

## 5. References

- Aaseth, J., Alexander, J. & Norseth, T. (1982) Uptake of  $^{51}\text{Cr}$ -chromate by human erythrocytes—a role of glutathione. *Acta pharmacol. toxicol.*, **50**, 310-315
- Abe, S., Ohsaki, Y., Kimura, K., Tsuneta, Y., Mikami, H. & Murao, M. (1982) Chromate lung cancer with special reference to its cell type and relation to the manufacturing process. *Cancer*, **49**, 783-787
- Abell, M.T. & Carlberg, J.R. (1974) A simple reliable method for the determination of airborne hexavalent chromium. *Am. ind. Hyg. Assoc. J.*, **35**, 229-233
- Ackermann, F. (1977) Method of instrumental neutron activation analysis and its application for the determination of trace metals in sediments (Ger.). *Dtsch. Gewaesserkd. Mitt.*, **21**, 53-60 [*Chem. Abstr.*, **88**, 15489g]
- Adachi, S. (1987) Effects of chromium compounds on the respiratory system. Part 5. Long term inhalation of chromic acid mist in electroplating by C57BL female mice and recapitulation on our experimental studies (Jpn.). *Jpn. J. ind. Health*, **29**, 17-33
- Adachi, S. & Takemoto, K. (1987) Occupational lung cancer. A comparison between humans and experimental animals (Jpn.). *Jpn. J. ind. Health*, **29**, 345-357
- Adachi, S., Yoshimura, H., Katayama, H. & Takemoto, K. (1986) Effects of chromium compounds on the respiratory system. Part 4. Long term inhalation of chromic acid mist in electroplating to ICR female mice (Jpn.). *Jpn. J. ind. Health*, **28**, 283-287
- Aitio, A., Järvisalo, J., Kiilunen, M., Tossavainen, A. & Vaittinen, P. (1984) Urinary excretion of chromium as an indicator of exposure to trivalent chromium sulphate in leather tanning. *Int. Arch. occup. environ. Health*, **54**, 241-249
- Aitio, A., Jarvisalo, J., Kiilunen, M., Kalliomaki, P.L. & Kalliomaki, K. (1988) Chromium. In: Clarkson, T.W., Friberg, L., Nordberg, G.F. & Sager, P.R., eds, *Biological Monitoring of Toxic Metals*, New York, Plenum, pp. 369-382
- Al-Badri, J.S., Sabir, S.M., Shehab, K.M., Jalil, M. & Al-Rawi, H. (1977) Determination of inorganic elements in Iraqi tobacco leaves and cigarettes by neutron activation analysis. *Iraqi J. Sci.*, **18**, 34-44
- Albers, P.H., Sileo, L. & Mulhern, B.M. (1986) Effects of environmental contaminants on snapping turtles of a tidal wetland. *Arch. environ. Contam. Toxicol.*, **15**, 39-49
- Alderson, M.R., Rattan, N.S. & Bidstrup, L. (1981) Health of workmen in the chromate-producing industry in Britain. *Br. J. ind. Med.*, **38**, 117-124
- Alexander, J., Aaseth, J. & Norseth, T. (1982) Uptake of chromium by rat liver mitochondria. *Toxicology*, **24**, 115-122

- Alwens, W. & Jonas, W. (1938) The chromate lung cancer (Ger.). *Unio int. contra cancrum*, 3, 103-118
- American Chrome & Chemicals (undated a) *Product Data Sheet: Chromium Oxide Metallurgical* ( $\text{Cr}_2\text{O}_3$ ), Corpus Christi, TX
- American Chrome & Chemicals (undated b) *Product Data Sheet: Accrox C* ( $\text{Cr}_2\text{O}_3$ ), Corpus Christi, TX
- American Chrome & Chemicals (undated c) *Product Data Sheet: Accrox R* ( $\text{Cr}_2\text{O}_3$ ), Corpus Christi, TX
- American Chrome & Chemicals (undated d) *Product Data Sheet: Accrox S* ( $\text{Cr}_2\text{O}_3$ ), Corpus Christi, TX
- American Chrome & Chemicals (undated e) *Product Data Sheet: Chromic Acid* ( $\text{CrO}_3$ ), Corpus Christi, TX
- American Chrome & Chemicals (undated f) *Product Data Sheet: Sodium Bichromate* ( $\text{Na}_2\text{Cr}_2\text{O}_7 \cdot 2\text{H}_2\text{O}$ ), Corpus Christi, TX
- American Chrome & Chemicals (undated g) *Product Data Sheet: Sodium Bichromate Anhydrous* ( $\text{Na}_2\text{Cr}_2\text{O}_7$ ), Corpus Christi, TX
- American Chrome & Chemicals (undated h) *Product Data Sheet: Sodium Chromate Anhydrous* ( $\text{Na}_2\text{CrO}_4$ ), Corpus Christi, TX
- American Chrome & Chemicals (undated i) *Product Data Sheet: Sodium Chromate Tetrahydrate* ( $\text{Na}_2\text{CrO}_4 \cdot 4\text{H}_2\text{O}$ ), Corpus Christi, TX
- American Conference of Governmental Industrial Hygienists (1988) *TLVs Threshold Limit Values and Biological Exposure Indices for 1988-89*, Cincinnati, OH, pp. 15-16, 24, 38
- American Society for Testing and Materials (1971) *Standard Test Method for Chromium Oxide in Chrome Ores* (ASTM E342-71 (Reapproved 1985)), Philadelphia, PA, pp. 1-3
- American Society for Testing and Materials (1978) *Standard Test Method for Chromic Oxide in Leather (Perchloric Acid Oxidation)* (ASTM D2807-78), Philadelphia, PA, pp. 1-4
- American Society for Testing and Materials (1981) *Standard Methods for Chemical Analysis of Chrome-containing Refractories and Chrome Ore* (ASTM C572-81), Philadelphia, PA, pp. 1-9
- American Society for Testing and Materials (1983) *Standard Methods for Chemical Analysis of Chromium and Ferrochromium* (ASTM E363-83), Philadelphia, PA, pp. 1-6
- American Society for Testing and Materials (1984a) *Standard Specification for Wrought Cobalt-Nickel-Chromium Molybdenum Alloy for Surgical Implant Applications* (ASTM F562-84), Philadelphia, PA, pp. 1-4
- American Society for Testing and Materials (1984b) *Standard Test Method for Lead and Chromium in Air Particulate Filter Samples of Lead Chromate Type Pigment Dusts by Atomic Absorption Spectroscopy* (ASTM D4358-84), Philadelphia, PA, pp. 1-5
- American Society for Testing and Materials (1985a) *Standard Test Method for Chromium in Workplace Atmospheres (Colorimetric Method)* (ASTM D3586-85), Philadelphia, PA, pp. 1-6
- American Society for Testing and Materials (1985b) *Standard Test Method for Low Concentrations of Chromium in Paint by Atomic Absorption Spectroscopy* (ASTM D3718-85a), Philadelphia, PA, pp. 1-4

- American Society for Testing and Materials (1986a) *Standard Test Method for Chromium in Water (ASTM D1687-86)*, Philadelphia, PA, pp. 1-9
- American Society for Testing and Materials (1986b) *Standard Test Method for Chemical Analysis of Strontium Chromate Pigment (ASTM D1845-86)*, Philadelphia, PA, pp. 1-3
- American Society for Testing and Materials (1987a) *Standard Specification for Cast Cobalt-Chromium-Molybdenum Alloy for Surgical Implant Applications (ASTM F75-87)*, Philadelphia, PA, pp. 1-2
- American Society for Testing and Materials (1987b) *Standard Specification for Thermo-mechanically Processed Cobalt-Chromium-Molybdenum Alloy for Surgical Implant Applications (ASTM F799-87)*, Philadelphia, PA, pp. 1-3
- American Society for Testing and Materials (1987c) *Standard Test Method for Analysis of Yellow, Orange, and Green Pigments Containing Lead Chromate and Chromium Oxide Green (ASTM D126-87)*, Philadelphia, PA, pp. 1-7
- American Society for Testing and Materials (1988a) *Standard Specification for Wrought Cobalt-Nickel-Chromium-Molybdenum-Tungsten-Iron Alloy for Surgical Implant Applications (ASTM F563-88)*, Philadelphia, PA, pp. 1-3
- American Society for Testing and Materials (1988b) *Standard Test Method for Chemical Analysis of Zinc Yellow Pigment (Zinc Chromate Yellow) (ASTM D44-88)*, Philadelphia, PA, pp. 1-5
- Andersen, O. (1983) Effects of coal combustion products and metal compounds on sister chromatid exchange (SCE) in a macrophage-like cell line. *Environ. Health Perspect.*, 47, 239-253
- Angerer, J. & Schaller, K.H. (1988) *Analysen in biologischem Material* (Analysis in Biological Material), Weinheim, Deutsche Forschungsgemeinschaft, pp. 1-16
- Anon. (1978) Chromic acid. *Chem. Mark. Rep.*, 213, 9
- Anon. (1979) Sodium bichromate. *Chem. Mark. Rep.*, 216, 9
- Anon. (1981) Problems of epidemiological evidence. *Environ. Health Perspect.*, 40, 11-20
- Anon. (1988a) Chemical profile: chromic acid. *Chem. Mark. Rep.*, 234, 54
- Anon. (1988b) Chemical profile: sodium bichromate. *Chem. Mark. Rep.*, 234, 82
- Arbeidsinspectie (Labour Inspection) (1986) *De Nationale MAC-Lijst 1986* (National MAC-List 1986), Voorburg, p. 10
- Arbejdstilsynet (Labour Inspection) (1988) *Graensevaerdier for Stoffer og Materialer* (Limit Values for Compounds and Materials) (No 3.1.0.2), Copenhagen, p. 14
- Arbetskyddsstyrelsens (National Board of Occupational Safety and Health) (1987) *Hygieniska Gränsvärden* (Hygienic Limit Values), Stockholm, p. 28
- Arlauskas, A., Baker, R.S.U., Bonin, A.M., Tandon, R.K., Crisp, P.T. & Ellis, J. (1985) Mutagenicity of metal ions in bacteria. *Environ. Res.*, 36, 379-388
- Atomergic Chemetals Corp. (1980) *Specification Sheet: Barium Chromate*, Farmingdale, NY
- Axelsson, G. & Rylander, R. (1980) Environmental chromium dust and lung cancer mortality. *Environ. Res.*, 23, 469-476
- Axelsson, G., Rylander, R. & Schmidt, A. (1980) Mortality and incidence of tumours among ferrochromium workers. *Br. J. ind. Med.*, 37, 121-127

- Bacon, F.E. (1964) Chromium and chromium alloys. In: Kirk, R.E. & Othmer, D.F., eds, *Encyclopedia of Chemical Technology*, 2nd ed., Vol. 5, New York, John Wiley & Sons, pp. 453-464
- Baetjer, A.M. (1950) Pulmonary carcinoma in chromate workers. II. Incidence on basis of hospital records. *Arch. ind. Hyg. occup. Med.*, 2, 505-516
- Baetjer, A.M., Damron, C. & Budacz, V. (1959a) The distribution and retention of chromium in men and animals. *Arch. ind. Health*, 20, 136-150
- Baetjer, A.M., Lowney, J.F., Steffee, H. & Budacz, V. (1959b) Effect of chromium on incidence of lung tumors in mice and rats. *Arch. ind. Health*, 20, 124-135
- Baker, R.S.U. (1984) Evaluation of metals in in vitro assays, interpretation of data and possible mechanisms of action. *Toxicol. environ. Chem.*, 7, 191-212
- Baker, R.S.U., Bonin, A.M., Arlauskas, A., Tandon, R.K., Crisp, P.T. & Ellis, J. (1984) Chromium(VI) and apparent phenotypic reversion in *Salmonella* TA100. *Mutat. Res.*, 138, 127-132
- Bakke, O., Jakobsen, K. & Eik-Nes, K.B. (1984) Concentration-dependent effects of potassium dichromate on the cell cycle. *Cytometry*, 5, 482-486
- Balsberg-Påhlsson, A.-M., Lithner, G. & Tyler, G. (1982) *Krom i Miljön* (Chromium in the Environment), Solna, Statens Naturvårdsverk
- Baranowska-Dutkiewicz, B. (1981) Absorption of hexavalent chromium by skin in man. *Arch. Toxicol.*, 47, 47-50
- Barbořík, M., Hanslian, L., Oral, L., Sehnalová, H. & Holuša, R. (1958) Carcinoma of the lungs in personnel working at electrolytic chromium plating (Czech). *Prac. Lek.*, 10, 413-417
- Barceló, J., Poschenrieder, C. & Gunsé, B. (1986) Impact of chromium on the environment. II. Chromium in living organisms (Sp.). *Circ. Farm.*, 293, 31-48
- Barium & Chemicals (1988a) *MSDS and Data Sheet: Calcium Chromate*, Steubenville, OH
- Barium & Chemicals (1988b) *Military Specification: Barium Chromate (MIL-B-55A)*, Steubenville, OH
- Barium & Chemicals (undated) *Barium, Strontium, Calcium ... and Other Chemical Products*, Steubenville, OH
- Belitskaya, E.N. (1981) Physiologic and hygienic characterization of working conditions for steel smelters in open-hearth process (Russ.). *Gig. Tr.*, 24, 9-11
- Belmont Metals (1989) *Typical Analysis: Electrolytic Chromium Metal*, Brooklyn, NY
- Bennicelli, C., Camoirano, A., Petruzzelli, S., Zanicchi, P. & De Flora, S. (1983) High sensitivity of *Salmonella* TA102 in detecting hexavalent chromium mutagenicity and its reversal by liver and lung preparations. *Mutat. Res.*, 122, 1-5
- Bertazzi, P.A., Zocchetti, C., Terzaghi, G.F., Riboldi, L., Guercilena, S. & Beretta, F. (1981) Mortality experience of paint production workers (Ital.). *Med. Lav.*, 6, 465-472
- Beszedits, S. (1988) Chromium removal from industrial wastewaters. In: Nriagu, J.O. & Nieboer, E., eds, *Chromium in the Natural and Human Environments*, New York, Wiley-Interscience, pp. 231-265
- Beyersmann, D. & Köster, A. (1987) On the role of trivalent chromium in chromium genotoxicity. *Toxicol. environ. Chem.*, 14, 11-22

- Beyersmann, D., Köster, A., Buttner, B. & Flessel, P. (1984) Model reactions of chromium compounds with mammalian and bacterial cells. *Toxicol. environ. Chem.*, **8**, 279-286
- Bhargava, O.P., Bumsted, H.E., Grunder, F.I., Hunt, B.L., Manning, G.E., Riemann, R.A., Samuels, J.K., Tatone, V., Waldschmidt, S.J. & Hernandez, P. (1983) Study of an analytical method for hexavalent chromium. *Am. ind. Hyg. Assoc. J.*, **44**, 433-436
- Bianchi, V. & Levis, A.G. (1984) Mechanisms of chromium genotoxicity. *Toxicol. environ. Chem.*, **9**, 1-25
- Bianchi, V. & Levis, A.G. (1985) Metals as genotoxic agents: the model of chromium. In: Irgolic, K.J. & Martell, A.E., eds, *Environmental Organic Chemistry*, Deersfield Beach, FL, VCH Publishers, pp. 447-462
- Bianchi, V. & Levis, A.G. (1987) Recent advances in chromium genotoxicity. *Toxicol. environ. Chem.*, **15**, 1-24
- Bianchi, V. & Levis, A.G. (1988) Genetic effects and mechanisms of action of chromium compounds. *Sci. total Environ.*, **71**, 351-355
- Bianchi, V., Levis, A.G. & Saggiaro, D. (1979) Differential cytotoxic activity of potassium dichromate on nucleoside uptake in BHK fibroblasts. *Chem.-biol. Interact.*, **24**, 137-151
- Bianchi, V., Dal Toso, R., Debetto, P., Levis, A.G., Luciani, S., Majone, F. & Tamino, G. (1980) Mechanisms of chromium toxicity in mammalian cell cultures. *Toxicology*, **17**, 219-224
- Bianchi, V., Debetto, P., Zantedeschi, A. & Levis, A.G. (1982a) Effects of hexavalent chromium on the adenylate pool of hamster fibroblasts. *Toxicology*, **25**, 19-30
- Bianchi, V., Nuzzo, F., Abbondandolo, A., Bonatti, S., Capelli, E., Fiorio, R., Giulotto, E., Mazzaccaro, A., Stefanini, M., Zaccaro, L., Zantedeschi, A. & Levis, A.G. (1982b) Scintillometric determination of DNA repair in human cell lines: a critical appraisal. *Mutat. Res.*, **93**, 447-463
- Bianchi, V., Celotti, L., Lanfranchi, G., Majone, F., Marin, G., Montaldi, A., Sponza, G., Tamino, G., Venier, P., Zantedeschi, A. & Levis, A.G. (1983) Genetic effects of chromium compounds. *Mutat. Res.*, **117**, 279-300
- Bianchi, V., Zantedeschi, A., Montaldi, A. & Majone, F. (1984) Trivalent chromium is neither cytotoxic nor mutagenic in permeabilized hamster fibroblasts. *Toxicol. Lett.*, **23**, 51-59
- Bidstrup, P.L. (1951) Carcinoma of the lung in chromate workers. *Br. J. ind. Med.*, **8**, 302-305
- Bidstrup, P.L. & Case, R.A.M. (1956) Carcinoma of the lung in workmen in the bichromates-producing industry in Great Britain. *Br. J. ind. Med.*, **13**, 260-264
- Bigaliev, A.B. (1981) Chromosomal aberrations in a lymphocyte culture from persons in contact with chromium (Russ.). *Tsitol. Genet.*, **15**, 63-68
- Bigaliev, A.B., Elemesova, M.S. & Turebaev, M.N. (1977a) Evaluation of the mutagenic activity of chromium compounds (Russ.). *Gig. Tr. prof. Zabol.*, **6**, 37-40
- Bigaliev, A.B., Turebaev, M.N. & Elemesova, M.S. (1977b) Cytogenetic study of the in vivo mutagenic properties of chromium compounds (Russ.). In: Dubinin, N.P., ed., *Genet. Posledstviya Zagryaznenia Okruzhayushehei Sredy* (Proceedings of a Symposium), Moscow, Nauka, pp. 173-176

