ORNL-EIS-74-69

HEAVY METALS and other TRACE ELEMENTS in AQUATIC ENVIRONMENTS

Lydia S. Corrill, Emily D. Copenhaver, and Harry V. Leland

OAK RIDGE NATIONAL LABORATORY
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CONTENTS

INTRODUCTION

A review considering transport and concentrations of trace elements in aquatic environments and the effects of metallic contaminants of particular interest in water pollution control and aquatic life preservation has been prepared for the yearly review issue of the Journal of the Water Pollution Control Federation (Vol. 46(6), pp. 1452ff, June, 1974). The documents abstracted in this compilation are those chosen for inclusion in the review. The purpose of the abstracted and keyworded citations is to provide more detailed information than could be included in the review itself.

This file remains as a Toxic Materials Information Center computer-searchable data base and will be updated during the coming year as we prepare a similar review for issue June 1975. Specific research inquiries in this area of concern may be addressed to the Toxic Materials Information Center, Oak Ridge National Laboratory, P. O. Box X, Oak Ridge, Tennessee 37830.

The review and compilation are joint efforts between two grantees of the NSF-RANN Environmental Aspects of Trace Contaminants Program--Harry V. Leland of the Environmental Pollution by Lead and Other Metals Project of the University of Illinois, Urbana; and Lydia S. Corrill and Emily D. Copenhaver of the Toxic Materials Information Center, Oak Ridge National Laboratory. The Toxic Materials Information Center is a component of the Environmental Information System Office of the Information Division, ORNL, and is funded primarily through the NSF-RANN Ecology and Analysis of Trace Contaminants Program at ORNL.

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1
Chromium, Cadmium, Arsenic, Selenium, Mercury, and Aquatic Life: A Brief Literature Review

; Great Lakes Laboratory, State University College at Buffalo

Speci Report # 9, 1971, November, Prepared for a Joint Legislative Committee on Environmental Management and Natural Resources, Sen. Glenn H. Harris Chairman; 1971, November

CHROMIUM; CADMIUM; ARSENIC; SELENIUM; AQUATIC BIOTA; REVIEW

2
Trace Elements in Water, A Bibliography

; Water Resources Scientific Information Center

WRSIC 71-202, Water Resources Scientific Information Center, Office of Water Resources Research, U.S. Department of Interior; 1971

TRACE ELEMENTS; BIBLIOGRAPHY

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Chromium in Water: A Bibliography

; Water Resources Scientific Information Center, Office of Water Resources Research, U.S. Department of the Interior

WRSIC 72-205, Water Resources Scientific Information Center, Office of Water Resources Research, U.S. Department of Interior; 1972

CHROMIUM; BIBLIOGRAPHY; WATER

4
Cadmium in Water: A Bibliography

; Water Resources Scientific Information Center, Office of Water Resources Research, U.S. Department of the Interior

WRSIC 73-209, Water Resources Scientific Information Center, Office of Water Resources Research, U.S. Department of Interior; 1973, March

CADMIUM; BIBLIOGRAPHY; WATER

5
Mercury and Heavy Metals

; Environmental Protection Agency, Washington, DC

Water Quality Standards Criteria Digest. A Compilation of Federal State Criteria; 1972, August

MERCURY; FEDERAL; STATE; STANDARDS; GUIDELINES

6
Water Quality Criteria Data Book, Volume 3: Effects of Chemicals on Aquatic Life for the Environmental Protection Agency Project No, 18050 GWV, Contract No. 68-01-0007 Water Pollution Control Research Series 18050GWV05/71

; Battelle's Columbus Laboratories

; 1971, May

WATER QUALITY; GUIDELINES; CHEMICALS; AQUATIC BIOLOGY

7
Mercury in the Biogeochemical Environment

; Department of Applied Earth Sciences, Stanford University, Stanford, CA 94305

Report of Progress, February 1, 1973 to October 1, 1973

MERCURY; BIOGEOCHEMISTRY; ROCKS; SOILS; MIGRATION; FAULTS; ORES; CINNABAR; FISH; SEDIMENTS; ANAEROBIC; IRON SULFIDE; TRANSPORT; DREDGING; PARTICULATES; LEACHING; ADSORPTION; EVAPORATION

Report deals mainly with the behavior of mercury in rocks, water, sediments, and fish in the New Almaden Area, California. There was no large halo, but solutions containing mercury were confined to narrow passage ways in the rocks. In sediments more of the mercury was in the smaller, organic particulates. The role of iron sulfides in controlling mercury in anaerobic sediments is discussed. Some experiments involved leaching mercury from ore dumps. Also mercury in fish was measured and found to be 3-4 ppm in mercury ore regions. Adsorption, coprecipitation and the evaporation of mercury from dilute solutions was studied.

