estimation of the average annual transports of sulfur dioxide from the CSFR and the former G.D.R. to north-east Bavaria. *Atmos Environ* 26A:1-16.
- Schouten JP, Vonk JM, de Graaf A. 1996. Short term effects of air pollution on emergency hospital admissions for respiratory disease: results of the APHEA project in two major cities in The Netherlands, 1977-89. *J Epidemiol Community Health* SO(Supp 1):S22-S29.
- Schwartz J. 1997. Air pollution and hospital admissions for cardiovascular disease in Tucson. *Epidemiology* 8:371-377.
- Seaton A. 1996. Particles in the air: the enigma of urban air pollution. *J R Soc Med* 89:604-607.
- *Selevan SG, Borkovec L, Zudova Z, et al. 1995. Semen quality in young men and air pollution in two Czech communities [Abstract]. *Epidemiology* 6:S85.
- *Setchell, BP and Waites GMH. 1975. The blood testis barrier. In eds. Creep RO, Astwood EB; executive ed. Geiger SR. *Handbook of Physiology: Endocrinology V*. American Physiological Society 1975. Washington DC.

- Shalamberidze OP, Tsereteli NT. 1971. Effect of low concentrations of sulfur and nitrogen dioxides on the estrual cycle and reproductive function of experimental animals. *Hygiene and Sanitation* 36:178-183.
- *Shapiro R. 1977. Genetic effects of bisulfite (sulfur dioxide). *Mutat Res* 39:149-176.
- *Sheppard D. 1988. Mechanisms of airway responses to inhaled sulfur dioxide. In: Loke J, ed. *Lung Biology in Health and Disease*. New York, NY: Marcel Dekker, 34:49-65.
- *Sheppard D. 1988. Sulfur dioxide and asthma-a double-edged sword? *J Allergy Clin Immunol* 82:961-964.
- *Sheppard D, Epstein J, Bethel RA, et al. 1983. Tolerance to sulfur dioxide-induced bronchoconstriction in subjects with asthma. *Environ Res* 30:412-419.
- *Sheppard D, Eschenbacher WL, Boushey HA, et al. 1984. Magnitude of the interaction between the bronchomotor effects of sulfur dioxide and those of dry (cold) air. *Am Rev Respir Dis* 130:52-55.
- *Sheppard D, Saisho A, Nadel JA, et al. 1981. Exercise increases sulfur dioxide-induced bronchoconstriction in asthmatic subjects. *Am Rev Respir Dis* 123:486-491.
- *Sheppard D, Wong WS, Uehara CF, et al. 1980. Lower threshold and greater bronchomotor responsiveness of asthmatic subjects to sulfur dioxide. *Am Rev Respir Dis* 122:873-878.
- Sherwood RJ. 1969. Miniature air samples for sulfur dioxide. *Am Ind Hyg Assoc J* 30:614-619.
- Sherwood RJ, Greenhalgh DMS. 1960. A personal air sampler. *Ann Occup Hyg* 2:127-132.
- Shi X, Mao Y. 1994. 8-Hydroxy-2'-deoxyguanosine formation and DNA damage induced by sulfur trioxide anion radicals. *Biochem Biophys Res Comm* 205:141-147.
- Shore S, Kobzik L, Long N, et al. 1995. Increased airway responsiveness to inhaled methacholine in a rat model of chronic bronchitis. *Am J Respir Crit Care Med* 151: 1931 - 1938.
- *Shy CM. 1977. Health hazards of sulfur oxides: A serious threat in our growing need for electric power. *Am Lung Assoc Bull* 63:2-7.
- *Shy CM, Hasselblad V, Burton RM, et al. 1973. Air pollution effects on ventilatory function of US schoolchildren: Results of studies in Cincinnati, Chattanooga, and New York. *Arch Environ Health* 27:124-128.
- *Siebke K, Badeck FW, Kohlmaier GH, et al. 1990. Modelling pollutant exchange between plant and environmental uptake and metabolism of sulfur dioxide by different leaf cell compartments. In *Developments in environmental modelling, 16: Modelling in Ecotoxicology*. New York, NY: Elsevier Science Publishing Co., Inc.
- *Singh J. 1982. Teratological evaluation of sulfur dioxide. *Proceedings-Institute of Environmental Sciences* 28:144-145.