- Bigaliev, A.B., Turebaev, M.N., Bigalieva, R.K. & Elemesova, M.S. (1977c) Cytogenetic examination of workers engaged in chrome production (Russ.). *Genetika*, 13, 545-547
- Bigaliev, A.B., Shpak, N.K. & Smagulov, A.S. (1979) Mechanisms of the cytogenetic action of chromium as an environmental pollutant. *Dokl. Biol. Sci.* (Engl. transl.), 245, 809-810
- Biggart, N.W. & Murphy, E.C., Jr (1988) Analysis of metal-induced mutations altering the expression or structure of a retroviral gene in a mammalian cell line. *Mutat. Res.*, 198, 115-129
- Bloomfield, J.J. & Blum, W. (1928) Health hazards in chromium plating. *Public Health Rep.*, 43, 2330-2347
- Bohgard, M., Jandiga, B.L. & Akselsson, K.R. (1979) An analytical procedure for determining chromium in samples of airborne dust. *Ann. occup. Hyg.*, 22, 241-251
- Bonatti, S., Meini, M. & Abbondandolo, A. (1976) Genetic effects of potassium dichromate in *Schizosaccharomyces pombe*. *Mutat. Res.*, 38, 147-150
- Bourne, H.G., Jr & Yee, H.T. (1950) Occupational cancer in a chromate plant. An environmental appraisal. *Ind. Med. Surg.*, 19, 563-567
- Bovet, P., Lob, M. & Grandjean, M. (1977) Spirometric alterations in workers in the chromium electroplating industry. *Int. Arch. occup. environ. Health*, 40, 25-32
- Bragt, P.C. & van Dura, E.A. (1983) Toxicokinetics of hexavalent chromium in the rat after intratracheal administration of chromates of different solubilities. *Ann. occup. Hyg.*, 27, 315-322
- Brakhnova, I.T. (1975) *Environmental Hazards of Metals* (translation), New York, Consultants Bureau, pp. 41-42
- Brambilla, G., Sciabà, L., Carlo, P., Finollo, R., Farina, A. & Parodi, S. (1980) DNA crosslinking in mammalian cells treated with potassium dichromate (Abstract No. 394). *Proc. Am. Assoc. Cancer Res.*, 21, 98
- Brams, A., Buchet, J.P., Crutzen-Fayt, M.C., De Meester, C., Lauwerys, R. & Léonard, A. (1987) A comparative study, with 40 chemicals, of the efficiency of the *Salmonella* assay and the SOS chromotest (kit procedure). *Toxicol. Lett.*, 38, 123-133
- Braver, E.R., Infante, P. & Chu, K. (1985) An analysis of lung cancer risk from exposure to hexavalent chromium. *Teratog. Carcinog. Mutagenesis*, 5, 365-378
- Brinton, H.P., Frasier, E.S. & Koven, A.L. (1952) Morbidity and mortality experience among chromate workers. *Public Health Rep.*, 67, 835-847
- Brinton, L.A., Blot, W.J., Becker, J.A., Winn, D.M., Browder, J.P., Farmer, J.C., Jr & Fraumeni, J.F., Jr (1984) A case-control study of cancers of the nasal cavity and paranasal sinuses. *Am. J. Epidemiol.*, 119, 896-906
- British Chrome & Chemical Ltd (1988) *MSDS: Basic Chromic Sulphate (Chrometan)*, Eaglescliffe, Stockton-on-Tees
- Brochard, P., Ameille, J., Brun, B., Gagnant, B. & Philbert, M. (1983) Bronchial cancer and chromium electroplating. About a new case (Fr.). *Arch. Mal. prof.*, 44, 35-37
- Bronzetti, G., Galli, A., Boccardo, P., Vellosi, R., Del Carratore, R., Sabbioni, E. & Edel, J. (1986) Genotoxicity of chromium *in vitro* on yeast: interaction with DNA. *Toxicol. environ. Chem.*, 13, 103-111

- Brune, D., Nordberg, G. & Wester, P.O. (1980) Distribution of 23 elements in the kidney, liver and lungs of workers from a smeltery and refinery in north Sweden exposed to a number of elements and of a control group. *Sci. total Environ.*, 16, 13-35
- Bryson, W.G. & Goodall, C.M. (1983) Differential toxicity and clearance kinetics of chromium (III) or (VI) in mice. *Carcinogenesis*, 4, 1535-1539
- Buckell, M. & Harvey, D.G. (1951) An environmental study of the chromate industry. *Br. J. ind. Med.*, 8, 298-301
- Bunker, V.W., Lawson, M.S., Delves, H.T. & Clayton, B.E. (1984) The uptake and excretion of chromium by the elderly. *Am. J. clin. Nutr.*, 39, 797-802
- Burges, D.C.L. (1980) Mortality study of nickel platers. In: Brown, S.S. & Sunderman, F.W., eds, *Nickel Toxicology*, London, Academic Press, pp. 15-18
- Burrows, D. (1983) Adverse chromate reactions on the skin. In: Burrows, D., ed., *Chromium: Metabolism and Toxicity*, Boca Raton, FL, CRC Press, pp. 137-163
- Byrne, C.J. & DeLeon, I.R. (1986) Trace metal residues in biota and sediments from Lake Pontchartrain, Louisiana. *Bull. environ. Contam. Toxicol.*, 37, 151-158
- Calder, L.M. (1988) Chromium contamination of groundwater. In: Nriagu, J.O. & Nieboer, E., eds, *Chromium in the Natural and Human Environments*, New York, Wiley Interscience, pp. 215-229
- Camusso, M. & Montesissa, C. (1988) Chromium (Part 1) (Ital.). *Chim. ind. (Milan)*, 70, 30-32
- Cantoni, O. & Costa, M. (1984) Analysis of the induction of alkali sensitive sites in the DNA by chromate and other agents that induce single strand breaks. *Carcinogenesis*, 5, 1207-1209
- Carelli, G., La Bua, R., Rimatori, V., Porcelli, D. & Iannaccone, A. (1981) Interferences in the spectrophotometric *s*-diphenylcarbazide determination of environmental hexavalent chromium in a chromium and zinc plating plant. *Scand. J. Work Environ. Health*, 7, 56-61
- Cary, E.E. (1982) Chromium in air, soil, and natural waters. In: Langård, S., ed., *Biological and Environmental Aspects of Chromium*, Amsterdam, Elsevier, pp. 49-64
- Casto, B.C., Meyers, J. & DiPaolo, J.A. (1979) Enhancement of viral transformation for evaluation of the carcinogenic or mutagenic potential of inorganic metal salts. *Cancer Res.*, 39, 193-198
- Cavalleri, A. & Minoia, C. (1985) Monitoring exposure to Cr(VI) and Cr(III) in workers by determination of chromium in urine, serum and red blood cells (Ital.). *G. ital. med. Lav.*, 7, 35-38
- Celotti, L., Furlan, D., Seccati, L. & Levis, A.G. (1987) Interactions of nitrilotriacetic acid (NTA) with Cr(VI) compounds in the induction of gene mutations in cultured mammalian cells. *Mutat. Res.*, 190, 35-39
- Chalupski, V.H. (1956) The manufacture and properties of chromium pigments. In: Udy, M.J., ed., *Chromium*, Vol. 1, New York, Reinhold, pp. 364-376
- Chemical Information Services Ltd (1988) *Directory of World Chemical Producers 1989/90 Edition*, Oceanside, NY

- Choi, Y.-J., Kim, Y.-W. & Cha, C.-W. (1987) A study on sister chromatid exchanges in lymphocytes in some metal plating workers (Korean). *Korea Univ. med. J.*, 24, 249-257
- Christie, N.T., Cantoni, O., Evans, R.M., Meyn, R.E. & Costa, M. (1984) Use of mammalian DNA repair-deficient mutants to assess the effects of toxic metal compounds on DNA. *Biochem. Pharmacol.*, 33, 1661-1670
- Chromium Association (1989) *World Production of Ferrochromium*, Paris
- Cikrt, M. & Bencko, V. (1979) Biliary excretion and distribution of  $^{51}\text{Cr(III)}$  and  $^{51}\text{Cr(VI)}$  in rats. *J. Hyg. Epidemiol. Microbiol. Immunol.*, 23, 241-246
- Clarkson, T.W., Nordberg, G.F. & Sager, P.R. (1985) Reproductive and developmental toxicity of metals. *Scand. J. Work Environ. Health*, 11, 145-154
- Claude, J., Kunze, E., Frentzel-Beyme, R., Paczkowski, K., Schneider, J. & Schubert, H. (1986) Life-style and occupational risk factors in cancer of the lower urinary tract. *Am. J. Epidemiol.*, 124, 578-589
- Claude, J.C., Frentzel-Beyme, R.R. & Kunze, E. (1988) Occupation and risk of cancer of the lower urinary tract among men. A case-control study. *Int. J. Cancer*, 41, 371-379
- Cobalt Development Institute (1985) *Cobalt in Superalloys*, London, Strobel & Sons
- Collaborative Study Group for the Micronucleus Test (1986) Sex difference in the micronucleus test. *Mutat. Res.*, 172, 151-163
- Collaborative Study Group for the Micronucleus Test (1988) Strain difference in the micronucleus test. *Mutat. Res.*, 204, 307-316
- Commission of the European Communities (1975) Council Directive of 16 June 1975 concerning the quality required of surface water intended for the abstraction of drinking water in the Member States. *Off. J. eur. Communities*, L194, 26-30
- Connett, P.H. & Wetterhahn, K.E. (1983) Metabolism of the carcinogen chromate by cellular constituents. *Struct. Bonding*, 54, 93-124
- Connett, P.H. & Wetterhahn, K.E. (1985) In vitro reaction of the carcinogen chromate with cellular thiols and carboxylic acids. *J. Am. chem. Soc.*, 107, 4282-4288
- Cook, W.A. (1987) *Occupational Exposure Limits — Worldwide*, Washington DC, American Industrial Hygiene Association, pp. 119, 133
- Copson, R.L. (1956) Production of chromium chemicals. In: Udy, M.J., ed., *Chromium*, Vol. 1, New York, Reinhold, pp. 262-282
- Corbett, T.H., Heidelberger, C. & Dove, W.F. (1970) Determination of the mutagenic activity to bacteriophage T4 of carcinogenic and noncarcinogenic compounds. *Mol. Pharmacol.*, 6, 667-679
- Cornelis, R. (1988) Analytical procedures and clinical reference materials in monitoring human exposures to trace metals with special reference to chromium, lead, and thallium. *Sci. total Environ.*, 71, 269-283
- Cornell, R.G. & Landis, J.R. (1984) Mortality patterns among nickel/chromium alloy foundry workers. In: Sunderman, F.W., Jr, ed., *Nickel in the Human Environment* (IARC Scientific Publications No. 53; IPCS Joint Symposia No. 4; CEC-EUR 916 EN), Lyon, IARC, pp. 87-93
- Costa, R., Strolego, G. & Levis, A.G. (1988) Mutagenicity of lead chromate in *Drosophila melanogaster* in the presence of nitrilotriacetic acid (NTA). *Mutat. Res.*, 204, 257-261

- Cupo, D.Y. & Wetterhahn, K.E. (1984) Repair of chromate-induced DNA damage in chick embryo hepatocytes. *Carcinogenesis*, 5, 1705-1708
- Cupo, D.Y. & Wetterhahn, K.E. (1985a) Binding of chromium to chromatin and DNA from liver and kidney of rats treated with sodium dichromate and chromium III chloride *in vivo*. *Cancer Res.*, 45, 1146-1151
- Cupo, D.Y. & Wetterhahn, K.E. (1985b) Modification of chromium(VI)-induced DNA damage by glutathione and cytochrome P-450 in chicken embryo hepatocytes. *Proc. natl Acad. Sci. USA*, 82, 6755-6759
- Custer, T.W., Franson, J.C., Moore, J.F. & Myers, J.E. (1986) Reproductive success and heavy metal contamination in Rhode Island common terns. *Environ. Pollut. (Ser. A)*, 41, 33-52
- Cyprus Specialty Metals (1988) *Specification Sheets: Chromite (Chrome Ore) and Chromite, Supergray*, Malvern, PA
- Dalager, N.A., Mason, T.J., Fraumeni, J.F., Jr, Hoover, R. & Payne, W.W. (1980) Cancer mortality among workers exposed to zinc chromate paints. *J. occup. Med.*, 22, 25-29
- Dams, R., Robbins, J.A., Rahn, K.A. & Winchester, J.W. (1970) Nondestructive neutron activation analysis of air pollution particulates. *Anal. Chem.*, 42, 861-867
- Danielsson, B.R.G., Hassoun, E. & Dencker, L. (1982) Embryotoxicity of chromium: distribution in pregnant mice and effects on embryonic cells *in vitro*. *Arch. Toxicol.*, 51, 233-245
- Danielsson, B.R.G., Dencker, L., Lindgren, A. & Tjälve, H. (1984) Accumulation of toxic metals in male reproduction organs. *Arch. Toxicol., Suppl.* 7, 177-180
- Davies, J.M. (1978) Lung-cancer mortality of workers making chrome pigments (letter to the Editor). *Lancet*, i, 384
- Davies, J.M. (1979) Lung cancer mortality of workers in chromate pigment manufacture: an epidemiological survey. *J. Oil col. chem. Assoc.*, 62, 157-163
- Davies, J.M. (1984a) Lung cancer mortality among workers making lead chromate and zinc chromate pigments in three English factories. *Br. J. ind. Med.*, 41, 158-169
- Davies, J.M. (1984b) Long term mortality study of chromate pigment workers who suffered lead poisoning. *Br. J. ind. Med.*, 41, 170-178
- Davis, G.K. (1956) Chromium in soils, plants, and animals. In: Udy, M.J., ed., *Chromium*, Vol. 1, New York, Reinhold, pp. 105-109
- Davis, J.M.G. (1972) The fibrogenic effects of mineral dusts injected into the pleural cavity of mice. *Br. J. exp. Pathol.*, 53, 190-201
- De Flora, S. (1978) Metabolic deactivation of mutagens in the *Salmonella*/microsome test. *Nature*, 271, 455-456
- De Flora, S. (1981a) Study of 106 organic and inorganic compounds in the *Salmonella*/microsome test. *Carcinogenesis*, 2, 283-298
- De Flora, S. (1981b) A 'spiral test' applied to bacterial mutagenesis assays. *Mutat. Res.*, 82, 213-227

- De Flora, S. (1982) Biotransformation and interaction of chemicals as modulators of mutagenicity and carcinogenicity. In: Sugimura, T., Kondo, S. & Takebe, H., eds, *Environmental Mutagens and Carcinogens*, Tokyo, University of Tokyo Press/New York, Alan R. Liss, pp. 527-541
- De Flora, S. & Boido, V. (1980) Effect of human gastric juice on the mutagenicity of chemicals. *Mutat. Res.*, 77, 307-315
- De Flora, S. & Wetterhahn, K.E. (1990) Mechanisms of chromium metabolism and genotoxicity. *Life Chem. Rep.* (in press)
- De Flora, S., Coppola, R., Camoirano, A., Battaglia, M.A. & Bennicelli, C. (1980) Mutagenicity and toxicity of chromyl chloride and its vapours. *Carcinogenesis*, 1, 583-587
- De Flora, S., Znacchi, P., Bennicelli, C. & Arillo, A. (1982) Influence of liver S-9 preparations from rats and rainbow trout on the activity of four mutagens. *Toxicol. Lett.*, 10, 345-349
- De Flora, S., Znacchi, P., Camoirano, A., Bennicelli, C. & Badolati, G. (1984a) Genotoxic activity and potency of 135 compounds in the Ames reversion test and in bacterial DNA-repair test. *Mutat. Res.*, 133, 161-198
- De Flora, S., Camoirano, A., Znacchi, P. & Bennicelli, C. (1984b) Mutagenicity testing with TA97 and TA102 of 30 DNA-damaging compounds, negative with other *Salmonella* strains. *Mutat. Res.*, 134, 159-165
- De Flora, S., Bennicelli, C., Znacchi, P., Camoirano, A., Morelli, A. & De Flora, A. (1984c) In vitro effects of N-acetylcysteine on the mutagenicity of direct-acting compounds and procarcinogens. *Carcinogenesis*, 5, 505-510
- De Flora, S., De Renzi, G.P., Camoirano, A., Astengo, M., Basso, C., Znacchi, P. & Bennicelli, C. (1985a) Genotoxicity assay of oil dispersants in bacteria (mutation, differential lethality, SOS DNA-repair) and yeast (mitotic crossing-over). *Mutat. Res.*, 158, 19-30
- De Flora, S., Morelli, A., Basso, C., Romano, M., Serra, D. & De Flora, A. (1985b) Prominent role of DT-diaphorase as a cellular mechanism reducing chromium(VI) and reverting its mutagenicity. *Cancer Res.*, 45, 3188-3196
- De Flora, S., Bennicelli, C., Camoirano, A., Serra, D., Romano, M., Rossi, G.A., Morelli, A. & De Flora, A. (1985c) In vivo effects of N-acetylcysteine on glutathione metabolism and on the biotransformation of carcinogenic and/or mutagenic compounds. *Carcinogenesis*, 6, 1735-1745
- De Flora, S., Russo, P., Pala, M., Fassina, G., Zunino, A., Bennicelli, C., Znacchi, P., Camoirano, A. & Parodi, S. (1985d) Assay of phenacetin genotoxicity using in vitro and in vivo test systems. *J. Toxicol. environ. Health*, 16, 355-377
- De Flora, S., Badolati, G.S., Serra, D., Picciotto, A., Magnolia, M.R. & Savarino, V. (1987a) Circadian reduction of chromium in the gastric environment. *Mutat. Res.*, 192, 169-174
- De Flora, S., Camoirano, A., Serra, D., Basso, C., Znacchi, P. & Bennicelli, C. (1987b) DT diaphorase and the action of chemical mutagens and carcinogens. *Chem. scripta*, 27A, 151-155
- De Flora, S., Camoirano, A., Romano, M., Astengo, M., Cesarone, C.F. & Millman, I. (1987c) Metabolism of mutagens and carcinogens in woodchuck liver and its relationship with hepatitis virus infection. *Cancer Res.*, 47, 4052-4058

- De Flora, S., Petruzzelli, S., Camoirano, A., Bennicelli, C., Romano, M., Rindi, M., Ghelarducci, L. & Giuntini, C. (1987d) Pulmonary metabolism of mutagens and its relationship with lung cancer and smoking habits. *Cancer Res.*, **47**, 4740-4745
- De Flora, S., Bennicelli, C., Camoirano, A., Serra, D. & Hochstein, P. (1988) Influence of DT diaphorase on the mutagenicity of organic and inorganic compounds. *Carcinogenesis*, **9**, 611-617
- De Flora, S., Serra, D., Camoirano, A. & Zancacchi, P. (1989a) Metabolic reduction of chromium, as related to its carcinogenic properties. *Biol. Trace Element Res.*, **21**, 179-187
- De Flora, S., Camoirano, A., Serra, D. & Bennicelli, C. (1989b) Genotoxicity and metabolism of chromium compounds. *Toxicol. environ. Chem.*, **19**, 153-160
- De Flora, S., Hietanen, E., Bartsch, H., Camoirano, A., Izzotti, A., Bagnasco, M. & Millman, I. (1989c) Enhanced metabolic activation of chemical hepatocarcinogens in woodchucks infected with hepatitis B virus. *Carcinogenesis*, **10**, 1099-1106
- De Flora, S., Serra, D., Basso, C. & Zancacchi, P. (1989d) Mechanistic aspects of chromium carcinogenicity. *Arch. Toxicol., Suppl.* **13**, 28-39
- De Flora, S., Bagnasco, M., Serra, D. & Zancacchi, P. (1990) Genotoxicity of chromium compounds. A review. *Mutat. Res.* (in press)
- Deknadt, G. (1982) In vivo study of the mutagenicity of heavy metals in mammals (Abstract no. 33). *Mutat. Res.*, **97**, 180
- Delachaux (1989) *Vacuum Grade (Super Alloys); Chromium Powders; Double Degassed Briquettes*, Gennevilliers
- De Marco, R., Bernardinelli, L. & Mangione, M.P. (1988) Death risk due to cancer of the respiratory apparatus in chromate production workers (Ital.). *Med. Lav.*, **79**, 368-376
- Deng, C.Z., Ou, B.X., Huang, J.C., Zhuo, Z.L., Xian, H.L., Yao, M.C., Chen, M.Y., Li, Z.X., Sheng, S.Y. & Yei, Z.F. (1983) Cytogenetic effects of electroplating workers (Chin.). *Acta sci. circumst.*, **3**, 267-271
- Deng, C.Z., Lee, H.H., Xian, H.L., Yao, M.C., Huang, J.C. & Ou, B.X. (1988) Chromosomal aberrations and sister chromatid exchanges of peripheral blood lymphocytes in Chinese electroplating workers: effect of nickel and chromium. *J. trace Elem. exp. Med.*, **1**, 57-62
- Deutsches Institut für Normung (German Standards Institute) (1987) *Photometric Determination of Chromium (VI) using 1,5-Diphenylcarbonohydrazide (D 24) (DIN 38405)*, Part 24, Berlin (West)
- DiPaolo, J.A. & Casto, B.C. (1979) Quantitative studies of in vitro morphological transformation of Syrian hamster cells by inorganic metal salts. *Cancer Res.*, **39**, 1008-1013
- Dixit, M.N., Bhale, G.L. & Thomas, A. (1976) Emission spectrographic determination of trace elements in plant materials. *Indian J. pure appl. Phys.*, **14**, 485-487
- Donaldson, R.M. & Barreras, R.F. (1966) Intestinal absorption of trace quantities of chromium. *J. Lab. clin. Med.*, **68**, 484-493
- Donaldson, D.L., Smith, C.C. & Yunice, A.A. (1986) Renal excretion of chromium-51 chloride in the dog. *Am. J. Physiol.*, **246**, F870-F878