8
Report on Selected Trace Metals in the Lake Michigan Basin

; Pesticides Technical Committee

Report of the Pesticides Technical Committee to the Lake Michigan Enforcement Conference on Selected Trace Metals in the Lake Michigan Basin, (Pesticides Technical Committee Chairman: Chris Poto, EPA, 1 North Wacker, Chicago, Illinois 60606) 87pp.; 1972, September

TRACE ELEMENTS; AIR; LAKES; FRESHWATER; AQUATIC BIOTA; HUMANS; ATMOSPHERE; EMISSIONS; INDUSTRY; ZINC; COPPER; NICKEL; CHROMIUM; SEDIMENTS; BIOACCUMULATION; MERCURY; ARSENIC; PRODUCTION; MUNICIPAL SEWAGE; TOXICITY; SAFE LIMITS

An attempt was made to pull together available literature and unpublished data concerning selected trace metals in the Lake Michigan Basin. The metals selected are those which may cause problems to aquatic life or humans, even at very low concentrations. Although data are available from many different sources, no attempt is presently being made to monitor the overall conditions within the Lake Michigan Basin. Little is known about the sources and amounts of metals now entering the Lake. Airborne emissions from power plants, steel mills, and incinerators may be contributing significant amounts of some metals to the Lake environment. More study should be encouraged so that reliable estimates can be made and the true significance of airborne emissions established. While data are available on water concentrations of heavy metals in Lake Michigan and its tributaries, the levels of sensitivity and number and frequency of samples are inadequate to establish present conditions. Zinc occurs in high enough concentrations so that it is detectable using present techniques. Copper, cadmium, nickel, lead and chromium, are generally below detectability in Lake Michigan. Heavy metals in both Indiana and Michigan tributaries are often below the level of detectability, and little information is available from Wisconsin tributaries. Recent data indicate that the Grand River may be a significant source of copper, nickel, chromium, and zinc to the southern basin of the Lake. The Environmental Research Group, Inc. recently sampled Lake Michigan waters, sediments, and aquatic organisms to establish a baseline for 35 elements. Biologically important metals such as cadmium and nickel were not included, but work may begin to provide a baseline for some metals in Lake Michigan. Generally, however, analytical sensitivities for metals in water samples must be improved before any meaningful conclusions about the actual heavy metals concentration in Lake Michigan and the contribution of the tributaries to these levels can be established. Furthermore, tributaries must be sampled at various flow stages to enable an estimate of sources and mass balance to be made.

9
Occurrence of Lead in Natural Waters

Abdullah, M.I.; Royle, L.G.; Dept. Oceangr., Univ. Liverpool, Liverpool, England

Part of Proceedings of International Symposium on Environmental Health Aspects of Lead, Amsterdam, Netherlands, October 2-6, 1972, Organized jointly by Commission of the European Communities, Directorate General of Social Affairs-Health Protection Directorate and Environmental Protection Agency, EUR 5004 d-e-f. Luxemburg: Commission of the European Communities, Directorate General for Dissertation of Knowledge, Centre for Information and Documentation, 113-24; 1973

LEAD; NATURAL WATERS; SALTWATER

10
Organic Mercury Compounds as Contaminants of the Human Environment

Adamovic, V.M.; Tomasevic, Z.; Od. Sanit. Hem., Zavod Zdravstvenu Zast., Beigrade, Yugoslavia

Hrana Ishrana (HRISAK), 14(7-8), 366-370; 1973

REVIEW; MERCURY; ORGANIC COMPOUNDS; HUMANS; CONTAMINATION

11
Long-Lived Pollutants in Sediments from the Laguna Atascosa National Wildlife Refuge, Texas

Ahr, W.M.; Dep. Geol., Texas A and M Univ., College Station, Tex.