- Singh J. 1985. Maternal sulfur dioxide exposure alters neonatal reflex development [Abstract]. *Teratology* 31:9B.
- *Singh J. 1989. Neonatal development altered by maternal sulfur dioxide exposure. *Neurotoxicology* 10:523-528.
- Singh J. 1990. Association of neonatal reflex development with birth weight deficits [Abstract]. *Teratology* 41:621.
- *Skalpe IO. 1964. Long-term effects of sulfur dioxide exposure in pulp mills. *Brit J Industr Med* 21:69-73.
- *Skornik WA, Brain JD. 1990. Effect of sulfur dioxide on pulmonary macrophage endocytosis at rest and during exercise. *Am Rev Respir Dis* 142:655-659.
- *Smith TJ, Peters JM, Reading JC, et al. 1977. Pulmonary impairment from chronic exposure to sulfur dioxide in a smelter. *Am Rev Respir Dis* 116:31-39.
- *Snashall PD and Baldwin C. 1982. Mechanisms of sulfur dioxide induced bronchoconstriction in normal and asthmatic man. *Thorax* 37:118-123.
- *Sorsa M, Kolmodin-Hedman B, Jarventaus H. 1982. No effect of sulphur dioxide exposure in aluminium industry, on chromosomal aberrations or sister chromatid exchanges. *Hereditas* 97:159-161.
- *Soskolne CL, Zeighami EA, NM Hanis, et al. 1984. Laryngeal cancer and occupational exposure to sulfuric acid. *Am J Epidemiol* 120:358-369.
- Soskolne CL, Pagano G, Cipollaro M et al. 1989. Epidemiologic and toxicologic evidence for chronic health effects and the underlying biological mechanisms involved in sub-lethal exposures to acidic pollutants. *Arch Environ Health* 44: 180-191.
- *Soyseth V, Kongerud J, Boe J. 1996. Allergen sensitization and exposure to irritants in infancy. *Allergy* 51:719-723.
- *Speizer FE, Frank NR. 1966. The uptake and release of sulfur dioxide by the human nose. *Arch Environ Health* 12:725-728
- *Spengler J, Brauer M, Koutakis P. 1990. Acid air and health. *Environ Sci Technol* 24(7):946-956.
- Spengler JD, Koutrakis P, Dockery DW, et al. 1996. Health effects of acid aerosols on North American children: air pollution exposures. *Environ Health Perspect* 104(5):492-499.
- *Spix C, Wichmann HE. 1996. Daily mortality and air pollutants: Findings from Koln, Germany. *J Epidemiol Community Health* 50(Suppl 1):S52-S58.
- Sprem N, Branica S. 1993. Effects of sulfur dioxide and smoke on the incidence of laryngotracheitis (croup). *Int J Pediatr Otorhinolaryngol* 26:245-250.
- *SRI. (Retrieval in progress)