- Douglas, G.R., Bell, R.D.L., Grant, C.E., Wytsma, J.M. & Bora, K.C. (1980) Effect of lead chromate on chromosomal aberration, sister-chromatid exchange and DNA damage in mammalian cells *in vitro*. *Mutat. Res.*, 77, 157-163
- Dry Color Manufacturers' Association (1982) *Classification and Chemical Description of the Mixed Metal Oxide Inorganic Colored Pigments*, 2nd ed., Arlington, VA
- Dunkel, V.C., Pienta, R.J., Sivak, A. & Traul, K.A. (1981) Comparative neoplastic transformation responses of Balb/3T3 cells, Syrian hamster embryo cells, and Rauscher murine leukemia virus-infected Fischer 344 rat embryo cells to chemical carcinogens. *J. natl Cancer Inst.*, 67, 1303-1315
- Dunkel, V.C., Zeiger, E., Brusick, D., McCoy, E., McGregor, D., Mortelmans, K., Rosenkranz, H.S. & Simmon, V.F. (1984) Reproducibility of microbial mutagenicity assays: I. Tests with *Salmonella typhimurium* and *Escherichia coli* using a standardized protocol. *Environ. Mutagenesis*, 6(Suppl. 2), 1-254
- Dunstan, L.P. & Garner, E.L. (1977) Chemical preparation of biological materials for accurate chromium determination by isotope dilution mass spectrometry. *Trace Subst. environ. Health*, 11, 334-337
- Dvizhkov, P.P. & Fedorova, V.I. (1967) On blastomogenic properties of chromic oxide (Russ.). *Vop. Onkol.*, 13, 57-62
- Egilsson, V., Evans, I.H. & Wilkie, D. (1979) Toxic and mutagenic effects of carcinogens on the mitochondria of *Saccharomyces cerevisiae*. *Mol. gen. Genet.*, 174, 39-46
- Eisenberg, M. & Topping, J.J. (1986) Trace metal residues in finfish from Maryland waters, 1978-1979. *J. environ. Sci. Health*, B21, 87-102
- Ekholm, U., Ulfvarsson, U. & Lindberg, E. (1983) *Exposure Conditions in Swedish Chromium Plating Industry* (Swed.) (Arbete och Hälsa 1983:24), Solna, Arbetarskyddsstyrelsen
- Elias, Z., Schneider, O., Aubry, F., Danière, M.C. & Poirot, O. (1983) Sister chromatid exchanges in Chinese hamster V79 cells treated with the trivalent chromium compounds chromic chloride and chromic oxide. *Carcinogenesis*, 4, 605-611
- Elias, Z., Poirot, O., Schneider, O., Danière, M.C., Terzetti, F., Guedenet, J.C. & Cavelier, C. (1986) Cellular uptake, cytotoxic and mutagenic effects of insoluble chromic oxide in V79 Chinese hamster cells. *Mutat. Res.*, 169, 159-170
- Elinder, C.G., Gerhardsson, L. & Oberdoerster, G. (1988) Biological monitoring of toxic metals — overview. In: Clarkson, T.W., Friberg, L., Nordberg, G.F. & Sager, P.R., eds, *Biological Monitoring of Toxic Metals*, New York, Plenum, pp. 1-71
- Elkem Metals Co. (1986) *Product Data Sheet: ELCHROMER<sup>®</sup> Electrolytic Chromium*, Pittsburgh, PA
- Eller, P.M., ed. (1984) *NIOSH Manual of Analytical Methods*, 3rd ed., Vols 1 and 2 (DHHS (NIOSH) Publ. No. 84-100), Washington DC, US Government Printing Office, pp. 7024-1-7024-3, 7200-1-7200-5, 7300-1-7300-5, 7600-1-7600-4, 8310-1-8310-6
- Eller, P.M., ed. (1985) *NIOSH Manual of Analytical Methods*, 3rd ed., 1st Suppl. (DHHS (NIOSH) Publ. No. 84-100), Washington DC, US Government Printing Office, pp. 8005-1-8005-5

- Elofsson, S.-A., Gamberale, F., Hindmarsh, T., Iregren, A., Isaksson, A., Johnsson, I., Knave, B., Lydahl, E., Mindus, P., Persson, H.E., Philipson, B., Steby, M., Struwe, G., Söderman, E., Wennberg, A. & Widén, L. (1980) Exposure to organic solvents. A cross-sectional epidemiological investigation on occupationally exposed car and industrial spray painters with special reference to the nervous system. *Scand. J. Work Environ. Health*, 6, 239-273
- Enterline, P.E. (1974) Respiratory cancer among chromate workers. *J. occup. Med.*, 16, 523-526
- ERAMET-SLN (Entreprise de Recherches et d'Activités — Métaux — Société le Nickel) (1989) *Western World Stainless Steel Production*, Paris
- Eurométaux (1986) *Usage of Nickel in Industry*, Brussels
- Fabry, L. (1980) Relation between the induction of micronuclei in bone-marrow cells by chromium salts and their carcinogenic potency (Fr.). *C.R. Soc. Biol.*, 174, 889-892
- Fairhurst, S. & Minty, C.A. (1990) *The Toxicity of Chromium and Inorganic Chromium Compounds* (Health and Safety Executive Toxicity Review), London, Her Majesty's Stationery Office (in press)
- Fan, A.M. & Harding-Barlow, I. (1987) Chromium. In: Fishbein, L., Furst, A. & Mehlman, M.A., eds, *Genotoxic and Carcinogenic Metals: Environmental and Occupational Occurrence and Exposure* (Advances in Modern Environmental Toxicology, Vol. XI), Princeton, NJ, Princeton Scientific Publishing, pp. 87-125
- Farrell, R.P., Judd, R.J., Lay, P.A., Dixon, N.E., Baker, R.S.U. & Bonin, A.M. (1989) Chromium(V)-induced cleavage of DNA: are chromium(V) complexes the active carcinogens in chromium(VI)-induced cancer? *Chem. Res. Toxicol.*, 2, 227-229
- Filiberti, R., Ceppi, M. & Vercelli, M. (1983) Distribution in the environment and toxic and carcinogenic effects of chromium (Ital.). *Riv. med. Lav. Ig. ind.*, 7, 245-259
- Fishbein, L. (1976) Environmental metallic carcinogens: an overview of exposure levels. *J. Toxicol. environ. Health*, 2, 77-109
- Fishbein, L. (1984) Overview of analysis of carcinogenic and/or mutagenic metals in biological and environmental samples. I. Arsenic, beryllium, cadmium, chromium and selenium. *Int. J. environ. anal. Chem.*, 17, 113-170
- Fitzgerald, P.R., Peterson, J. & Lue-Hing, C. (1985) Heavy metals in tissues of cattle exposed to sludge-treated pastures for eight years. *Am. J. vet. Res.*, 46, 703-707
- Foa, V., Riboldi, L., Patroni, M., Zocchetti, C., Sbrana, C. & Mutti, A. (1988) Effects derived from long-term low-level chromium exposure in ferro-alloy metallurgy. Study of absorption and renal function in workers. *Sci. total Environ.*, 71, 389-400
- Fornace, A.J., Jr (1982) Detection of DNA single-strand breaks produced during the repair of damage by DNA-protein cross-linking agents. *Cancer Res.*, 42, 145-149
- Fornace, A.J., Jr, Seres, D.S., Lechner, J.F. & Harris, C.C. (1981) DNA-protein cross-linking by chromium salts. *Chem.-biol. Interact.*, 36, 345-354
- Fradkin, A., Janoff, A., Lane, B.P. & Kuschner, M. (1975) In vitro transformation of BHK21 cells grown in the presence of calcium chromate. *Cancer Res.*, 35, 1058-1063

- Franchini, I., Mutti, A., Cavatorta, A., Corradi, A., Cosi, A., Olivetti, G. & Borghetti, A. (1978) Nephrotoxicity of chromium. Remarks on an experimental and epidemiological investigation. *Contrib. Nephrol.*, 10, 98-110
- Franchini, I., Magnani, F. & Mutti, A. (1983) Mortality experience among chromeplating workers. Initial findings. *Scand. J. Work Environ. Health*, 9, 247-252
- Franzen, E., Pohle, R. & Knoblich, K. (1970) Industrial hygiene studies in electroplating. III. Chromium in urine (Ger.). *Z. ges. Hyg.*, 16, 657-661
- Fregert, S. & Gruvberger, B. (1972) Chemical properties of cement. *Berufsdermatosen*, 20, 238-245
- Frentzel-Beyme, R. (1983) Lung cancer mortality of workers employed in chromate pigment factories. A multicentric European epidemiological study. *J. Cancer Res. clin. Oncol.*, 105, 183-188
- Friedman, J., Shabtai, F., Levy, L.S. & Djaldetti, M. (1987) Chromium chloride induces chromosomal aberrations in human lymphocytes *via* indirect action. *Mutat. Res.*, 191, 207-210
- Fukunaga, M., Kurachi, Y. & Mizuguchi, Y. (1982) Action of some metal ions on yeast chromosomes. *Chem. pharm. Bull.*, 30, 3017-3019
- Furst, A. (1971) Trace elements related to specific chronic diseases: cancer. In: Cannon, H.L. & Hopps, H.C., eds, *Environmental Geochemistry in Health and Disease*, Boulder, CO, Geological Society of America, pp. 109-130
- Furst, A., Schlauder, M. & Sasmore, D.P. (1976) Tumorigenic activity of lead chromate. *Cancer Res.*, 36, 1779-1783
- Gafafer, W.M., ed. (1953) *Health of Workers in Chromate Producing Industry: A Study* (US Public Health Service, Division of Occupational Health Publications No. 192), Washington DC, US Public Health Service
- Gale, T.F. (1978) Embryotoxic effects of chromium trioxide in hamsters. *Environ. Res.*, 16, 101-109
- Gale, T.F. (1982) The embryotoxic response to maternal chromium trioxide exposure in different strains of hamsters. *Environ. Res.*, 29, 196-203
- Gale, T.F. & Bunch, J.D., III (1979) The effect of time of administration of chromium trioxide on the embryotoxic response in hamsters. *Teratology*, 19, 81-86
- Galli, A., Boccardo, P., Del Carratore, R., Cundari, E. & Bronzetti, G. (1985) Conditions that influence the genetic activity of potassium dichromate and chromium chloride in *Saccharomyces cerevisiae*. *Mutat. Res.*, 144, 165-169
- Gaughhofer, J. (1984) Chromium (Ger.). In: Merian, E., ed., *Metallen im Umwelt* (Metals in the Environment), Weinheim, Verlag Chemie, pp. 409-424
- Gava, C., Perazzolo, L., Zentilin, L., Levis, A.G., Corain, B., Bombi, G.G., Palumbo, M. & Zatta, P. (1989a) Genotoxic potentiality and DNA binding properties of acetylacetone, maltol, and their aluminium(III) and chromium(III) neutral complexes. *Toxicol. environ. Chem.*, 22, 149-157
- Gava, C., Costa, R., Zordan, M., Venier, P., Bianchi, V. & Levis, A.G. (1989b) Induction of gene mutations in *Salmonella* and *Drosophila* by soluble Cr(VI) compounds: synergistic effects of nitrilotriacetic acid (NTA). *Toxicol. environ. Chem.* (in press)

- Gentile, J.M., Hyde, K. & Schubert, J. (1981) Chromium genotoxicity as influenced by complexation and rate effects. *Toxicol. Lett.*, 7, 439-448
- Gilani, S.H. & Marano, M. (1979) Chromium poisoning and chick embryogenesis. *Environ. Res.*, 19, 427-431
- Glaser, U., Hochrainer, D., Klöppel, H. & Kuhnen, H. (1985) Low level chromium (VI) inhalation effects on alveolar macrophages and immune functions in Wistar rats. *Arch. Toxicol.*, 57, 250-256
- Glaser, U., Hochrainer, D., Klöppel, H. & Oldiges, H. (1986) Carcinogenicity of sodium dichromate and chromium [VI/III] oxide aerosols inhaled by male Wistar rats. *Toxicology*, 42, 219-232
- Gläss, E. (1955) Studies on the effect of heavy metal salts on mitosis in root tips of *Vicia faba* (Ger.). *Z. Botanik.*, 43, 359-403
- Gomes, E.R. (1972) Incidence of chromium-induced lesions among electroplating workers in Brazil. *Ind. Med.*, 41, 21-25
- Gómez-Arroyo, S., Altamirano, M. & Villalobos-Pietrini, R. (1981) Sister chromatid exchanges induced by some chromium compounds in human lymphocytes *in vitro*. *Mutat. Res.*, 90, 425-431
- Gray, S.J. & Sterling, K. (1950) The tagging of red cells and plasma proteins with radioactive chromium. *J. clin. Invest.*, 29, 1604-1613
- Green, M.H.L., Muriel, W.J. & Bridges, B.A. (1976) Use of a simplified fluctuation test to detect low levels of mutagens. *Mutat. Res.*, 38, 33-42
- Gresh, J.T. (1944) Chromic acid poisoning resulting from inhalation of mist developed from five per cent chromic acid solution. II. Engineering aspects of chromic acid poisoning from anodizing operations. *J. ind. Hyg. Toxicol.*, 26, 127-130
- Grogan, C.H. (1957) Experimental studies in metal carcinogenesis. VIII. On the etiological factor in chromate cancer. *Cancer*, 10, 625-638
- Gross, E. & Kölsch, F. (1943) On lung cancer in the chromium pigment industry (Ger.). *Arch. Gewerbepathol. Gewerbehyg.*, 12, 164-170
- Guillemin, M.P. & Berode, M. (1978) A study on the difference in chromium exposure in workers in two types of electroplating process. *Ann. occup. Hyg.*, 21, 105-112
- Haguenoer, J.M., Dubois, G., Frimat, P., Cantineau, A., Lefrançois, H. & Furon, D. (1981) Mortality from bronchopulmonary cancer in a zinc- and lead-chromate producing factory (Fr.). In: *Prevention of Occupational Cancer, International Symposium* (Occupational Safety and Health Series No. 46), Geneva, International Labour Office, pp. 168-176
- Haguenoer, J.M., Leveque, G. & Frimat, P. (1982) Determinations of chromium, nickel and cobalt in cement of northern France and Belgium in relation to dermatoses (Fr.). *Arch. Mal. prof.*, 43, 241-247
- Haines, A.T. & Nieboer, E. (1988) Chromium hypersensitivity. In: Nriagu, J.O. & Nieboer, E., eds, *Chromium in the Natural and Human Environments*, New York, John Wiley & Sons, pp. 497-532
- Hama, G., Fredrick, W., Millage, D. & Brown, H. (1954) Absolute control of chromic acid mist. Investigation of a new surface-active agent. *Am. ind. Hyg. Q.*, 15, 211-216

- Hamamy, H.A., Al-Hakkak, Z.S. & Hussain, A.F. (1987) Chromosome aberrations in workers at a tannery in Iraq. *Mutat. Res.*, 189, 395-398
- Hamilton, J.W. & Wetterhahn, K.E. (1986) Chromium(VI)-induced DNA damage in chick embryo liver and blood cells *in vivo*. *Carcinogenesis*, 7, 2085-2088
- Hamilton-Koch, W., Snyder, R.D. & LaVelle, J.M. (1986) Metal-induced DNA damage and repair in human diploid fibroblasts and Chinese hamster ovary cells. *Chem.-biol. Interactions*, 59, 17-28
- Handa, B.K. (1988) Occurrence and distribution of chromium in natural waters of India. In: Nriagu, J.O. & Nieboer, E., eds, *Chromium in the Natural and Human Environments*, New York, Wiley Interscience, pp. 189-214
- Hansen, K. & Stern, R.M. (1984) A survey of metal-induced mutagenicity *in vitro* and *in vivo*. *J. Am. Coll. Toxicol.*, 3, 381-430
- Hansen, K. & Stern, R.M. (1985) Welding fumes and chromium compounds in cell transformation assays. *J. appl. Toxicol.*, 5, 306-314
- Hanslian, L., Navrátil, J., Jurák, J. & Kotrle, M. (1967) The impairment of higher respiratory pathways by chromic acid aerosol (Czech.). *Prac. Lék.*, 19, 294-298
- Hartford, W.H. (1963) Chromium. In: Kolthoff, I.M. & Elving, P.J., eds, *Treatise on Analytical Chemistry*, Part II, Vol. 8, New York, John Wiley & Sons, pp. 273-377
- Hartford, W.H. (1979) Chromium compounds. In: Mark, H.F., Othmer, D.F., Overberger, C.G., Seaborg, G.T. & Grayson, M., eds, *Kirk-Othmer Encyclopedia of Chemical Technology*, 3rd ed., Vol. 6, New York, John Wiley & Sons, pp. 82-120
- Hartford, W.H. & Copson, R.L. (1964) Chromium compounds. In: Kirk, R.E., Othmer, D.F., Grayson, M. & Eckroth, D., eds, *Encyclopedia of Chemical Technology*, 2nd ed., Vol. 5, New York, John Wiley & Sons, pp. 485-486, 494, 499, 510
- Hartwig, A. & Beyersmann, D. (1987) Enhancement of UV and chromate mutagenesis by nickel ions in the Chinese hamster HGPRT assay. *Toxicol. environ. Chem.*, 14, 33-42
- Harzdorf, A.C. (1987) Analytical chemistry of chromium species in the environment, and interpretation of results. *Int. J. environ. anal. Chem.*, 29, 249-261
- Hatch, G.G. & Anderson, T.M. (1986) Chemical enhancement of simian adenovirus SA7 transformation of hamster embryo cells: evaluation of diverse chemicals (Abstract No. OD5). In: Ramel, C., Lambert, B. & Magnusson, J., eds, *Fourth International Conference on Environmental Mutagens*, Stockholm, June 24-28, 1985, New York, Alan R. Liss, p. 34
- Haworth, S., Lawlor, T., Mortelmans, K., Speck, W. & Zeiger, E. (1983) *Salmonella* mutagenicity test results for 250 chemicals. *Environ. Mutagenesis*, 5 (Suppl. 1), 3-142
- Hayashi, M., Sofuni, T. & Ishidate, M., Jr (1982) High-sensitivity in micronucleus induction of a mouse strain (MS). *Mutat. Res.*, 105, 253-256
- Hayes, R.B. (1988) Review of occupational epidemiology of chromium chemicals and respiratory cancer. *Sci. total Environ.*, 71, 331-339
- Hayes, R.B., Lilienfeld, A.M. & Snell, L.M. (1979) Mortality in chromium chemical production workers: a prospective study. *Int. J. Epidemiol.*, 8, 365-374