Geol. Soc. Amer. Bull. (BUGMAF) 1973, 84(8), 2511-15; 1973

DDT; SOILS; LEAD; ARSENIC; ORGANOCHLORINE INSECTICIDE; INSECTICIDES

DDT (dichlorodiphenyltrichloroethane) and some heavy metals are long-lived pollutants which may be retained in sedimentary layers and may be relocated by postdepositional biological or mechanical processes. This study shows the DDT profiles and the lead-arsenic content of some sediment cores from the Laguna Atascosa National Wildlife Refuge (Texas), an area surrounded by croplands that have been treated extensively with pesticides. DDT is most abundant near the tops of the core samples and it may be enriched in subsurface clayey layers. Therefore, postdepositional processes have relocated the DDT into secondary host strata. The relocation is attributed to burrowing and mixing by crabs, worms, and other organisms because burrows are ubiquitous and deep. Burrowing activity can be effective as an agent for relocation of tracers of pollutants in several ways: (1) physical mixing; (2) generation of open canals for continuous circulation of surface fluids deep into the substrate; and (3) ingestion at one site and excretion at another. Because DDT is persistent, it is concentrated through ecological levels in the environment. Lead and arsenic concentrations are not concentrated in the sediments of Laguna Atascosa, and no trend exists with depth in the substrate or with sediment type. Either lead and arsenic are very effectively retained in soils after their application or the metals have been transported as complexes or solutions thorugh the coastal environment and into the Gulf of Mexico.

12
Removal of Heavy Metal Impurities from Liquids

Albenesius, E.L.; Russell, E.R.; Tharin, D.W.; McJunkin, A.P.; United States Atomic Energy Commission

Ger. Offen. (GWXXBX) 2313702 (B 01J, C 02C, C01G), 20 Mar. 1972, 21 pp.; 1972

ARSENIC; REMOVAL; RUBBER; MERCURY; LEAD; METALS; DEUTERIUM; OXIDE; TIRES; ABSORPTION; WASTE PURIFICATION

13
Accumulation of Toxic Metals with Special Reference to their Absorption, Excretion, and Biological Half-Times. Task Group on Metal Accumulation

Albert, R.; Berlin, M.; Friklea, J.; Friberg, L.; Goyer, R.A.; Henderson, R.; Hernberg, S.; Kazantzis, G.; Kehoe, R.A; Med. Cent., New York Univ., New York, NY

Environ. Physiol. Biochem. 3(2), 65-107; 1973

REVIEW; METALS; BIOACCUMULATION; TOXICITY; ABSORPTION; EXCRETION; BIOLOGICAL HALF-TIMES

14
Mercury Content of Albacore Tuna (THUNNUS ALBACARES)

Aldrin, J.P.; Lemaitre, P.; Fonteneau, A.; Lab. Dir. Peches, Abidjan, Ivory Coast

Rec1. Med. Vet. (RMVEAG) 1973, 149(6), 779-92; 1973

MERCURY; TUNA; SWORDFISH; MARLIN

TAXONOMY: THUNNUS ALBACARES; THUNNUS OBESUS; KATSUWONUS PELAMUS; ISURUS GLAUCUS

The mean levels of mercury in muscles of 1-6-year-old T. ALBACARES and T. OBESUS, caught between Dakar and Pointe-Noire, were 0.48 and 0.46 ppm, respectively the Hg level increased from 0.1 to 1.0-1.4 ppm as the age of fish increased from 1 to 6 years. The mean levels of Hg in XIPHIAS GLAUDIUS, KATSUWONUS PELAMIS, and ISURUS GLAUCUS were 1.7, 0.2, and 1.1 ppm.

15
Migration of Lead and Zinc in Surface Waters During the Sharp Enrichment of the Waters with Sulfides of the Metals

Alekspenko, V.A.; Danchev, V.V.; Plerov, V.E.; Karaqand, Kaz. Politekh. Inst., Karaganda, USSR

Izv. Akad. Nauk Kaz. SSR, Ser. Geol. (IKAGA8), 30(2) 76-77; 1973

WATER; LEAD; ZINC; MIGRATION; RIVERS; SEDIMENTS

16
Microbiological Formation of Potentially Hazardous Organometallic Compounds in Water

Alexander, M.; Water Resour. Mar. Sci. Cent., Cornell Univ., Ithaca, NY

PB Report No. 218698/3, 22p.; 1972

ORGANOMETALLIC COMPOUNDS; WATER; SELENIUM DIMETHYLSELENIDE; TELLURIUM; DIMETHYLTELLURIDE; TOXICITY; MICROBIOLOGY; TRANSFORMATION; MICROORGANISM

TAXONOMY: PENICILLIUM

17
Agronomic Controls Over the Environmental Cycling of Trace Elements

Allaway, W.H.; U.S. Plant, Soil, and Nutrition, Laboratory, U.S. Department of Agriculture, Ithica, N.Y.