- Stacy RW, Seal E, House DE, et al. 1983. A survey of effects of gaseous and aerosol pollutants on pulmonary function of normal males. *Arch Environ Health* 38 : 104-115.
- Stammati A, Zanetti C, Pizzoferrato L, et al. 1992. *In vitro* model for the evaluation of toxicity and antinutritional effects of sulfites. *Food Addit Contam* 9:551-560.
- *Steenland K, Schnorr T, Beaumont J, et al. 1988. Incidence of laryngeal cancer and exposure to acid mists. *British Journal of Industrial Medicine* 45:766-776.
- *Strandberg LG. 1964. Sulfur dioxide absorption in the respiratory tract. Studies on the absorption in rabbits, its dependence on concentration and breathing phase. *Arch Environ Health* 9:160-166.
- *Stratmann U, Lehmann RR, Steinbach T, et al. 1991. Effect of sulfur dioxide inhalation on the respiratory tract of the rat. *Zbl Hyg* 192:324-335.
- *Stucki G, Hanselmann KW, Hurzeler RA. 1993. Biological sulfuric acid transformation: Reactor design and process optimization. *Biotechnol Bioeng* 41:303-315.
- Suarez-Almazor ME, Soskolne CL, Fung K, et al. 1992. Empirical assessment of the effect of different summary worklife exposure measures on the estimation of risk in case-referent studies of occupational cancer. *Stand J Work Environ Health* 18:233-241.
- *Sugiura Y, Ohashi Y, Nakai Y. 1997. Improvement of mucosal pathology of the sinuses after exposure to sulfur dioxide by nebulization of s-carboxymethylcysteine. *Acta Otolaryngol (Stockh) Suppl* 531:10-16.
- *Sunyer J, Castellsague, Saez M, et al. 1996. Air pollution and mortality in Barcelona. *J Epidemiol Community Health* SO(Suppl 1):76-80.
- Sunyer J, Spix C, Quenel P, et al. 1997. Urban air pollution and emergency admissions for asthma in four European cities: The APHEA Project. *Thorax* 52:760-765.
- Takeuchi TL, Suzuki I. 1994. Effect of pH on sulfite oxidation by *Thiobacillus thiooxidans* cells with sulfurous acid or sulfur dioxide as a possible substrate. *J Bacteriol* 176:913-916.
- Tanaka N, Turekian KK. 1991. Use of cosmogenic ³⁵S to determine the rates of removal of atmospheric sulfur dioxide. *Nature* 352:226-228.
- *Tango T. 1994. Effect of air pollution on lung cancer: A Poisson regression model based on vital statistics. *Environ Health Perspect* 102:41-45.
- Tanner RL, Dasgupta PK, Adams DF, et al. 1987. Determination of sulfur-containing gases in the atmosphere. In Lodge JP, ed. *Methods of air sampling and analysis*. 3rd ed. Chelsea, MI: Lewis Publishers, Inc. 506-510.
- *Tejnorova I. 1978. Sulfite oxidase activity in liver and kidney tissue in five laboratory animal species. *Toxicol App Pharmacol* 44:251-256.
- Tewari A, Shukla NP. 1991. Air pollution adverse effects of sulfur dioxide. *Rev Environ Health* 9:39-46.

- Thomas RL, Dharmarajan V, Lundquist GL, et al. 1976. Measurement of sulfuric acid aerosol, sulfur trioxide and the total sulfate content of the ambient air. *Anal Chem* 48:639-642.
- Thompson DC, Szarek JL, Altieri RJ, et al. 1990. Nonadrenergic bronchodilation induced by high concentrations of sulfur dioxide. *J Appl Physiol* 69:1786-1791.
- *Thurston GD, Ito K, Lippmann M, et al. 1989. Reexamination of London, England, mortality in relation to exposure to acidic aerosols during 1963-1972 winters. *Environmental Health Perspectives* 79:73-82.
- *Topinka J, Binkova B, Dejmek J et al. 1995. DNA adducts induced by environmental pollution in human placenta [Abstract]. *Epidemiology* 6:S84.
- *Touloumi G, Samoli E, Katsouyanni K. 1996. Daily mortality and "winter type" air pollution in Athens, Greece-a time series analysis within the APHEA project. *J Epidemiol Community Health* 50 (Suppl 1):S47-S51.
- Tseng RYM, Li CK. 1990. Low level atmospheric sulfur dioxide pollution and childhood asthma. *Ann Allergy* 65:379-383.
- *Utell MJ, Frampton MW. 1992. Sulfur dioxide and sulfuric acid aerosols. Boston, MA: In *Environmental and Occupational Medicine*, 2nd ed. Little, Brown and Company 519-527.
- *Vander AJ, Sherman JH, Luciano DS. 1975. Energy and cellular metabolism. In: *Human physiology: The mechanisms of body function*. New York, NY: McGraw Hill, Inc., 86-88.
- Vaughan TR, Jennelle LF, Lewis TR. 1969. Long-term exposure to low levels of air pollutants. Effects on pulmonary function in the beagle. *Arch Environ Health* 19:45-50.
- Velasquez H, Ramfrez H, Diaz J, et al. 1996. Determination of atmospheric sulfur dioxide by ion chromatography in the city of Cabimas, Venezuela. *J Chromatogr A* 739:295-299.
- *Verhoeff AP, Hoek G, Schwartz J, et al. 1996. Air pollution and daily mortality in Amsterdam. *Epidemiology* 7:225-230.
- *Vieira, I, Sonnier, M, Cresteil, T. 1996. Developmental expression of CYP2E1 in the human liver: Hypermethylation control of gene expression during the neonatal period. *Eur J Biochem* 238:476-483.
- *WA DE. 1998. WAC ambient air quality standards for sulfur oxides. Washington Department of Energy, Air Quality Program. Title 173, Chapter 173-474.
- Wakisaka I, Yanagihashi T, Nakano A, et al. 1990. Interaction of sulfur dioxide and nicotine aerosol as sensory irritants. *Med J Kagoshima Univ* 42:59-67.
- *Wang AL, Blackford TL, Lee LY. 1996. Vagal bronchopulmonary C-fibers and acute ventilatory response to inhaled irritants. *Respir Physiol* 104:23 1-239.
- *Wang X, Ding H, Ryan L, et al. 1997. Association between air pollution and low birth weight: A community-based study. *Environ Health Perspect* 105:5 14-520.