- Hayes, S., Gordon, A., Sadowski, I. & Hayes, C. (1984) RK bacterial test for independently measuring chemical toxicity and mutagenicity: short-term forward selection assay. *Mutat. Res.*, 130, 97-106
- Hayes, R.B., Sheffet, A. & Spirtas, R. (1989) Cancer mortality among a cohort of chromium pigment workers. *Am. J. ind. Med.*, 16, 127-133
- Haynes, E. (1907) *Metal Alloy* (Kokomo, Ind.). Patent No. 873, 745 [Chem. Abstr., 1908, 2]
- Health and Safety Executive (1987) *Occupational Exposure Limits 1987* (Guidance Note EH 4d87), London, Her Majesty's Stationery Office, p. 11
- Heck, J.D. & Costa, M. (1982a) In vitro assessment of the toxicity of metal compounds. I. Mammalian cell transformation. *Biol. Trace Element Res.*, 4, 71-82
- Heck, J.D. & Costa, M. (1982b) In vitro assessment of the toxicity of metal compounds. II. Mutagenesis. *Biol. Trace Element Res.*, 4, 319-330
- Heigl, A. (1978) Polarographic determination of copper, lead, tin, cadmium, nickel, zinc, iron, cobalt and chromium in waste water (Ger.). *Chimia*, 32, 339-344 [Chem. Abstr., 90, 76081f]
- Heit, M. (1979) Variability of the concentrations of seventeen trace elements in the muscle and liver of a single striped bass, *Morone saxatilis*. *Bull. environ. Contam. Toxicol.*, 23, 1-5
- Hellquist, H., Irander, K., Edling, C. & Ödkvist, L.M. (1983) Nasal symptoms and histopathology in a group of spray painters. *Acta otolaryngol.*, 96, 495-500
- Hernberg, S., Collan, Y., Degerth, R., Englund, A., Engzell, U., Kuosma, E., Mutanen, P., Nordlinder, H., Hansen, H.S., Schultz-Larsen, K., Søgaaard, H. & Westerholm, P. (1983a) Nasal cancer and occupational exposures. Preliminary report of a joint Nordic case-referent study. *Scand. J. Work Environ. Health*, 9, 208-213
- Hernberg, S., Westerholm, P., Schultz-Larsen, K., Degerth, R., Kuosma, E., Englund, A., Engzell, U., Hansen, H.S. & Mutanen, P. (1983b) Nasal and sinonasal cancer. Connection with occupational exposures in Denmark, Finland and Sweden. *Scand. J. Work Environ. Health*, 9, 315-326
- Hopkins, L.L., Jr (1965) Distribution in the rat of physiological amounts of injected  $^{51}\text{Cr}(\text{III})$  with time. *Am. J. Physiol.*, 209, 731-735
- Howarth, C.L. (1956) Chromium chemicals in the textile industry. In: Udy, M.J., ed., *Chromium*, Vol. 1, New York, Reinhold, pp. 283-290
- Hueper, W.C. (1955) Experimental studies in metal cancerigenesis. VII. Tissue reactions to parenterally introduced powdered metallic chromium and chromite ore. *J. natl Cancer Inst.*, 16, 447-462
- Hueper, W.C. (1958) Experimental studies in metal cancerigenesis. X. Cancerigenic effects of chromite ore roast deposited in muscle tissue and pleural cavity of rats. *Arch. ind. Health*, 18, 284-291
- Hueper, W.C. (1961) Environmental carcinogenesis and cancers. *Cancer Res.*, 21, 842-857
- Hueper, W.C. & Payne, W.W. (1959) Experimental cancers in rats produced by chromium compounds and their significance to industry and public health. *Am. ind. Hyg. Assoc. J.*, 20, 274-280
- Hueper, W.C. & Payne, W.W. (1962) Experimental studies in metal carcinogenesis. Chromium, nickel, iron, arsenic. *Arch. environ. Health*, 5, 445-462

- Huff, J.W., Sastry, K.S., Gordon, M.P. & Wacker, W.E.C. (1964) The action of metal ions on tobacco mosaic virus ribonucleic acid. *Biochemistry*, 3, 501-506
- Husgafvel-Pursiainen, K., Kalliomäki, P.-L. & Sorsa, M. (1982) A chromosome study among stainless steel welders. *J. occup. Med.*, 24, 762-766
- Hyodo, K., Suzuki, S., Furuya, N. & Meshizuka, K. (1980) An analysis of chromium, copper, and zinc in organs of a chromate workers. *Int. Arch. occup. environ. Health*, 46, 141-150
- IARC (1973) *IARC Monographs on the Evaluation of Carcinogenic Risk of Chemicals to Man*, Vol. 2, *Some Inorganic and Organometallic Compounds*, Lyon, pp. 100-125
- IARC (1979) *IARC Monographs on the Evaluation of the Carcinogenic Risk of Chemicals to Humans*, Suppl. 1, *Chemicals and Industrial Processes Associated with Cancer in Humans*, IARC Monographs Volumes 1 to 20, Lyon, pp. 29-30
- IARC (1980a) *IARC Monographs on the Evaluation of the Carcinogenic Risk of Chemicals to Humans*, Vol. 23, *Some Metals and Metallic Compounds*, Lyon, pp. 205-323
- IARC (1980b) *IARC Monographs on the Evaluation of the Carcinogenic Risk of Chemicals to Humans*, Vol. 23, *Some Metals and Metallic Compounds*, Lyon, pp. 325-415
- IARC (1981) *IARC Monographs on the Evaluation of the Carcinogenic Risk of Chemicals to Humans*, Vol. 25, *Wood, Leather and Some Associated Industries*, Lyon, pp. 201-247
- IARC (1982) *IARC Monographs on the Evaluation of the Carcinogenic Risk of Chemicals to Humans*, Suppl. 4, *Chemicals, Industrial Processes and Industries Associated with Cancer in Humans*. IARC Monographs Volumes 1 to 29, Lyon, pp. 91-93
- IARC (1987a) *IARC Monographs on the Evaluation of Carcinogenic Risks to Humans*, Suppl. 7, *Overall Evaluations of Carcinogenicity: An Updating of IARC Monographs Volumes 1 to 42*, Lyon, pp. 165-168
- IARC (1987b) *IARC Monographs on the Evaluation of Carcinogenic Risks to Humans*, Suppl. 6, *Genetic and Related Effects: An Updating of Selected IARC Monographs from Volumes 1 to 42*, Lyon, pp. 165-168
- IARC (1988) *Information Bulletin on the Survey of Chemicals Being Tested for Carcinogenicity*, No. 13, Lyon, pp. 34, 123, 259
- IARC (1989) *IARC Monographs on the Evaluation of Carcinogenic Risks to Humans*, Vol. 47, *Some Organic Solvents, Resin Monomers and Related Compounds, Pigments and Occupational Exposures in Paint Manufacture and Painting*, Lyon, pp. 307-326
- Iijima, S., Matsumoto, N. & Lu, C.-C. (1983a) Transfer of chromic chloride to embryonic mice and changes in the embryonic mouse neuroepithelium. *Toxicology*, 26, 257-265
- Iijima, S., Spindle, A. & Pedersen, R.A. (1983b) Developmental and cytogenetic effects of potassium dichromate on mouse embryos *in vitro*. *Teratology*, 27, 109-115
- Il'inykh, S.V. (1977) Method for the determination of chromium in canned food packed into cans made of chrome-plated tin (Russ.). In: *Hygienic Aspect of Defence of Health of Workers*, Moscow, Erismana Institute of Hygiene, pp. 193-194 [*Chem. Abstr.*, 89, 88934d]
- Imreh, S. & Radulescu, D. (1982) Cytogenetic effects of chromium *in vivo* and *in vitro* (Abstract No. 56). *Mutat. Res.*, 97, 192-193

- Institut National de Recherche et de Sécurité (National Institute for Research and Safety) (1986) [*Limit Values for Dangerous Substances in Work Place Air*] (ND 1609-125-86) (in French), Paris, p. 562
- Ivankovic, S. & Preussmann, R. (1975) Absence of toxic and carcinogenic effects after administration of high doses of chromic oxide pigment in subacute and long-term feeding experiments in rats. *Food Cosmet. Toxicol.*, **13**, 347-351
- Iyengar, V. & Woittiez, J. (1988) Trace elements in human clinical specimens: evaluation of literature data to identify reference values. *Clin. Chem.*, **34**, 474-481
- Jackson, J.F. & Linskens, H.F. (1982) Metal ion induced unscheduled DNA synthesis in *Petunia* pollen. *Mol. gen. Genet.*, **187**, 112-115
- Jacquet, P. & Draye, J.P. (1982) Toxicity of chromium salts to cultured mouse embryos. *Toxicol. Lett.*, **12**, 53-57
- Jayjock, M.A. & Levin, L. (1984) Health hazards in a small automotive body repair shop. *Ann. occup. Hyg.*, **28**, 19-29
- Jin, X. & Hou, D. (1984) Chemical behaviour of chromium in the environment (Chin.). *Changchun Dizhi Xueyuan Xuebao*, **3**, 91-99
- Johansson, A., Wiernik, A., Jarstrand, C. & Camner, P. (1986) Rabbit alveolar macrophages after inhalation of hexa- and trivalent chromium. *Environ. Res.*, **39**, 372-385
- de Jong, G.J. & Brinkman, U.A.T. (1978) Determination of chromium (III) and chromium (VI) in sea water by atomic absorption spectrometry. *Anal. chim. Acta*, **98**, 243-250
- Kada, T., Hirano, K. & Shirasu, T. (1980) Screening of environmental chemical mutagens in the rec-assay system with *Bacillus subtilis*. In: de Serres, F.J. & Hollaender, A., eds, *Chemical Mutagens: Principles and Methods for Their Detection*, Vol. 6, New York, Plenum, pp. 149-173
- Kalinina, L.M. & Minseitova, S.R. (1983a) Induction of mutagenic repair in cells of *Escherichia coli* under the action of potassium bichromate (translation). *Dokl. Akad. Nauk SSR*, **268**, 720-722
- Kalinina, L.M. & Minseitova, S.R. (1983b) Mutagenic effects and DNA-damaging action in *Escherichia coli* cells treated with potassium bichromate (translation). *Genetika*, **19**, 1941-1947
- Kalinina, L.M. & Minseitova, S.R. (1983c) DNA repair pathways in *Escherichia coli* K-12 cells after mutation induction by potassium dichromate (translation). *Dokl. Akad. Nauk SSR*, **272**, 208-210
- Kaneko, T. (1976) Chromosome damage in cultured human leukocytes induced by chromium chloride and chromium trioxide (Jpn.). *Jpn. J. ind. Health*, **18**, 136-137
- Kanematsu, N., Hara, M. & Kada, T. (1980) Rec assay and mutagenicity studies on metal compounds. *Mutat. Res.*, **77**, 109-116
- Kaths, D.S. (1981) *In Vivo Cytogenetic Effect of Some Salts of the Heavy Metals Cadmium, Chromium, Mercury, and Platinum in Assays of Micronuclei and Sister Chromatid Exchange*, Thesis, Freiburg, Freiburg University
- Kawanishi, S., Inoue, S. & Sano, S. (1986) Mechanism of DNA cleavage induced by sodium chromate(VI) in the presence of hydrogen peroxide. *J. biol. Chem.*, **261**, 5952-5958

- Kelly, W.F., Ackrill, P., Day, J.P., O'Hara, M., Tye, C.T., Burton, I., Orton, C. & Harris, M. (1982) Cutaneous absorption of trivalent chromium: tissue levels and treatment by exchange transfusion. *Br. J. ind. Med.*, 39, 397-400
- Kerr, L.A. & Edwards, W.C. (1981) Chromate poisoning in livestock from oil field wastes. *Vet. hum. Toxicol.*, 23, 401-402
- Kettrup, A., zur Mühlen, T. & Angerer, J. (1985) *Luftanalysen* (Air Analysis), Weinheim, Deutsche Forschungsgemeinschaft, pp. 1-9
- Kharab, P. & Singh, I. (1985) Genotoxic effects of potassium dichromate, sodium arsenite, cobalt chloride and lead nitrate in diploid yeast. *Mutat. Res.*, 155, 117-120
- Kharab, P. & Singh, I. (1987) Induction of respiratory deficiency in yeast by salts of chromium, arsenic, cobalt and lead. *Ind. J. exp. Biol.*, 25, 141-142
- Kiilunen, M., Kivistö, H., Ala-Laurila, P., Tossavainen, A. & Aitio, A. (1983) Exceptional pharmacokinetics of trivalent chromium during occupational exposure to chromium lignosulfonate dust. *Scand. J. Work Environ. Health*, 9, 265-271
- Kiilunen, M., Jarvisalo, J., Mäkitie, O. & Aitio, A. (1987) Analysis, storage stability and reference values for urinary chromium and nickel. *Int. Arch. occup. environ. Health*, 59, 43-50
- Kim, S., Iwai, Y., Fujino, M., Furumoto, M., Sumino, K. & Miyasaki, K. (1985) Chromium-induced pulmonary cancer. Report of a case and a review of the literature. *Acta pathol. jpn.*, 35, 643-654
- Kishi, R., Tarumi, T., Uchino, E. & Miyake, H. (1987) Chromium content of organs of chromate workers with lung cancer. *Am. J. ind. Med.*, 11, 67-74
- Kitagawa, S., Seki, H., Kametani, F. & Sakurai, H. (1988) EPR study on the interaction of hexavalent chromium with glutathione or cysteine: production of pentavalent chromium and its stability. *Inorg chim. Acta*, 152, 251-255
- Kjuus, H., Skjærven, R., Langård, S., Lien, J.T. & Aamodt, T. (1986) A case-referent study of lung cancer, occupational exposures and smoking. I. Comparison of title-based and occupation-based occupational information. *Scand. J. Work Environ. Health*, 12, 193-202
- Klein, F. (1985) Nickel and chromium concentrations in ambient air of work places in the iron and steel industry (Fr.). In: Brown, S.S. & Sunderman, F.W., Jr, eds, *Progress in Nickel Toxicology*, Oxford, Blackwell Scientific, pp. 195-197
- Kleinfeld, M. & Rosso, A. (1965) Ulcerations of the nasal septum due to inhalation of chromic acid mist. *Ind. Med. Surg.*, 34, 242-243
- Kleisbauer, J.-P., Poirier, R., Favre, R. & Laval, P. (1972) The problem of bronchial carcinomas of occupational origin (two cases) (Fr.). *Marseille méd.*, 109, 699-704
- Knudsen, I. (1980) The mammalian spot test and its use for the testing of potential carcinogenicity of welding fume particles and hexavalent chromium. *Acta pharmacol. toxicol.*, 47, 66-70
- Koli, A.K. & Whitmore, R. (1983) Trace elements in fish from the Savannah River near Savannah River nuclear plant. *Environ. int.*, 9, 361-362

- Kolihova, D., Sychra, V. & Dudova, N. (1978) Atomic absorption spectrometric analysis of ilmenite and inorganic pigments based on titanium dioxide. III. Determination of copper, manganese, chromium and iron by atomic absorption spectrometry with electro-thermic atomization (Czech.). *Chem. Listy*, 72, 1081-1087 [*Chem. Abstr.*, 90, 40259f]
- Kominsky, J.R., Rinsky, R. & Stroman, R. (1978) *Goodyear Aerospace Corp.* (Health Hazard Evaluation Report No. 77-127-516), Cincinnati, OH, National Institute for Occupational Safety and Health
- Koponen, M. (1985) *Applications of Some Instrumental Methods in Metal Aerosol Characterization* (Original Reports 2/1985), Kuopio, University of Kuopio
- Koponen, M., Gustafsson, T., Kalliomäki, P.-L. & Pyy, L. (1981) Chromium and nickel aerosols in stainless steel manufacturing, grinding and welding. *Am. ind. Hyg. Assoc. J.*, 42, 596-601
- Korallus, U., Ehrlicher, H. & Wüstefeld, E. (1974a) Trivalent chromium compounds: results of a study in occupational medicine. Part 3: Clinical study (Ger.). *Arbeitsmed. Sozialmed. Präventivmed.*, 9, 248-252
- Korallus, U., Ehrlicher, H. & Wüstefeld, E. (1974b) Trivalent chromium compounds: results of a study in occupational medicine. Part 1: General; technology; preliminary study (Ger.). *Arbeitsmed. Sozialmed. Präventivmed.*, 9, 51-54
- Korallus, U., Ehrlicher, H. & Wüstefeld, E. (1974c) Trivalent chromium compounds: results of study in occupational medicine. Part 2: Analysis of disease status (Ger.). *Arbeitsmed. Sozialmed. Präventivmed.*, 9, 76-79
- Korallus, U., Lange, H.-J., Neiss, A., Wüstefeld, E. & Zwingers, T. (1982) Relationships between environmental hygiene control measures and mortality from bronchial cancer in the chromate producing industry (Ger.). *Arbeitsmed. Sozialmed. Präventivmed.*, 17, 159-167
- Kortenkamp, A., Ozolins, Z., Beyersmann, D. & O'Brien, P. (1989) Generation of PM2 DNA breaks in the course of reduction of chromium(VI) by glutathione. *Mutat. Res.*, 216, 19-26
- Koshi, K. (1979) Effects of fume particles from stainless steel welding on sister chromatid exchanges and chromosome aberrations in cultured Chinese hamster cells. *Ind. Health*, 17, 39-49
- Koshi, K. & Iwasaki, K. (1983) Solubility of low-solubility chromates and their clastogenic activity in cultured cells. *Ind. Health*, 21, 57-65
- Koshi, K., Yagami, T. & Nakanishi, Y. (1984) Cytogenetic analysis of peripheral blood lymphocytes from stainless steel welders. *Ind. Health*, 22, 305-318
- Koshi, K., Sertia, F., Sawatari, K. & Suzuki, Y. (1987) Cytogenetic analysis of bone marrow cells and peripheral blood lymphocytes from rats exposed to chromium fumes by inhalation (Abstract No. 21). *Mutat. Res.*, 181, 365
- Kramer, H.L., Steiner, J.W. & Vallely, P.J. (1983) Trace element concentrations in the liver, kidney, and muscle of Queensland cattle. *Bull. environ. Contam. Toxicol.*, 30, 588-594
- Kretzschmar, J.G., Delespaul, I., De Rijck, T. & Verduyn, G. (1977) The Belgian network for the determination of heavy metals. *Atmos. Environ.*, 11, 263-271

- Krishnaja, A.P. & Rege, M.S. (1982) Induction of chromosomal aberrations in fish *Boleophthalmus dussumieri* after exposure *in vivo* to mitomycin C and heavy metals mercury, selenium and chromium. *Mutat. Res.*, 102, 71-82
- Kroner, R.C. (1973) The occurrence of trace metals in surface waters. In: Sabadell, J.E., ed., *Proceedings of a Symposium on Traces of Heavy Metals in Water Removal Processes and Monitoring*, Springfield, VA, National Technical Information Service, pp. 311-322
- Kumpulainen, J.T., Lehto, J., Koivistoinen, P., Uusitupa, M. & Vuori, E. (1983) Determinations of chromium in human milk, serum and urine by electrothermal atomic absorption spectrometry without preliminary ashing. *Sci. total Environ.*, 31, 71-80
- Kurokawa, Y., Matsushima, M., Imazawa, T., Takamura, N., Takahashi, M. & Hayashi, Y. (1985) Promoting effect of metal compounds on rat renal tumorigenesis. *J. Am. Coll. Toxicol.*, 4, 321-330
- Kuschner, M. & Laskin, S. (1971) Experimental models in environmental carcinogenesis. *Am. J. Pathol.*, 64, 183-196
- Lalor, E. (1973) Zinc and strontium chromates. In: Patton, T.C., ed., *Pigment Handbook*, Vol. 1, New York, John Wiley & Sons, pp. 847-859
- Lane, B.P. & Mass, M.J. (1977) Carcinogenicity and cocarcinogenicity of chromium carbonyl in heterotopic tracheal grafts. *Cancer Res.*, 37, 1476-1479
- Lanfranchi, G., Paglialunga, S. & Levis, A.G. (1988) Mammalian cell transformation induced by chromium(VI) compounds in the presence of nitrilotriacetic acid. *J. toxicol. environ. Health*, 24, 251-260
- Langård, S. (1980) Chromium. In: Waldron, H.A., ed., *Metals in the Environment*, London, Academic Press, pp. 111-132
- Langård, S. (1982) Absorption, transport and excretion of chromium in man and animals. In: Langård, S., ed., *Biological and Environmental Aspects of Chromium*, Amsterdam, Elsevier, pp. 149-169
- Langård, S. & Kommedal, T.M. (1975) Bronchial carcinoma in a young man exposed to chromates (Norw.). *Tidsskr. Nor. Lægeforen.*, 95, 819-820
- Langård, S. & Norseth, T. (1975) A cohort study of bronchial carcinomas in workers producing chromate pigments. *Br. J. ind. Med.*, 32, 62-65
- Langård, S. & Norseth, T. (1979) Cancer in the gastrointestinal tract in chromate pigment workers. *Arch. Hig. Rada Toksikol.*, 30 (Suppl.), 301-304
- Langård, S. & Vigander, T. (1983) Occurrence of lung cancer in workers producing chromium pigments. *Br. J. ind. Med.*, 40, 71-74
- Langård, S., Gundersen, N., Tsalev, D.L. & Gylseth, B. (1978) Whole blood chromium level and chromium excretion in the rat after zinc chromate inhalation. *Acta pharmacol. toxicol.*, 42, 142-149
- Langård, S., Andersen, A. & Gylseth, B. (1980) Incidence of cancer among ferrochromium and ferrosilicon workers. *Br. J. ind. Med.*, 37, 114-120
- Langård, S., Andersen, A. & Ravnstad, J. (1990) Incidence of cancer among ferrochromium and ferrosilicon workers; an extended observation period. *Br. J. ind. Med.*, 47, 14-19

- Langerwerf, J.S.A., Bakkeren, H.A. & Jongen, W.M.T. (1985) A comparison of the mutagenicity of soluble trivalent chromium compounds with that of potassium chromate. *Eco-toxicol. environ. Saf.*, 9, 92-100
- Laskin, S., Kuschner, M. & Drew, R.T. (1970) Studies in pulmonary carcinogenesis. In: Hanna, M.G., Jr, Nettesheim, P. & Gilbert, J.R., eds, *Inhalation Carcinogenesis* (US Atomic Energy Commission Symposium Series No. 18), Oak Ridge, TN, US Atomic Energy Commission, Division of Technical Information Extension, pp. 321-351
- Lautner, G.M., Carver, J.C. & Konzen, R.B. (1978) Measurement of chromium(VI) and chromium (III) in stainless steel welding fumes with electron spectroscopy for chemical analysis and neutron activation analysis. *Am. ind. Hyg. Assoc. J.*, 39, 651-660
- LaVelle, J.M. (1986a) Potassium chromate potentiates frameshift mutagenesis in *E. coli* and *S. typhimurium*. *Mutat. Res.*, 171, 1-10
- LaVelle, J.M. (1986b) Chromium(VI) comutagenesis: characterization of the interaction of  $K_2CrO_4$  with azide. *Environ. Mutagenesis*, 8, 717-725
- LaVelle, J.M. & Witmer, C.M. (1984) Chromium(VI) potentiates mutagenesis by sodium azide but not ethylmethanesulfonate. *Environ. Mutagenesis*, 6, 311-320
- Lee, K.P., Ulrich, C.E., Geil, R.G. & Trochimowicz, H.J. (1988) Effects of inhaled chromium dioxide dust on rats exposed for two years. *Fundam. appl. Toxicol.*, 10, 125-145
- Léonard, A. & Deknuddt, G. (1981) Mutagenicity test with chromium salts in mouse (Abstract). *Mutat. Res.*, 80, 287
- Léonard, A. & Lauwerys, R.R. (1980) Carcinogenicity and mutagenicity of chromium. *Mutat. Res.*, 76, 227-239
- Letterer, E., Neidhardt, K. & Klett, H. (1944) Chromate lung cancer and chromate pneumoconioses. A clinical, patho-anatomical, and occupational hygiene study (Ger.). *Arch. Gewerbepathol. Gewerbehyg.*, 12, 323-361
- Levis, A.G. & Bianchi, V. (1982) Mutagenic and cytogenetic effects of chromium compounds. In: Langård, S., ed., *Biological and Environmental Aspects of Chromium*, Amsterdam, Elsevier, pp. 171-208
- Levis, A.G. & Majone, F. (1979) Cytotoxic and clastogenic effects of soluble chromium compounds on mammalian cell cultures. *Br. J. Cancer*, 40, 523-533
- Levis, A.G. & Majone, F. (1981) Cytotoxic and clastogenic effects of soluble and insoluble compounds containing hexavalent and trivalent chromium. *Br. J. Cancer*, 44, 219-235
- Levis, A.G., Buttignol, M. & Vettorato, L. (1977) DNA synthesis inhibition in BHK fibroblasts treated *in vitro* with potassium dichromate. *Experientia*, 33, 82-84
- Levis, A.G., Bianchi, V., Tamino, G. & Pegoraro, B. (1978a) Cytotoxic effects of hexavalent and trivalent chromium on mammalian cells *in vitro*. *Br. J. Cancer*, 37, 386-396
- Levis, A.G., Buttignol, M., Bianchi, V. & Sponza, G. (1978b) Effects of potassium dichromate on nucleic acid and protein syntheses and on precursor uptake in BHK fibroblasts. *Cancer Res.*, 38, 110-116
- Levy, L.S. & Venitt, S. (1986) Carcinogenicity and mutagenicity of chromium compounds: the association between bronchial metaplasia and neoplasia. *Carcinogenesis*, 7, 831-836
- Levy, L.S., Martin, P.A. & Bidstrup, P.L. (1986) Investigation of the potential carcinogenicity of a range of chromium containing materials on rat lung. *Br. J. ind. Med.*, 43, 243-256

- Lewalter, J., Korallus, U., Harzdorf, C. & Weidemann, H. (1985) Chromium bond detection in isolated erythrocytes: a new principle of biological monitoring of exposure to hexavalent chromium. *Int. Arch. occup. environ. Health*, 55, 305-318
- Li, M.-C., Sheng, K.-L., Ching, C.-F., Chen, C.-H., Chin, P.-K., Jung, T.-W. & Wang, H.-P. (1979) Determination of trace elements in environmental samples by proton-induced X-ray emission analysis (Chin.). *K'o Hsueh Tung Pao*, 24, 19-21 [*Chem. Abstr.*, 90, 145297v]
- Lindberg, E. & Hedenstierna, G. (1983) Chrome plating: symptoms, findings in the upper airways and effects on lung function. *Arch. environ. Health*, 38, 367-374
- Lindberg, E. & Vesterberg, O. (1983) Monitoring exposure to chromic acid in chrome plating by measuring chromium in urine. *Scand. J. Work Environ. Health*, 9, 333-340
- Littorin, M., Högstedt, B., Strömbäck, B., Karlsson, A., Welinder, H., Mitelman, F. & Skerfving, S. (1983) No cytogenetic effects in lymphocytes of stainless steel welders. *Scand. J. Work Environ. Health*, 9, 259-264
- Llagostera, M., Garrido, S., Guerrero, R. & Barbé, J. (1986) Induction of SOS genes of *Escherichia coli* by chromium compounds. *Environ. Mutagenesis*, 8, 571-577
- Löfroth, G. (1978) The mutagenicity of hexavalent chromium is decreased by microsomal metabolism. *Naturwissenschaften*, 65, 207-208
- Loprieno, N., Boncristiani, G., Venier, P., Montaldi, A., Majone, F., Bianchi, V., Paglialunga, S. & Levis, A.G. (1985) Increased mutagenicity of chromium compounds by nitrilotriacetic acid. *Environ. Mutagenesis*, 7, 185-200
- Love, A.H.G. (1983) Chromium — biological and analytical considerations. In: Burrows, D., ed., *Chromium: Metabolism and Toxicity*, Boca Raton, FL, CRC Press, pp. 1-12
- Luciani, S., Dal Toso, R., Rebellato, A.M. & Levis, A.G. (1979) Effects of chromium compounds on plasma membrane  $Mg^{2+}$ -ATPase activity of BHK cells. *Chem.-biol. Interact.*, 27, 59-67
- Lumio, J. (1953) On the lesions in the upper airways among chromium platers (Swed.). *Nord. hyg. Tidskr.*, 5-6, 86-91
- Ma, T.H., Harris, M.M., Van Anderson, A., Ahmed, I., Mohammad, K., Bare, J.L. & Lin, G. (1984) Tradescantia-micronucleus (Trad-MCN) tests on 140 health-related agents. *Mutat. Res.*, 138, 157-167
- Machle, W. & Gregorius, F. (1948) Cancer of the respiratory system in the United States chromate-producing industry. *Public Health Rep.*, 63, 1114-1127
- Macrae, W.D., Whiting, R.F. & Stich, H.F. (1979) Sister-chromatid exchanges induced in cultured mammalian cells by chromate. *Chem.-biol. Interactions*, 26, 281-286
- Majone, F. (1977) Effects of potassium dichromate on mitosis of cultured mammalian cells. *Caryologia*, 30, 469-481
- Majone, F. & Levis, A.G. (1979) Chromosomal aberrations and sister chromatid exchanges in Chinese hamster cells treated *in vitro* with hexavalent chromium compounds. *Mutat. Res.*, 67, 231-238
- Majone, F. & Rensi, D. (1979) Mitotic alterations, chromosome aberrations and sister chromatid exchanges induced by hexavalent and trivalent chromium on mammalian cells *in vitro*. *Caryologia*, 32, 379-392

- Majone, F., Marin, G. & Levis, A.G. (1982) Chromium-induced sister chromatid exchanges in CHO cells. *Caryologia*, 35, 225-235
- Majone, F., Montaldi, A., Ronchese, F., De Rossi, A., Chieco-Bianchi, L. & Levis, A.G. (1983) Sister chromatid exchanges induced *in vivo* and *in vitro* by chemical carcinogens in mouse lymphocytes carrying endogenized Moloney leukemia virus. *Carcinogenesis*, 4, 33-37
- Makarov-Zemlyanskii, Y.Y., Men'shikov, B.I. & Strakhov, I.P. (1978) Persulphate method for determining chromium (III) in solutions with a 'silver free' catalyst (Russ.). *Kozh.-Obuvn. Prom-st.*, 20, 43-45 [*Chem. Abstr.*, 89, 76343x]
- Maltoni, C. (1974) Occupational carcinogenesis. *Excerpta med. int. Congr. Ser.*, 322, 19-26
- Maltoni, C. (1976) Predictive value of carcinogenesis bioassays. *Ann. N.Y. Acad. Sci.*, 271, 431-443
- Maltoni, C., Morisi, L. & Chieco, P. (1982) Experimental approach to the assessment of the carcinogenic risk of industrial inorganic pigments. *Adv. mod. environ. Toxicol.*, 2, 77-92
- Mancuso, T.F. (1975) Considerations of chromium as an industrial carcinogen. In: Hutchinson, T.C., ed., *Proceedings of the International Conference on Heavy Metals in the Environment, Toronto, 1975*, Toronto, Institute for Environmental Studies, pp. 343-356
- Mancuso, T.F. & Hueper, W.C. (1951) Occupational cancer and other health hazards in a chromate plant: a medical appraisal — I. Lung cancer in chromate workers. *Ind. Med. Surg.*, 20, 358-363
- Marzin, D.R. & Phi, H.V. (1985) Study of the mutagenicity of metal derivatives with *Salmonella typhimurium* TA102. *Mutat. Res.*, 155, 49-51
- Matsui, S. (1980) Evaluation of a *Bacillus subtilis* rec-assay for the detection of mutagens which may occur in water environments. *Water Res.*, 14, 1613-1619
- Matsumoto, N., Ijima, S. & Katsunuma, H. (1976) Placental transfer of chromic chloride and its teratogenic potential in embryonic mice. *J. toxicol. Sci.*, 2, 1-13
- McGean-Rohco (1984) *Data Sheet: Speciality Chromium Chemicals*, Cleveland, OH
- McGregor, D.B., Martin, R., Cattanaach, P., Edwards, I., McBride, D. & Caspary, W.J. (1987) Responses of the L5178Y tk<sup>+</sup>/tk<sup>-</sup> mouse lymphoma cell forward mutation assay to coded chemicals. I: Results for nine compounds. *Environ. Mutagenesis*, 9, 143-160
- McLean, J.R., McWilliams, R.S., Kaplan, J.G. & Birnboim, H.C. (1982) Rapid detection of DNA strand breaks in human peripheral blood cells and animal organs following treatment with physical and chemical agents. *Progr. Mutat. Res.*, 3, 137-141
- Mellor, J.W. (1931) *A Comprehensive Treatise on Inorganic and Theoretical Chemistry*, Vol. 11, Chapt. 60, *Chromium*, London, Longmans, Green & Co.
- Merian, E. (1984) Introduction on environmental chemistry and global cycles of arsenic, beryllium, cadmium, chromium, cobalt, nickel, selenium, and their derivatives. *Toxicol. environ. Chem.*, 8, 9-38
- Mertz, W. (1969) Chromium occurrence and function in biological systems. *Physiol. Rev.*, 49, 163-239
- Mertz, W., Roginski, E.E. & Reba, R.C. (1965) Biological activity and fate of intravenous chromium (III) in the rat. *Am. J. Physiol.*, 209, 489-494

- Meyers, J.B. (1950) Acute pulmonary complications following inhalation of chromic acid mist. *Arch. ind. Hyg. occup. Med.*, 2, 742-747
- Michel-Briand, C. & Simonin, M. (1977) Bronchopulmonary carcinomas in two workers employed in the same workshop of a chrome electroplating factory (Fr.). *Arch. Mal. prof.*, 38, 1001-1013
- Miller, C.A. & Costa, M. (1988) Characterization of DNA-protein complexes induced in intact cells by the carcinogen chromate. *Mol. Carcinogenesis*, 1, 125-133
- Miller, C.A. & Costa, M. (1989) Immunological detection of DNA-protein complexes induced by chromate. *Carcinogenesis*, 10, 667-672
- Min, B.C. (1976) A study on the concentration of heavy metals in the tributaries of Han river (Korean). *Kongjung Poken Chapchi*, 13, 337-347 [*Chem. Abstr.*, 90, 92066k]
- Mineral Pigments Corp. (undated a) *Specification Sheet: Jet Milled Dark Chromium Oxide (J-5351)*, Beltsville, MD
- Mineral Pigments Corp. (undated b) *Specification Sheet: Jet Milled Light Chrome Yellow (J-1222)*, Beltsville, MD
- Mineral Pigments Corp. (undated c) *Specification Sheet: Jet Milled Medium Chrome Yellow (J-1238)*, Beltsville, MD
- Mineral Pigments Corp. (undated d) *Specification Sheet: Jet Milled Strontium Chromate (J-1365)*, Beltsville, MD
- Ministry of Health & Welfare (1978) *Drinking Water Standards*, Tokyo
- Mitchell, A.J. (1969) An unsuspected hazard of chrome stripping. *Trans. Soc. occup. Med.*, 19, 128-130
- Mitchell, A.D., Rudd, C.J. & Caspary, V.J. (1988) Evaluation of the L5178Y mouse lymphoma cell mutagenesis assay: intralaboratory results for sixty-three coded chemicals tested at SRI International. *Environ. mol. Mutagenesis*, 12 (Suppl. 13), 37-101
- Miyaki, M., Murata, I., Osabe, M. & Ono, T. (1977) Effect of metal cations on misincorporation by *E. coli* DNA polymerases. *Biochem. biophys. Res. Commun.*, 77, 854-860
- Mohn, G.R. & Ellenberger, J. (1977) The use of *Escherichia coli* K12/343/113 ( $\lambda$ ) as a multi-purpose indicator strain in various mutagenicity testing procedures. In: Kilbey, B.J., Legator, M., Nichols, W. & Ramel, C., eds, *Handbook of Mutagenicity Test Procedures*, Amsterdam, Elsevier, pp. 95-118
- Molina, D. & Abell, M.T. (1987) An ion chromatographic method for insoluble chromates in paint aerosol. *Am. ind. Hyg. Assoc. J.*, 48, 830-835
- Molos, J.E. (1947) Use of plastic chips in the control of chromic acid mist. *Ind. Med.*, 16, 404-405
- Montaldi, A., Zentilin, L., Paglialunga, S. & Levis, A.G. (1987a) Solubilization by nitrilotriacetic acid (NTA) of genetically active Cr(VI) and Pb(II) from insoluble metal compounds. *J. Toxicol. environ. Health*, 21, 387-394
- Montaldi, A., Zentilin, L., Zordan, M., Bianchi, V., Levis, A.G., Clonfero, E. & Paglialunga, S. (1987b) Chromosomal effects of heavy metals (Cd, Cr, Hg, Ni and Pb) on cultured mammalian cells in the presence of nitrilotriacetic acid (NTA). *Toxicol. environ. Chem.*, 14, 183-200

- Moreton, J., Bettelley, J., Mathers, H., Nicholls, A., Perry, R.W., Ratcliffe, D.B. & Svensson, L. (1983) Investigation of techniques for the analysis of hexavalent chromium, total chromium and total nickel in welding fume: a co-operative study. *Ann. occup. Hyg.*, 37, 137-156
- Morimoto, K. & Koizumi, A. (1981) Inhibition repair of radiation-induced chromosome breaks: effects of chromium trioxide on cultured human lymphocytes. *Ind. Health*, 19, 259-262
- Morning, J.L. (1975) *Chromium* (Bulletin 667, Bureau of Mines), Washington DC, US Department of the Interior
- Morning, J.L. (1978) Chromium. In: *Minerals Yearbook 1976*, Vol. 1, *Metals, Minerals and Fuels*, Washington DC, Bureau of Mines, US Government Printing Office, pp. 297-308
- Morris, B.W., Griffiths, H., Hardisty, C.A. & Kemp, G.J. (1989) Increased concentrations of chromium in plasma, urine and red blood cells in a group of stainless steel welders. *At. Spectr.*, 10, 1-3
- Mukubo, K. (1978) Studies on experimental lung tumor by the chemical carcinogens and inorganic substances. III. Histopathological studies on lung tumour in rats induced by pertracheal vinyl tube infusion of 20-methylcholanthrene combined with chromium and nickel powders (Jpn.). *J. Nara med. Assoc.*, 29, 321-340
- Mutti, A., Cavatora, A., Borghi, L., Canali, M., Giaroli, C. & Franchini, I. (1979) Distribution and urinary excretion of chromium. Studies on rats after administration of single and repeated doses of potassium dichromate. *Med. Lav.*, 70, 171-179
- Mutti, A., Pedroni, C., Arfini, G., Franchini, I., Minoia, C., Micoli, G. & Baldi, C. (1984) Biological monitoring of occupational exposure to different chromium compounds at various valency states. *Int. J. environ. anal. Chem.*, 17, 35-41
- Myhr, B.C. & Caspary, W.J. (1988) Evaluation of the L5178Y mouse lymphoma cell mutagenesis assay: intralaboratory results for sixty-three coded chemicals tested at Litton Bionetics, Inc. *Environ. mol. Mutagenesis*, 12 (Suppl. 13), 103-194
- Nagaya, T. (1986) No increase in sister-chromatid exchange frequency in lymphocytes of chromium platers. *Mutat. Res.*, 170, 129-132
- Nagaya, T., Ishikawa, N. & Hata, H. (1989) Sister chromatid exchange analysis in lymphocytes of workers exposed to hexavalent chromium. *Br. J. ind. Med.*, 46, 48-51
- Nakamura, S.-I., Oda, Y., Shimada, T., Oki, I. & Sugimoto, K. (1987) SOS-inducing activity of chemical carcinogens and mutagens in *Salmonella typhimurium* TA1535/pSK1002: examination with 151 chemicals. *Mutat. Res.*, 192, 239-246
- Nakamuro, K., Yoshikawa, K., Sayato, Y. & Kurata, H. (1978) Comparative studies of chromosomal aberration and mutagenicity of trivalent and hexavalent chromium. *Mutat. Res.*, 58, 175-181
- National Chemical Co. (undated a) *Specification Sheet: No. 10 Chromium Phosphate*, Chicago, IL
- National Chemical Co. (undated b) *Specification Sheet: No. 4 Calcium Chromate*, Chicago, IL
- National Chemical Co. (undated c) *Specification Sheet: No. 6 Barium Chromate*, Chicago, IL
- National Chemical Co. (undated d) *Chrome Yellow Specifications*, Chicago, IL