Ware JH, Ferris BG, Dockery DW, et al. 1986. Effects of ambient sulfur oxides and suspended particles on respiratory health of preadolescent children” *Am Rev Respir Dis* 133:834-842.

*Welch K, Higgins I, Oh M, et al. 1982. Arsenic exposure, smoking, and respiratory cancer in copper smelter workers. *Arch Environ Health* 37:325-335.

*West. JR. Smith, HW, Chasis, H. 1948. Glomerular filtration rate, effective renal blood flow, and maximal tubular excretory capacity in infancy. *J Pediatr* 32a:10-18.

Whitenberger JL, Frank RN. 1963. Human exposures to sulfur dioxide. *Arch Environ Health* 7:244-245.

*WHO. 1979. Environmental health criteria 8: Sulfur oxides and suspended particulate matter. World Health Organization, Geneva.

WHO. 1987. Air quality guidelines for Europe. (WHO Regional Publication, European Series No. 23). Regional Office for Europe, Copenhagen 338-360.

*Widdowson EM, Dickerson JWT. 1964. Chemical composition of the body. In: Comar CL, Bronner F, eds. *Mineral metabolism: An advanced treatise. Volume II. The elements, Part A.* New York, NY: Academic Press 0

Windholtz M, ed. 1983. *The Merck Index.* 10th ed. Rahway, NJ: Merck and Co., Inc. 1288-1289.

Wojcik GS, Chang JS. 1997. A re-evaluation of sulfur budgets, lifetimes, and scavenging ratios for eastern North America. *J Atmos Chem* 26:109-145.

*Wolff RK. 1986. Effects of airborne pollutants on mucociliary clearance. *Environmental Health Perspectives* 66:223-237.

*WY DEQ. 1998. Sulfur oxides. Wyoming Department of Environmental Quality, Air Quality Division. Wyoming Code of Regulations 020-020-001. Section 4.

Xu X, Gao J, Dockery DW, et al. 1994. Air pollution and daily mortality in residential areas of Beijing, China. *Arch Environ Health* 49:216-222.

*Yadav JS, Kaushik VK. 1996. Effect of sulphur dioxide exposure on human chromosomes. *Mutat Res* 359:25-29.

Yamada T. 1992. A numerical simulation of airflows and sulfur dioxide concentration distribution in an arid south-western valley. *Atmos Environ* 26A: 1771- 178 1.

Yi SM, Holsen TM, No11 KE. 1997. Comparison of dry deposition predicted from models and measured with a water surface sampler. *Environ Sci Technol* 31:272-278.

*Yokoyama E, Yoder RE, Frank NR. 197 1. Distribution of ³⁵S in the blood and its excretion in urine in dogs exposed to ³⁵sulfur dioxide. *Arch Environ Health* 22:389-395.

Zeeduk H, Velds CA. 1973. The transport of sulfur dioxide over a long distance. *Atmos Environ* 7:849-862.

*Ziegler, EE, Eklwards, BB, Jensen, RL, Mahaffey, KR, Foman, SJ 1978. Absorption and retention of lead by infants. *Pediatr Res* 12:29-34.