- National Chemical Co. (undated e) *Specification Sheet: Molybdate Orange Nos. 1720, 1730 and 1740*, Chicago, IL
- National Chemical Co. (undated f) *Specification Sheet: No. 3 Strontium Chromate*, Chicago, IL
- National Institute for Occupational Safety and Health (1973) *Occupational Exposure to Chromic Acid*, Cincinnati, OH, pp. 15-16
- National Institute for Occupational Safety and Health (1975) *Occupational Exposure to Chromium VI*, Cincinnati, OH, pp. 23-24
- National Institute for Occupational Safety and Health (1977) *National Occupational Hazard Survey 1972-74*, Cincinnati, OH
- National Institute for Occupational Safety and Health (1984a) Method 7024. Chromium compounds as Cr. In: *NIOSH Manual of Analytical Methods*, Vol. 1, Cincinnati, OH, pp. 1-3
- National Institute for Occupational Safety and Health (1984b) Method 7600. Chromium hexavalent. In: *NIOSH Manual of Analytical Methods*, Vol. 1, Cincinnati, OH, pp. 1-4
- National Institute for Occupational Safety and Health (1988) NIOSH recommendations for occupational safety and health standards 1988. *Morbidity and Mortality Weekly Report*, 37(Suppl. 7), 9
- National Oceanic and Atmospheric Administration (1987) *National Status and Trends Program for Marine Environmental Quality. Progress Report. A Summary of Selected Data on Chemical Contaminants in Tissues Collected During 1984, 1985, and 1986 (NOAA Technical Memorandum NOS OMA 38)*, Rockville, MD, National Ocean Service, US Department of Commerce, pp. 1-23, D-10-D-11, E-3
- National Research Council (1974) *Chromium*, Washington DC, National Academy of Sciences
- Nestmann, E.R., Matula, T.I., Douglas, G.R., Bora, K.C. & Kowbel, D.J. (1979) Detection of the mutagenic activity of lead chromate using a battery of microbial tests. *Mutat. Res.*, 66, 357-365
- Nettesheim, P., Hanna, M.G., Jr, Doherty, D.G., Newell, R.F. & Hellman, A. (1971) Effect of calcium chromate dust, influenza virus, and 100 R whole-body X radiation on lung tumor incidence in mice. *J. natl Cancer Inst.*, 47, 1129-1144
- Newbold, R.F., Amos, J. & Connell, J.R. (1979) The cytotoxic, mutagenic and clastogenic effects of chromium-containing compounds on mammalian cells in culture. *Mutat. Res.*, 67, 55-63
- Newman, D. (1890) A case of adeno-carcinoma of the left inferior turbinated body, and perforation of the nasal septum, in the person of a worker in chrome pigments. *Glasgow med. J.*, 33, 469-470
- Newton, M.F. & Lilly, L.J. (1986) Tissue-specific clastogenic effects of chromium and selenium salts *in vivo*. *Mutat. Res.*, 169, 61-69
- Ngaha, E.O. (1981) Renal effects of potassium dichromate in the rat: comparison of urinary enzyme excretion with corresponding tissue patterns. *Gen. Pharmacol.*, 12, 497-500
- Nickel Development Institute (1987a) *Design Guidelines for the Selection and Use of Stainless Steel*, Toronto

- Nickel Development Institute (1987b) *Nickel Base Alloys*, Toronto
- Nieboer, E. & Jusys, A.A. (1988) Biological chemistry of chromium. In: Nriagu, J.O. & Nieboer, E., eds, *Chromium in the Natural and Human Environments*, New York, John Wiley & Sons, pp. 21-79
- Nieboer, E. & Shaw, S.L. (1988) Mutagenic and other genotoxic effects of chromium compounds. In: Nriagu, J.O. & Nieboer, E., eds, *Chromium in the Natural and Human Environments*, New York, John Wiley & Sons, pp. 399-441
- Nieboer, E., Yassi, A., Haines, A.T. & Jusys, A.A. (1984) *Effects of Chromium Compounds on Human Health*, Toronto, Ontario Ministry of Labour
- Nijs, M. & Kirsch-Volders, M. (1986) Induction of spindle inhibition and abnormal mitotic figures by Cr(II), Cr(III) and Cr(VI) ions. *Mutagenesis*, 1, 247-252
- Nise, G. & Vesterberg, O. (1979) Direct determination of chromium in urine by electrothermal atomic absorption spectrometry. *Scand. J. Work Environ. Health*, 5, 404-410
- Nishimura, M. & Umeda, M. (1978) Mutagenic effect of some metal compounds on cultured mammalian cells (Abstract No. 19). *Mutat. Res.*, 54, 246-247
- Nishio, A. & Uyeki, E.M. (1985) Inhibition of DNA synthesis by chromium compounds. *J. Toxicol. environ. Health*, 15, 237-244
- Nishioka, N. (1975) Mutagenic activities of metal compounds in bacteria. *Mutat. Res.*, 31, 185-189
- Nishiyama, H., Yano, H., Nishiwaki, Y., Kitaya, T., Matsuyama, T., Kodama, T., Suemasu, K., Tamai, S. & Takemoto, K. (1985) Lung cancer in chromate workers — analysis of 11 cases. *Jpn. J. clin. Oncol.*, 15, 489-497
- Nishiyama, H., Nishiwaki, Y., Kodama, T., Matsuyama, T., Araki, T. & Takemoto, K. (1988) Lung cancer in chromate workers found by mass survey (Abstract No. 1.15). *Lung Cancer (J. int. Assoc. Study Lung Cancer)*, 4 (Suppl.)
- Nissing, W. (1975) Trace-element pollution of the Lower Rhine and its significance in drinking-water supply (Ger). *Ber. Arbeitsgem. Rheinwasserwerke*, 32, 83-94 [*Chem. Abstr.*, 88, 176854n]
- Nomiyama, H., Yotoriyama, M. & Nomiyama, K. (1980) Normal chromium levels in urine and blood of Japanese subjects determined by direct flameless atomic absorption spectrophotometry, and valency of chromium in urine after exposure to hexavalent chromium. *Am. ind. Hyg. Assoc. J.*, 41, 98-102
- Norseth, T. (1980) Cancer hazards caused by nickel and chromium exposure. *J. Toxicol. environ. Health*, 6, 1219-1227
- Norseth, T. (1981) The carcinogenicity of chromium. *Environ. Health Perspect.*, 40, 121-130
- Norseth, T. (1986) The carcinogenicity of chromium and its salts. *Br. J. ind. Med.*, 43, 649-651
- Norseth, T., Alexander, J., Aaseth, J. & Langård, S. (1982) Biliary excretion of chromium in the rat: a role of glutathione. *Acta pharmacol. toxicol.*, 51, 450-455
- Nriagu, J.O. & Nieboer, E., eds (1988) *Chromium in the Natural and Human Environments*, New York, John Wiley & Sons
- Oberly, T.J., Piper, C.E. & McDonald, D.S. (1982) Mutagenicity of metal salts in the L5178Y mouse lymphoma assay. *J. Toxicol. environ. Health*, 9, 367-376

- O'Brien, D.M. & Hurley, D.E. (1981) *An Evaluation of Engineering Control Technology for Spray Painting* (DHSS (NIOSH) Publ. No. 81-121), Cincinnati, OH, National Institute for Occupational Safety and Health
- Occidental Chemical Corp. (1987a) *Technical Bulletin: Chromic Acid*, Niagara Falls, NY
- Occidental Chemical Corp. (1987b) *Technical Bulletin: Potassium Bichromate*, Niagara Falls, NY
- Occidental Chemical Corp. (1987c) *Technical Bulletin: Sodium Chromate Anhydrous*, Niagara Falls, NY
- Ogawa, H., Misawa, S., Morita, M., Abe, T., Kawai, K. & Nishioka, H. (1978) Sister chromatid exchanges of human lymphocytes induced by metal compounds (Jpn.). *Progr. Med. (Tokyo)*, 107, 584-585
- Ohno, H., Hanaoka, F. & Yamada, M.-A. (1982) Inducibility of sister-chromatid exchanges by heavy-metal ions. *Mutat. Res.*, 104, 141-145
- Ohsaki, Y., Abe, S., Homma, Y., Yozawa, K., Kishi, F., Murao, M., Sato, H., Date, F., Kawachi, F., Kobayashi, T. & Fujita, I. (1974) High incidence of lung cancer in chromate workers (Jpn.). *J. Jpn. Soc. intern. Med.*, 63, 1198-1203
- Ohsaki, Y., Abe, S., Kimura, K., Tsuneta, Y., Mikami, H. & Murao, M. (1978) Lung cancer in Japanese chromate workers. *Thorax*, 33, 372-374
- Okada, S., Ohba, H. & Taniyama, M. (1981) Alterations in ribonucleic acid synthesis by chromium (III). *J. inorg. Biochem.*, 15, 223-331
- Okada, S., Suzuki, M. & Ohba, H. (1983) Enhancement of ribonucleic acid synthesis by chromium (III) in mouse liver. *J. inorg. Biochem.*, 19, 95-103
- Okada, S., Tsukada, H. & Ohba, H. (1984) Enhancement of nucleolar RNA synthesis by chromium (III) in regenerating rat liver. *J. inorg. Biochem.*, 21, 113-124
- Okubo, T. & Tsuchiya, K. (1977) An epidemiological study on lung cancer among chromium plating workers. *Keio J. Med.*, 26, 171-177
- Okubo, T. & Tsuchiya, K. (1979) Epidemiological study of chromium platers in Japan. *Biol. Trace Elem. Res.*, 1, 35-44
- Okubo, T. & Tsuchiya, K. (1987) Mortality determined in a cohort study of chromium-plating workers (Abstract). *Scand. J. Work Environ. Health*, 13, 179
- Olivier, P. & Marzin, D. (1987) Study of the genotoxic potential of 48 inorganic derivatives with the SOS chromotest. *Mutat. Res.*, 189, 263-269
- Olsen, J. & Sabroe, S. (1984) Occupational causes of laryngeal cancer. *J. Epidemiol. Community Health*, 38, 117-121
- O'Neill, I.K., Schuller, P. & Fishbein, L., eds (1986) *Environmental Carcinogens. Selected Methods of Analysis*, Vol. 8, *Some Metals: As, Be, Cd, Cr, Ni, Pb, Se, Zn* (IARC Scientific Publications No. 71), Lyon, IARC
- Osaki, S., Osaki, T., Shibata, S. & Takashima, Y. (1976) Determination of hexavalent and total chromium in sea water by isotope dilution mass spectrometry (Jpn.). *Bunseki Kagaku*, 25, 358-362 [*Chem. Abstr.*, 86, 126960g]
- Pacyna, J.M. & Nriagu, J.O. (1988) Atmospheric emissions of chromium from natural and anthropogenic sources. In: Nriagu, J.O. & Nieboer, E., eds, *Chromium in the Natural and Human Environments*, New York, John Wiley & Sons, pp. 105-123

- Pagano, G., Esposito, A., Bove, P., De Angelis, M., Rota, A. & Giordano, G.G. (1983) The effects of hexavalent and trivalent chromium on fertilization and development in sea urchins. *Environ. Res.*, 30, 442-452
- Papp, J.F. (1983) Chromium. In: *Mineral Commodity Profiles 1983*, Washington DC, Bureau of Mines, US Department of the Interior, pp. 1-21
- Papp, J.F. (1985) Chromium. In: *Bulletin 675, Mineral Facts and Problems*, Washington DC, Bureau of Mines, US Department of the Interior, pp. 1-18
- Papp, J.F. (1987) Chromium. In: *1986 Bureau of Mines Minerals Yearbook*, Washington DC, Bureau of Mines, US Department of the Interior, pp. 1-20
- Papp, J.F. (1988) Chromium. In: *1987 Bureau of Mines Minerals Yearbook*, Washington DC, Bureau of Mines, US Department of the Interior, pp. 1-17
- Paschin, Y.V. & Kozachenko, V.I. (1981) Mutagenic activity of chromium compounds (Russ.). *Gig. Sanit.*, 5, 46-49
- Paschin, Y.V. & Kozachenko, V.I. (1982) The modifying effect of hexavalent chromate on the mutagenic activity of thio-TEPA. *Mutat. Res.*, 103, 367-370
- Paschin, Y.V. & Toropsev, S.N. (1982) Chromosome damage induced *in vivo* by heavy metal ion detected by indirect testing. *Acta biol. acad. sci. hung.*, 33, 419-422
- Paschin, Y.V. & Toropsev, S.N. (1983) Induction of micronuclei in mouse red cells by chromium ion (Russ.). *Bull. exp. Biol. Med.*, 95, 72-74
- Paschin, Y.V., Kozachenko, V.I. & Zacepilova, T.A. (1981) Complex testing of the genetic activity of the hexavalent chromium ion *in vitro* and *in vivo* (Russ.). *Tsitol. Genet.*, 15, 66-69
- Paschin, Y.V., Zacepilova, T.A. & Kozachenko, V.I. (1982) Induction of dominant lethal mutations in male mice by potassium dichromate. *Mutat. Res.*, 103, 345-347
- Paschin, Y.V., Kozachenko, V.I. & Sal'nikova, L.E. (1983) Differential mutagenic response at the HGPRT locus in V79 and CHO Chinese hamster cells after treatment with chromate. *Mutat. Res.*, 122, 361-365
- Patel, B., Balani, M.C. & Patel, S. (1985) Sponge 'sentinel' of heavy metals. *Sci. total Environ.*, 41, 143-152
- Patierno, S.R., Banh, D. & Landolph, J.R. (1988) Transformation of C3H/10T1/2 mouse embryo cells to focus formation and anchorage independence by insoluble lead chromate but not soluble calcium chromate: relationship to mutagenesis and internalization of lead chromate particles. *Cancer Res.*, 48, 5280-5288
- Payne, W.W. (1960a) Production of cancers in mice and rats by chromium compounds. *Arch. ind. Health*, 21, 530-535
- Payne, W.W. (1960b) The role of roasted chromite ore in the production of cancer. *Arch. environ. Health*, 1, 20-26
- Pedersen, N.B. (1982) The effects of chromium on the skin. In: Langård, S., ed., *Biological and Environmental Aspects of Chromium*, Amsterdam, Elsevier, pp. 249-277
- Pedersen, P., Thomsen, E. & Stern, R.M. (1983) Detection by replica plating of false revertant colonies induced in the *Salmonella*-mammalian microsome assay by hexavalent chromium. *Environ. Health Perspect.*, 51, 227-230

- Pedersen, B., Thomsen, E. & Stern, R.M. (1987) Some problems in sampling, analysis and evaluation of welding fumes containing Cr(VI). *Ann. occup. Hyg.*, 31, 325-338
- Pelkonen, L. & Fräki, J. (1983) Prevalence of dichromate sensitivity. *Contact Derm.*, 9, 190-194
- Perone, V.B., Moffitt, A.E., Jr, Possick, P.A., Key, M.M., Danzinger, S.J. & Gellin, G.A. (1974) The chromium, cobalt, and nickel contents of American cement and their relationship to cement dermatitis. *Am. ind. Hyg. Assoc. J.*, 35, 301-306
- Petrilli, F.L. & De Flora, S. (1977) Toxicity and mutagenicity of hexavalent chromium on *Salmonella typhimurium*. *Appl. environ. Microbiol.*, 33, 805-809
- Petrilli, F.L. & De Flora, S. (1978a) Oxidation of inactive trivalent chromium to the mutagenic hexavalent form. *Mutat. Res.*, 58, 167-173
- Petrilli, F.L. & De Flora, S. (1978b) Metabolic deactivation of hexavalent chromium mutagenicity. *Mutat. Res.*, 54, 139-147
- Petrilli, F.L. & De Flora, S. (1980) Mutagenicity of chromium compounds. In: *Chromium Symposium 80. Focus of a Standard*, Pittsburg, PA, Industrial Health Foundation, pp. 76-99
- Petrilli, F.L. & De Flora, S. (1982) Interpretations on chromium mutagenicity and carcinogenicity. In: Sorsa, M. & Vainio, H., eds, *Mutagens in Our Environment*, New York, Alan R. Liss, pp. 453-464
- Petrilli, F.L., De Renzi, G.P. & De Flora, S. (1980) Interaction between polycyclic aromatic hydrocarbons, crude oil and oil dispersants in the *Salmonella* mutagenesis assay. *Carcinogenesis*, 1, 51-56
- Petrilli, F.L., Camoirano, A., Bennicelli, C., Znacchi, P., Astengo, M. & De Flora, S. (1985) Specificity and inducibility of the metabolic reduction of chromium(VI) mutagenicity by subcellular fractions of rat tissues. *Cancer Res.*, 45, 3179-3187
- Petrilli, F.L., Znacchi, P., Camoirano, A., Astengo, M., Basso, C. & De Flora, S. (1986a) Selective genotoxicity of chromium compounds. In: Serrone, D., ed., *Chromium Symposium 1986. An Update*, Pittsburg, PA, Industrial Health Foundation, pp. 100-111
- Petrilli, F.L., Bennicelli, C., Serra, D., Romano, M., De Flora, A. & De Flora, S. (1986b) Metabolic reduction and detoxification of hexavalent chromium. In: Serrone, D., ed., *Chromium Symposium 1986. An Update*, Pittsburg, PA, Industrial Health Foundation, pp. 112-130
- Petrilli, F.L., Rossi, G.A., Camoirano, A., Romano, M., Serra, D., Bennicelli, C., De Flora, A. & De Flora, S. (1986c) Metabolic reduction of chromium by alveolar macrophages and its relationships to cigarette smoke. *J. clin. Invest.*, 77, 1917-1924
- Petruzzelli, S., De Flora, S., Bagnasco, M., Hietanen, E., Camus, A.-M., Saracci, R., Izzotti, A., Bartsch, H. & Giuntini, C. (1989) Carcinogen metabolism studies in human bronchial and lung parenchymal tissues. *Am. Rev. respir. Dis.*, 140, 417-422
- Pfeil, E. (1935) Lung tumors as occupational disease in chromate plants (Ger.). *Dtsch. med. Wochenschr.*, 61, 1197-1200
- Pokrovskaya, L.V. & Shabynina, N.K. (1973) Carcinogenous hazards in the production of chromium ferroalloys (Russ.). *Gig. Tr. prof. Zabol.*, 10, 23-26

- Pokrovskaya, L., Tushnakova, N., Gorodnova, N. & Andreeva, T. (1976) Dust factor and occupational disease of workers at open-cast mining of chromium-ore (Russ.). In: Domin, S., Kaznelson, B. & Zislin, D., eds, *Occupational Diseases of Dust Etiology*, Vol. 3, Moscow, Medizina, pp. 38-43
- Polak, L. (1983) Immunology of chromium. In: Burrows, D., ed., *Chromium: Metabolism and Toxicology*, Boca Raton, FL, CRC Press, pp. 51-123
- Polak, L., Turk, J.L. & Frey, J.R. (1973) Studies on contact hypersensitivity to chromium compounds. *Progr. Allergy*, 17, 145-226
- Poschenrieder, C., Barceló, J. & Gunsé, B. (1986) The impact of chromium in the environment. I. Natural and anthropogenic presence of chromium in the environment (Sp.). *Circ. Farm.*, 290, 23-38
- Price-Jones, M.J., Gubbings, G. & Chamberlain, M. (1980) The genetic effects of crocidolite asbestos: comparison of chromosome abnormalities and sister-chromatid exchanges. *Mutat. Res.*, 79, 331-336
- Princi, F., Miller, L.H., Davis, A. & Cholak, J. (1962) Pulmonary disease of ferrochromium workers. *J. occup. Med.*, 4, 301-310
- Raffetto, G., Parodi, S., Parodi, C., De Ferrari, M., Troiano, R. & Brambilla, G. (1977) Direct interaction with cellular targets as the mechanism for chromium carcinogenesis. *Tumori*, 63, 503-512
- Rafnsson, V. & Jóhannesdóttir, S.G. (1986) Mortality among masons in Iceland. *Br. J. ind. Med.*, 43, 522-525
- Rainaldi, G., Colella, C.M., Piras, A. & Mariani, T. (1982) Thioguanine resistance, ouabain resistance and sister chromatid exchanges in V79/AP4 Chinese hamster cells treated with potassium dichromate. *Chem.-biol. Interact.*, 42, 45-51
- Raithel, H.J., Ebner, G., Schaller, K.H., Schellmann, B. & Valentin, H. (1987) Problems in establishing norm values for nickel and chromium concentrations in human pulmonary tissue. *Am. J. ind. Med.*, 12, 55-70
- Rasmuson, A. (1985) Mutagenic effects of some water-soluble metal compounds in a somatic eye-color test system in *Drosophila melanogaster*. *Mutat. Res.*, 157, 157-162
- Rasmussen, L. (1977) Epiphytic bryophytes as indicators of the changes in the background levels of airborne metals from 1951-75. *Environ. Pollut.*, 14, 37-45
- Retnev, V.M. (1960) On the effect produced by chromium compounds contained in cement dust on the development of bronchial asthma (Russ.). *Gig. Tr. prof. Zabol.*, 7, 29-33
- Reuzel, P.G.J., Beems, R.B., De Raat, W.K. & Lohman, P.H.M. (1986) Carcinogenicity and in vitro genotoxicity of the particulate fraction of two stainless steel welding fumes. *Excerpta med. int. Congr. Ser.*, 676, 329-332
- Riley, E.C. & Goldman, F.H. (1937) Control of chromic acid mists from plating tanks. *Public Health Rep.*, 52, 172-174
- Rivedal, E. & Sanner, T. (1981) Metal salts as promoters of in vitro morphological transformation of hamster embryo cells initiated by benzo[a]pyrene. *Cancer Res.*, 41, 2950-2953
- Rivolta, G., Tomasini, M. & Colombi, A. (1982) Case study of lung cancer due to chromates diagnosed through cytologic examination of the sputum without X-ray evidence (Ital.). *Med. Lav.*, 73, 40-44

- Robison, S.H., Cantoni, O. & Costa, M. (1982) Strand breakage and decreased molecular weight of DNA induced by specific metal compounds. *Carcinogenesis*, 3, 657-662
- Robison, S.H., Cantoni, O. & Costa, M. (1984) Analysis of metal-induced DNA lesions and DNA-repair replication in mammalian cells. *Mutat. Res.*, 131, 173-181
- Rodriguez-Arnaiz, R. & Molina Martinez, R.F. (1986) Genetic effects of potassium dichromate and chromium trioxide in *Drosophila melanogaster*. *Cytologia*, 51, 421-425
- Roe, F.J.C. & Carter, R.L. (1969) Chromium carcinogenesis: calcium chromate as a potent carcinogen for the subcutaneous tissues of the rat. *Br. J. Cancer*, 23, 172-176
- Rogers, S.J., Pagano, D.A. & Zeiger, E. (1987) Mutagenicity of CrIII and CrVI compounds in the presence of mannitol, dithiothreitol and anaerobiosis (Abstract No. 237). *Environ. Mutagenesis*, 9 (Suppl. 8), 91
- Rosensteel, R.E. (1974) *Harris Structural Steel Company (Health Hazard Evaluation Report No. 73-99-108)*, Cincinnati, OH, National Institute for Occupational Safety and Health
- Roskill Information Services (1974) *Chromium: World Survey of Production, Consumption and Prices*, 2nd ed., London, pp. 8, 80-93
- Rossi, S.C. & Wetterhahn, K.E. (1989) Chromium[V] is produced upon reduction of chromate by mitochondrial electron transport chain complexes. *Carcinogenesis*, 10, 913-920
- Rossmann, T.G. & Molina, M. (1986) The genetic toxicology of metal compounds: II. Enhancement of ultraviolet light-induced mutagenesis in *Escherichia coli* WP2. *Environ. Mutagenesis*, 8, 263-271
- Rossmann, T.G., Molina, M. & Meyer, L.W. (1984) The genetic toxicology of metal compounds: I. Induction of  $\lambda$  prophage in *E. coli* WP2<sub>s</sub>( $\lambda$ ). *Environ. Mutagenesis*, 6, 59-69
- Rössner, P., Bencko, V. & Šrám, R.J. (1981) Combined action of chromium and nickel on mouse and hamster fibroblast cell lines. *J. Hyg. Epidemiol. Microbiol.*, 25, 252-258
- Royle, H. (1975a) Toxicity of chromic acid in the chromium plating industry (2). *Environ. Res.*, 10, 141-163
- Royle, H. (1975b) Toxicity of chromic acid in the chromium plating industry (1). *Environ. Res.*, 10, 39-53
- Rudnykh, A.A. & Saichenko, S.PI (1985) Reparative DNA synthesis in the lymphocytes of rats exposed to potassium dichromate and manganese chloride *in vivo* (Russ.). *Tsitol. Genet.*, 19, 391-392
- Ruiz-Rubio, M., Alejandre-Durán, E. & Pueyo, C. (1985) Oxidative mutagens specific for A.T base pairs induced forward mutations to L-arabinose resistance in *Salmonella typhimurium*. *Mutat. Res.*, 147, 153-163
- Ryberg, D. & Alexander, J. (1984) Inhibitory action of hexavalent chromium (Cr(VI)) on the mitochondrial respiration and a possible coupling to the reduction of Cr(VI). *Biochem. Pharmacol.*, 33, 2461-2466
- Sadiq, M., Zaidi, T.H., Hoda, A.-U. & Mian, A.A. (1982) Heavy metal concentrations in shrimp, crab, and sediment obtained from AD-Damman sewage outfall area. *Bull. environ. Contam. Toxicol.*, 29, 313-319
- Salmon, L., Atkins, D.H.F., Fischer, E.M.R. & Law, D.V. (1977) Retrospective analysis of air samples in the UK 1957-1974. *J. radioanal. Chem.*, 37, 867-880

- Sanderson, C.J. (1976) The uptake and retention of chromium by cells. *Transplantation*, 21, 526-529
- Saner, G., Yüzbaşıyan, V. & Çigdem, S. (1984) Hair chromium concentration and chromium excretion in tannery workers. *Br. J. ind. Med.*, 41, 263-266
- Sano, T. (1978) Pathology of chromium lesions (Jpn.). *Rodo no Kagaku*, 33, 4-14
- Sarto, F., Levis, A.G. & Paulon, C. (1980) Clastogenic activity of hexavalent and trivalent chromium in cultured human lymphocytes. *Caryologia*, 33, 239-250
- Sarto, F., Cominato, I., Bianchi, V. & Levis, A.G. (1982) Increased incidence of chromosomal aberrations and sister chromatid exchanges in workers exposed to chromic acid (CrO<sub>3</sub>) in electroplating factories. *Carcinogenesis*, 3, 1011-1016
- Sasaki, I. (1985) Inorganic pigments. In: Japan Chemical Week, ed., *Japan Chemical Annual 1985*, Tokyo, The Chemical Daily Co. Ltd, p. 78
- Sasaki, I. (1986) Inorganic pigments. In: Japan Chemical Week, ed., *Japan Chemical Annual 1986*, Tokyo, The Chemical Daily Co. Ltd, p. 78
- Sasaki, I. (1987) Inorganic pigments. In: Japan Chemical Week, ed., *Japan Chemical Annual 1987/1988*, Tokyo, The Chemical Daily Co. Ltd, p. 88
- Satoh, K., Fukuda, Y., Torii, K. & Katsuno, N. (1981) Epidemiological study of workers engaged in the manufacture of chromium compounds. *J. occup. Med.*, 23, 835-838
- Sax, I.R. & Lewis, R.J., Sr (1987) *Hawley's Condensed Chemical Dictionary*, 11th ed., New York, Van Nostrand-Reinhold, pp. 66, 118, 278-281, 953-954, 1057-1058, 1098
- Sayato, Y. & Nakamuro, K. (1980) Chromium as an inorganic pollutant (Jpn.). *Kagaku no Ryoiki Zokan*, 126, 111-117
- Schaaper, R.M., Koplitz, R.M., Tkeshelashvili, L.K. & Loeb, L.A. (1987) Metal-induced lethality and mutagenesis: possible role of apurinic intermediates. *Mutat. Res.*, 177, 179-188
- Schaller, K.-H., Essing, H.-G., Valentin, H. & Schäcke, G. (1972) Quantitative chromium determination in urine by flameless atomic absorption spectrometry (Ger.). *Z. klin. Chem. klin. Biochem.*, 10, 434-437
- Schiek, R.C. (1973) Lead chromate pigments. Chrome yellow and chrome orange. In: Patton, T.C., ed., *Pigment Handbook*, Vol. 1, New York, John Wiley & Sons, pp. 357-363
- Schroeder, H.A., Balassa, J.J. & Vinton, W.H., Jr (1964) Chromium, lead, cadmium, nickel and titanium in mice: effect on mortality, tumors and tissue levels. *J. Nutr.*, 83, 239-250
- Schroeder, H.A., Balassa, J.J. & Vinton, W.H., Jr (1965) Chromium, cadmium and lead in rats: effects on lifespan, tumors and tissue levels. *J. Nutr.*, 86, 51-66
- Sen, P. & Costa, M. (1986) Incidence and localization of sister chromatid exchanges induced by nickel and chromium compounds. *Carcinogenesis*, 7, 1527-1533
- Sen, P., Conway, K. & Costa, M. (1987) Comparison of the localization of chromosome damage induced by calcium chromate and nickel compounds. *Cancer Res.*, 47, 2142-2147
- Sequi, P. (1980) Behaviour of chromium and mercury in soil (Ital.). In: Frigerio, A., ed., *Rischi Tossic. Inquin. Met.: Cromo Mercurio [Conv. Naz.]*, Milan, DST Publishers, pp. 27-50
- Sharma, B.K., Singhal, P.C. & Chugh, K.S. (1978) Intravascular haemolysis and acute renal failure following potassium dichromate poisoning. *Postgrad. med. J.*, 54, 414-415

- Sheehy, J.W., Mortimer, V.D., Jones, J.H. & Spottswood, S.E. (1984) *Control Technology Assessment: Metal Plating and Cleaning Operations* (NIOSH Technical Report), Cincinnati, OH, National Institute for Occupational Safety and Health
- Sheffet, A., Thind, I., Miller, A.M. & Louria, D.B. (1982) Cancer mortality in a pigment plant utilizing lead and zinc chromates. *Arch. environ. Health*, 37, 44-52
- Shimkin, M.B. & Leiter, J. (1940) Induced pulmonary tumors in mice. III. The role of chronic irritation in the production of pulmonary tumors in strain A mice. *J. natl Cancer Inst.*, 1, 241-254
- Shimkin, M.B., Stoner, G.D. & Theiss, J.C. (1977) Lung tumor response in mice to metals and metal salts. *Adv. exp. Med. Biol.*, 91, 85-91
- Sibley, S.F. (1976) Cobalt. In: *Mineral Facts and Problems*, Washington DC, Bureau of Mines, US Government Printing Office, pp. 269-280
- Silverstein, M., Mirer, F., Kotelchuck, D., Silverstein, B. & Bennett, M. (1981) Mortality among workers in a die-casting and electroplating plant. *Scand. J. Work Environ. Health*, 7 (Suppl. 4), 156-165
- Sina, J.F., Bean, C.L., Dysart, G.R., Taylor, V.I. & Bradley, M.O. (1983) Evaluation of the alkaline elution/rat hepatocyte assay as a predictor of carcinogenic/mutagenic potential. *Mutat. Res.*, 113, 357-391
- Singh, I. (1983) Induction of reverse mutation and mitotic gene conversion by some metal compounds in *Saccharomyces cerevisiae*. *Mutat. Res.*, 117, 149-152
- Sirover, M.A. & Loeb, L.A. (1976) Infidelity of DNA synthesis *in vitro*: screening for potential metal mutagens or carcinogens. *Science*, 194, 1434-1436
- Slavin, W. (1981) Determination of chromium in the environment and in the work place. *Atmos. Spectrosc.*, 2, 8-12
- Smith, D.E., Slade, M.D., Spencer, O.K., Roberts, W.L. & Ruckman, J.H. (1976) Metal concentrations in air particulate in the Four Corners area. *Utah Acad. Proc.*, 53, 75-83
- Snow, E.T. & Xu, L.-S. (1989) Effects of chromium(III) on DNA replication *in vitro*. *Biol. Trace Element Res.*, 21, 61-72
- Snyder, R.D. (1988) Role of active oxygen species in metal-induced DNA strand breakage in human diploid fibroblasts. *Mutat. Res.*, 193, 237-246
- Sokolowska, D.M. & Jongen, W.M.F. (1984) Heavy metals and *Salmonella typhimurium*: mutagenicity and interaction with model compounds (Abstract No. I.1.7). *Mutat. Res.*, 130, 168
- Sontag, G., Kerschbaumer, M. & Kainz, G. (1977) Determination of toxic heavy metals in effluent Austrian medicinal and table water (Ger.). *Z. Wasser Abwasser Forsch.*, 10, 166-169 [*Chem. Abstr.*, 88, 110183m]
- Sora, S., Agostoni Carbone, M.L., Pacciarini, M. & Magni, G.E. (1986) Disomic and diploid meiotic products induced in *Saccharomyces cerevisiae* by the salts of 27 elements. *Mutagenesis*, 1, 21-28
- Sorahan, T., Burges, D.C.L. & Waterhouse, J.A.H. (1987) A mortality study of nickel/chromium platers. *Br. J. ind. Med.*, 44, 250-258

- Sponza, G. & Levis, A.G. (1980) Effects of potassium dichromate, mitomycin C and methyl-methane-sulphonate on the *in vitro* synthesis of poly dT catalyzed by DNA-polymerase  $\alpha$  from calf thymus with poly dA.(dT)<sub>n</sub> (Abstract). In: *Atti Associazione Genetica Italiana*, Vol. 26, Sassari, Poddighe, pp. 303-305
- Steffee, C.H. & Baetjer, A.M. (1965) Histopathologic effects of chromate chemicals. Report of studies in rabbits, guinea pigs, rats and mice. *Arch. environ. Health*, 11, 66-75
- Steinhoff, D., Gad, S.C., Hatfield, K. & Mohr, U. (1986) Carcinogenicity study with sodium dichromate in rats. *Exp. Pathol.*, 30, 129-141
- Stella, M., Montaldi, A., Rossi, R., Rossi, G. & Levis, A.G. (1982) Clastogenic effects of chromium on human lymphocytes *in vitro* and *in vivo*. *Mutat. Res.*, 101, 151-164
- Stern, R.M. (1982) Chromium compounds: production and occupational exposure. In: Langård, S., ed., *Biological and Environmental Aspects of Chromium*, Amsterdam, Elsevier, pp. 5-47
- Stern, R.M., Thomsen, E. & Furst, A. (1984) Cr(VI) and other metallic mutagens in fly ash and welding fumes. *Toxicol. environ. Chem.*, 8, 95-108
- Stern, F.B., Beaumont, J.J., Halperin, W.E., Murthy, L.I., Hills, B.W. & Fajen, J.M. (1987) Mortality of chrome leather tannery workers and chemical exposures in tanneries. *Scand. J. Work Environ. Health*, 13, 108-117
- Stoner, G.D., Shimkin, M.B., Troxell, M.C., Thompson, T.L. & Terry, L.S. (1976) Test for carcinogenicity of metallic compounds by the pulmonary tumor response in strain A mice. *Cancer Res.*, 36, 1744-1747
- Stowe, H.D., Braselton, W.E., Kaneene, J.B. & Slanker, M. (1985) Multielement assays of bovine tissue specimens by inductively coupled argon plasma emission spectroscopy. *Am. J. vet. Res.*, 46, 561-565
- Sugiyama, M., Patierno, S.R., Cantoni, O. & Costa, M. (1986a) Characterization of DNA lesions induced by CaCrO<sub>4</sub> in synchronous and asynchronous cultured mammalian cells. *Mol. Pharmacol.*, 29, 606-613
- Sugiyama, M., Wang, X.-W. & Costa, M. (1986b) Comparison of DNA lesions and cytotoxicity induced by calcium chromate in human, mouse and hamster cell lines. *Cancer Res.*, 46, 4547-4551
- Sugiyama, M., Ando, A., Foruno, A., Furlong, N.B., Hidaka, T. & Ogura, R. (1987) Effects of vitamin E, vitamin B<sub>2</sub> and selenite on DNA single strand breaks induced by sodium chromate(VI). *Cancer Lett.*, 38, 1-7
- Sugiyama, M., Costa, M., Nakagawa, T., Hidaka, T. & Ogura, R. (1988) Stimulation of polyadenosine diphosphoribose synthesis by DNA lesions induced by sodium chromate in Chinese hamster V-79 cells. *Cancer Res.*, 48, 1100-1104
- Sullivan, C.P., Donachie, M.J., Jr & Morral, F.R. (1970) *Cobalt-base Superalloys 1970*, Brussels, Centre d'information du Cobalt, pp. 1-4, 38-44
- Sunderman, F.W., Jr (1976) A review of the carcinogenicities of nickel, chromium and arsenic compounds in man and animals. *Prev. Med.*, 5, 279-294
- Sunderman, F.W., Jr (1984) Recent advances in metal carcinogenesis. *Ann. clin. Lab. Sci.*, 14, 93-122

- Sunderman, F.W., Jr (1986) Carcinogenicity and mutagenicity of some metals and their compounds. In: O'Neill, I.K., Schuller, P. & Fishbein, L., eds, *Environmental Carcinogens: Selected Methods of Analysis*, Vol. 8, *Some Metals: As, Be, Cd, Cr, Ni, Pb, Se, Zn* (IARC Scientific Publications No. 71), Lyon, IARC, pp. 17-43
- Sunderman, F.W., Jr, Lau, T.J. & Cralley, L.J. (1974) Inhibitory effect of manganese upon muscle tumorigenesis by nickel subsulfide. *Cancer Res.*, 34, 92-95
- Sunderman, F.W., Jr, McCully, K.S., Taubman, S.B., Allpass, P.R., Reid, M.C. & Rinehimer, L.A. (1980) Manganese inhibition of sarcoma induction by benzo[a]pyrene in rats. *Carcinogenesis*, 1, 613-620
- Suzuki, Y. (1988) Reduction of hexavalent chromium by ascorbic acid in rat lung lavage fluid. *Arch. Toxicol.*, 62, 116-122
- Suzuki, Y., Homma, K., Minami, M. & Yoshikawa, H. (1984) Distribution of chromium in rats exposed to hexavalent chromium and trivalent chromium aerosols. *Ind. Health*, 22, 261-277
- Takahashi, W., Pfenninger, K. & Wong, L. (1983) Urinary arsenic, chromium, and copper levels in workers exposed to arsenic-based wood preservatives. *Arch. environ. Health*, 38, 209-214
- Takemoto, K., Kawai, H. & Yoshimura, H. (1977) Studies on the relation of chromium and pulmonary disease. II. Chromium contamination of lung cancer (Jpn.). In: *Proceedings of the 50th Annual Meeting of the Japan Association of Industrial Health*, Tokyo, Japan Association of Industrial Health, pp. 368-369
- Tamaro, M., Banfi, E., Venturini, S. & Monti-Bragadin, C. (1975) Hexavalent chromium compounds are mutagenic for bacteria (Ital.). In: *Proceedings of the 17th National Congress of the Italian Society of Microbiology*, Padua, Società Italiana di Microbiologia, pp. 411-415
- Tamino, G. & Peretta, L. (1980) Variations of DNA physico-chemical parameters in its interactions with mutagenic and/or carcinogenic compounds. In: Borsellino, A., Omodeo, P., Strom, R., Vecli, A. & Wamke, E., eds, *Developments in Biophysical Research*, New York, Plenum, pp. 335-346
- Tamino, G., Peretta, L. & Levis, A.G. (1981) Effects of trivalent and hexavalent chromium on physico-chemical properties of mammalian cell nucleic acids and synthetic polynucleotides. *Chem.-biol. Interactions*, 37, 309-319
- Tandon, S.K., Mathur, A.K. & Gaur, J.S. (1977) Urinary excretion of chromium and nickel among electroplaters and pigment industry workers. *Int. Arch. occup. environ. Health*, 40, 71-76
- Taylor, F.H. (1966) The relationship of mortality and duration of employment as reflected by a cohort of chromate workers. *Am. J. public Health*, 56, 218-229
- Teleky, L. (1936) Cancer in chromium workers (Ger.). *Dtsch. med. Wochenschr.*, 62, 1353
- Teraoka, H. (1987) Distribution of 24 elements in the internal organs of normal males and the metallic workers in Japan. *Arch. environ. Health*, 36, 155-165
- Thomsen, E. & Stern, R.M. (1979) A simple analytical technique for the determination of hexavalent chromium in welding fumes and other complex matrices. *Scand. J. Work Environ. Health*, 5, 386-403

- Tkeshelashvili, L.K., Shearman, C.W., Zakour, R.A., Koplitz, R.M. & Loeb, L.A. (1980) Effects of arsenic, selenium and chromium on the fidelity of DNA synthesis. *Cancer Res.*, **40**, 2455-2460
- Torgimsen, T. (1982) Analysis of chromium. In: Langård, S., ed., *Biological and Environmental Aspects of Chromium*, Amsterdam, Elsevier, pp. 65-99
- Tossavainen, A. (1976) Metal fumes in foundries. *Scand. J. Work Environ. Health*, **2** (Suppl. 1), 42-49
- Traul, K.A., Takayama, K., Kachevsky, V., Hink, R.J. & Wolff, J.S. (1981) A rapid in vitro assay for carcinogenicity of chemical substances in mammalian cells utilizing an attachment-independence endpoint. *J. appl. Toxicol.*, **1**, 190-195
- Triebig, G., Zschesche, W., Schaller, K.H., Weltle, D. & Valentin, H. (1987) Studies on the nephrotoxicity of heavy metals in iron and steel industries. In: Foá, V., Emmett, E.A., Maroni, M. & Colombi, A., eds, *Occupational and Environmental Chemical Hazards. Cellular and Biochemical Indices for Monitoring Toxicity*, Chichester, Ellis Horwood, pp. 334-338
- Tsapakos, M.J. & Wetterhahn, K.E. (1983) The interaction of chromium with nucleic acids. *Chem.-biol. Interactions*, **46**, 265-277
- Tsapakos, M.J., Hampton, T.H. & Jennette, K.W. (1981) The carcinogen chromate induces DNA cross-links in rat liver and kidney. *J. biol. Chem.*, **256**, 3623-3626
- Tsapakos, M.J., Hampton, T.H. & Wetterhahn, K.E. (1983a) Chromium(VI)-induced DNA lesions and chromium distribution in rat kidney, liver and lung. *Cancer Res.*, **43**, 5662-5667
- Tsapakos, M.J., Hampton, T.H., Sinclair, P.R., Sinclair, J.F., Bement, W.J. & Wetterhahn, K.E. (1983b) The carcinogen chromate causes DNA damage and inhibits drug-mediated induction of porphyrin accumulation and glucuronidation in chick embryo hepatocytes. *Carcinogenesis*, **4**, 959-966
- Tso, W.-W. & Fung, W.-P. (1981) Mutagenicity of metallic cations. *Toxicol. Lett.*, **8**, 195-200
- Tsuchiya, K. (1965) The relation of occupation to cancer, especially cancer of the lung. *Cancer*, **18**, 136-144
- Tsuda, H. & Kato, K. (1977) Chromosomal aberrations and morphological transformation in hamster embryonic cells treated with potassium dichromate *in vitro*. *Mutat. Res.*, **46**, 87-94
- Tsuneta, Y. (1982) Investigations of the pathogenesis of lung cancer observed among chromate factory workers (Jpn.). *Hokkaido J. med. Sci.*, **57**, 175-187
- Työsuojeluhallitus (National Finnish Board of Occupational Safety and Health) (1987) *HTP-Azvoit 1987* (TLV-Values 1987) (Safety Bull. 25), Helsinki, p. 19
- Udy, M.C. (1956) The physical and chemical properties of compounds of chromium. In: Udy, M.J., ed., *Chromium*, Vol. 1, New York, Reinhold, pp. 164-165, 206
- Ulitzur, S. & Barak, M. (1988) Detection of genotoxicity of metallic compounds by the bacterial bioluminescence test. *J. Biolumin. Chemilumin.*, **2**, 95-99
- Umeda, M. & Nishimura, M. (1979) Inducibility of chromosomal aberrations by metal compounds in cultured mammalian cells. *Mutat. Res.*, **67**, 221-229

- US Department of Commerce (1978) *US Imports for Consumption and General Imports* (FT 246/Annual 1977), Washington DC, Bureau of the Census, US Government Printing Office, pp. 231-233, 247, 293
- US Environmental Protection Agency (1977) *Environmental Monitoring Near Industrial Sites, Chromium* (US NTIS PB-271 881), Washington DC
- US Environmental Protection Agency (1978) *Reviews of the Environmental Effects of Pollutants. III. Chromium* (US EPA 600/1-78-023), Washington DC
- US Environmental Protection Agency (1979) Facilities engaged in leather tanning and finishing; effluent limitations guidelines, pretreatment standards, and new source performance standards. *Fed. Regist.*, 44, 38746-38776
- US Environmental Protection Agency (1983) *Methods for the Chemical Analysis of Water and Wastes* (US EPA-600/4-79-020), Cincinnati, OH, Environmental Monitoring and Support Laboratory
- US Environmental Protection Agency (1984) *Health Assessment Document for Chromium, Final Report* (US EPA-600/8-83-014F), Research Triangle Park, NC, Environmental Criteria and Assessment Office
- US Environmental Protection Agency (1986) *Test Methods for Evaluating Solid Waste, Vol. 1A, Laboratory Manual Physical/Chemical Methods* (SW-846), 3rd ed., Washington DC, Office of Solid Waste and Emergency Response
- US Environmental Protection Agency (1988) Maximum contaminant levels for inorganic chemicals. *US Code fed. Regul., Title 40*, Part 141.11, p. 530
- US Occupational Safety and Health Administration (1987) Air contaminants. *US Code fed. Regul., Title 29*, Part 1910.1000, pp. 676-682
- Uyeki, E.M. & Nishio, A. (1983) Antiproliferative and genotoxic effects of chromium on cultured mammalian cells. *J. Toxicol. environ. Health*, 11, 227-235
- Van Bemst, A., Beaufils, B., Hewett, P.J. & Stern, R.M. (1983) Interlaboratory calibration of a standardized analytical method for hexavalent and total chromium in welding fumes. *Weld. World*, 21, 10-15
- Vandenbalck, J.L. & Patriarche, G.J. (1987) Electrochemical micro-determinations of thallium(I) and chromium (VI) ions using DPASV and DP polarography. *Sci. total Environ.*, 60, 97-104
- Vandervort, R. & Cromer, J. (1975) *Peabody Galion Corp.* (Health Hazard Evaluation/Toxicity Determination Report NIOSH-TR-73-47-172), Cincinnati, OH, National Institute for Occupational Safety and Health
- Venier, P., Montaldi, A., Majone, F., Bianchi, V. & Levis, A.G. (1982) Cytotoxic, mutagenic and clastogenic effects of industrial chromium compounds. *Carcinogenesis*, 3, 1331-1338
- Venier, P., Montaldi, A., Busi, L., Gava, C., Zentilin, L., Tecchio, G., Bianchi, V. & Levis, A.G. (1985a) Genetic effects of chromium tannins. *Carcinogenesis*, 6, 1327-1335
- Venier, P., Montaldi, A., Gava, G., Zentilin, L., Tecchio, G., Bianchi, V., Paglialunga, S. & Levis, A.G. (1985b) Effects of nitrilotriacetic acid on the induction of gene mutations and sister-chromatid exchanges by insoluble chromium compounds. *Mutat. Res.*, 156, 219-228

- Venier, P., Gava, C., Zordan, M., Bianchi, V., Levis, A.G., De Flora, S., Bennicelli, C. & Camoirano, A. (1987) Interactions of chromium with nitrilotriacetic acid (NTA) in the induction of genetic effects in bacteria. *Toxicol. environ. Chem.*, **14**, 201-218
- Venier, P., Montini, R., Zordan, M., Clonfero, E., Paleologo, M. & Levis, A.G. (1989) Induction of SOS response in *Escherichia coli* strain PQ37 by 16 chemical compounds and human urine extracts. *Mutagenesis*, **4**, 51-57
- Venitt, S. (1986) Genetic toxicology in chromium and nickel compounds. In: Stern, R.M., Berlin, A., Fletcher, A.C. & Järvisalo, J., eds, *Health Hazards and Biological Effects of Welding Fumes and Gases*, Amsterdam, Excerpta Medica, pp. 249-266
- Venitt, S. & Bosworth, D. (1983) The development of anaerobic methods for bacterial mutation assays: aerobic and anaerobic fluctuation test of human faecal extracts and reference mutagens. *Carcinogenesis*, **4**, 339-345
- Venitt, S. & Levy, S.L. (1974) Mutagenicity of chromates in bacteria and its relevance to chromate carcinogenesis. *Nature*, **250**, 493-495
- Verschoor, M.A., Bragt, P.C., Herber, R.F.M., Zielhuis, R.L. & Zwennis, W.C.M. (1988) Renal function of chrome-plating workers and welders. *Int. Arch. occup. environ. Health*, **60**, 67-70
- Versieck, J., Hoste, J., Barbier, F., Steyaert, H., De Rudder, J. & Michels, H. (1978) Determination of chromium and cobalt in human serum by neutron activation analysis. *Clin. Chem.*, **24**, 303-308
- Vieux, B., Garland, J., Warren, G. & Rogers, S. (1986) Mutagenic mechanisms of substitutionally inert metal complexes of PtII, PtIV, CrIII and potassium dichromate (Abstract No. PM 30). In: Ramel, C., Lambert, B. & Magnusson, J., eds, *Proceedings of the Fourth International Conference on Environmental Mutagens, Stockholm, June 24-28 1985*, New York, Alan R. Liss, p. 262
- Vigliani, E.C. & Zurlo, N. (1955) Experiences of the 'Clinica del Lavoro' with some MAKs of industrial toxins (Ger.). *Arch. Gewerbepathol. Gewerbehyg.*, **13**, 528-534
- Vos, G., Hovens, J.P.C. & Hagel, P. (1986) Chromium, nickel, copper, zinc, arsenic, selenium, cadmium, mercury and lead in Dutch fishery products 1977-1984. *Sci. total Environ.*, **52**, 25-40
- Wacker, W.E.C. & Vallee, B.L. (1959) Nucleic acids and metals. I. Chromium, manganese, nickel, iron and other metals in ribonucleic acid from diverse biological sources. *J. biol. Chem.*, **234**, 3257-3262
- Wahlberg, J.E. & Skog, E. (1963) The percutaneous absorption of sodium chromate ( $^{51}\text{Cr}$ ) in the guinea-pig. *Acta dermatovenerol.*, **43**, 102-108
- van der Wal, J.F. (1985) Exposure of welders to fumes, Cr, Ni, Cu and gases in Dutch industries. *Ann. occup. Hyg.*, **29**, 377-389
- Wallach, S. & Verch, R.L. (1984) Placental transport of chromium. *J. Am. Coll. Nutr.*, **3**, 69-74
- Wapner, K.L., Morris, D.M. & Black, J. (1986) Release of corrosion products by F-75 cobalt base alloy in the rat. II: Morbidity apparently associated with chromium release *in vivo*: a 120-day rat study. *J. biomed. Mat. Res.*, **20**, 219-233

- Warner, J.S. (1984) Occupational exposure to airborne nickel in producing and using primary nickel products. In: Sunderman, F.W., Jr, ed., *Nickel in the Human Environment* (IARC Scientific Publications No. 53), Lyon, IARC, pp. 419-437
- Warren, G., Schultz, P., Bancroft, D., Bennett, K., Abbott, E.H. & Rogers, S. (1981) Mutagenicity of a series of hexacoordinate chromium(III) compounds. *Mutat. Res.*, 90, 111-118
- Watanabe, S. & Fukuchi, Y. (1984) Cancer mortality of chromate-producing workers. In: Eustace, I.E., ed., *XXI International Congress on Occupational Health, 9-14 September, 1984, Dublin, Ireland*, London, Permanent Commission and International Association on Occupational Health, p. 442
- Watanabe, M., Takayama, Y.-I., Koike, M. & Yamamoto, M. (1985) In vivo clastogenicity of lead chromate in mice. *Tohoku J. exp. Med.*, 146, 373-374
- Waterhouse, J.A.H. (1975) Cancer among chromium platers (Abstract). *Br. J. Cancer*, 32, 262
- Watling, H.R. & Watling, R.J. (1982) Metal concentrations in oysters from the southern African coast. *Bull. environ. Contam. Toxicol.*, 28, 460-466
- Wayne Pigment Corp. (1985a) *MSDS: Molybdate Orange Light 64*, Milwaukee, WI
- Wayne Pigment Corp. (1985b) *MSDS: Molybdate Orange Dark 664*, Milwaukee, WI
- Weast, R.C., ed. (1985) *CRC Handbook of Chemistry and Physics*, 66th ed., Boca Raton, FL, CRC Press, pp. B-70, B-75, B-82, B-88—B-89, B-106, B-127, B-142, B-147, B-159
- Wedrychowski, A., Schmidt, W.N. & Hnilica, L.S. (1986a) DNA-protein crosslinking by heavy metals in Novikoff hepatoma. *Arch. Biochem. Biophys.*, 251, 397-402
- Wedrychowski, A., Schmidt, W.N., Ward, W.S. & Hnilica, L.S. (1986b) Cross-linking of cytokeratins to DNA *in vivo* by chromium salt and *cis*-diamminedichloroplatinum(II). *Biochemistry*, 25, 1-9
- Westbrook, J.H. (1979) Chromium and chromium alloys. In: Mark, H.F., Othmer, D.F., Overberger, C.G., Seaborg, G.T. & Grayson, M., eds, *Kirk-Othmer Encyclopedia of Chemical Technology*, 3rd ed., Vol. 6, New York, John Wiley & Sons, pp. 54-82
- Wetterhahn-Jennette, K. (1981) The role of metals in carcinogenicity: biochemistry and metabolism. *Environ. Health Perspect.*, 40, 233-252
- Whiting, R.F., Stich, H.F. & Koropatnick, D.J. (1979) DNA damage and DNA repair in cultured human cells exposed to chromate. *Chem.-biol. Interactions*, 26, 267-280
- Whitney, R.G. & Risby, T.H. (1975) *Selected Methods in the Determination of First Row Transition Metals in Natural Fresh Water*, University Park, PA, Pennsylvania University Press
- Wiegand, H.J., Ottenwälder, H. & Bolt, H.M. (1984a) Disposition of intratracheally administered chromium(III) and chromium(VI) in rabbits. *Toxicol. Lett.*, 22, 273-276
- Wiegand, H.J., Ottenwälder, H. & Bolt, H.M. (1984b) The reduction of chromium (VI) to chromium (III) by glutathione: an intracellular redox pathway in the metabolism of the carcinogen chromate. *Toxicology*, 33, 341-348
- Wild, D. (1978) Cytogenetic effects in the mouse of 17 chemical mutagens and carcinogens evaluated by the micronucleus test. *Mutat. Res.*, 56, 319-327
- Windholz, M., ed. (1983) *The Merck Index*, 10th ed., Rahway, NJ, Merck & Co., pp. 76-77, 140, 229, 315-319, 777, 1100, 1233-1234, 1267, 1456-1457

- Wong, M.H., Choy, C.K., Lau, W.M. & Cheung, Y.H. (1981) Heavy-metal contamination of the Pacific oysters (*Crassostrea gigas*) cultured in Deep Bay, Hong Kong. *Environ. Res.*, 25, 302-309
- World Health Organization (1970) *European Standards for Drinking Water*, 2nd ed., Geneva, p. 33
- World Health Organization (1988) *Chromium* (Environmental Health Criteria 61), Geneva, International Programme on Chemical Safety
- Yagi, T. & Nishioka, H. (1977) DNA damage and its degradation by metal compounds. *Sci. Eng. Rev. Doshisha Univ.*, 18, 1-8
- Yamamoto, A., Wada, O. & Ono, T. (1981) A low-molecular-weight, chromium-binding substance in mammals. *Toxicol. appl. Pharmacol.*, 59, 515-523
- Yassi, A. & Nieboer, E. (1988) Carcinogenicity of chromium compounds. In: Nriagu, J.O. & Nieboer, E., eds, *Chromium in the Natural and Human Environments*, New York, John Wiley & Sons, pp. 443-495
- Yasuda, Y. (1980) Abnormalities in mouse sperm and sterility after injection of potassium bichromate (Abstract). *Teratology*, 22, 13A
- Yunusova, K.K. & Pavlovskaya, G.S. (1975) The effect of the chromium plating regimen on the protective properties of chromine (Russ.). *Zashch. Met.*, 11, 248-250 [*Chem. Abstr.*, 83, 123027k]
- Zakour, R.A. & Glickman, B.W. (1984) Metal-induced mutagenesis in the *lacI* gene of *Escherichia coli*. *Mutat. Res.*, 126, 9-18
- Zey, J.N. & Aw, T.-C. (1984) *American Transportation Corp. (Health Hazard Evaluation Report No. 82-025-1413)*, Cincinnati, OH, National Institute for Occupational Safety and Health
- Zhang, X., Jixun, D. & Tsungci, F. (1984) The mutagenic effect of hexavalent chromium and antimutagenic effect of cysteine detected by the Tradescantia-micronucleus technique (Chin.). *Zhandong Haiyang Xueyan Xuebao*, 14, 81-83
- Zimmering, S. (1983) The *mei-9<sup>a</sup>* test for chromosome loss in *Drosophila*: a review of assays of 21 chemicals for chromosome breakage. *Environ. Mutagenesis*, 5, 907-921
- Zober, A. (1979) On the problems of evaluating bronchial carcinoma after exposure to chromium compounds (Ger.). *Int. Arch. occup. environ. Health*, 43, 107-121