Am. Soc. Agronomy, 20, 235; 1968

AGRICULTURE; TRACE CYCLING; CONTROLS

18
Biological and Physico-Chemical Aspects of the Radiocontamination of Marine Species and Sediments

Ancellin, J.; Avargues, M.; Bovard, P.; Gueguenlat, P.; Vilquin, A.

Part of Radioactive Contamination of the Marine Enviornment, Proceedings of Symposium held by the International Atomic Energy Energy Agency, Seattle, WA, July 10-14, 1972 (225-241) 786p.; 1973

ADSORPTION; ALGAE; AQUATIC ECOSYSTEMS; CERIUM 144; CESIUM 137; COBALT 60; DIFFUSION; FISH; FOOD CHAINS; INVERTEBRATES; IRON 55; MANGANESE 54; MARINE DISPOSAL; MICROORGANISMS; RADIOACTIVE WASTE DISPOSAL; RADIOECOLOGY; RADIONUCLIDE MIGRATION; RETENTION; RUTHENIUM 106; SEDIMENTS; SOLUBILITY; STRONTIUM 85; UPTAKE; VERTEBRATES; ZINC 65; SALTWATER; CERIUM; CESIUM; COBALT; IRON; MANGANESE; ZINC; STRONTIUM; RUTHENIUM

Various aspects of the physico-chemical and biological fate of radioactive pollutants in the marine environment are reviewed in the light of the results of recent radioecological research. In studying contamination of any kind, it is necessary to take into account the relative importance of physico-chemical and biological processes that take place simultaneously. In a certain number of cases the mechanisms whereby elements present in small quantities in seawater are adsorbed on to living organisms are similar to those that apply to inert bodies. The contribution of the species to fixation of the element is passive, and the physico-chemical properties of the contaminants and of the contaminated carrier can dominate its own biological properties, particularly the physiological barrier of regulation. Various types of equilibration of the pollution of the organs, notably in fish, with the pollution of the environment are examined, together with the the differences in the capability of various competing sites for adsorption of a specific pollutant, for example the capability of sediments on the one hand and the living species in contact with the sediments on the other.

19
Is Lead Really a "our Letter Word?

Anderson, M.M.; Wixson, B.G.

Presented at the Seventh Annual Conference on Trace Substances in Environmental Health University of Missouri-Columbia, Columbia, MO 65201, June 12-14, 1973; 1974

LEAD; INDUSTRY; MINES; SMELTER; ENVIRONMENTAL SAFEGUARDS; SETTLING PONDS; SAMPLING; SULFUR DIOXIDE; FURNACING; ACID PLANT; TAILINGS; MILLING; ALGAE; RECIRCULATION; ARTIFICAL MEANDERS; SINTERING

A practical, common sense, working partnership developed in the NSF (RANN) Lead Project has allowed environmentalists to work with engineers from industry to expose and resolve problems for social and economic benefits. In the New Lead Belt (SE Missouri) a formalized cooperative research effort among the AMAX Lead Corporation of Missouri, the University of Missouri, and the U.S. forest service began in 1970 when tree discoloration, or bronzing, was noticed in the new growths on trees down-wind from a smelter. A network of atmospheric monitoring stations was set up around the smelter and data from these stations showed SO(2) to be the cause of the tree bronzing. Costly, but effective, measures were taken by the AMAX Corporation to eliminate the problem. Measures have also been taken to eliminate lead dust, CO(2) and carbonate, and organic pollution of streams nearby.

20
Flow and Chemical Characteristics of the St. Johns River at Jacksonville, FL

Anderson, W.; Goolsby, D.A.

United States Geological Survey, Bureau of Geology, Florida Department of Natural Resources, Consolidated City of Jacksonville, Open-File Report 73008; 1973

FLOW CHARACTERISTICS; CHEMISTRY; RIVERS; ESTUARIES; CHLORIDE; STRATIFICATION; TEMPERATURE

GEOGRAPHICAL DESCRIPTION: U.S., Florida (S) Jacksonville, St. John's River

The St. Johns River at Jacksonville, which is 21 miles upstream from the ocean, is part of a tidal estuary that for practical purposes may be considered to end at Lake George, 106 miles upstream from the ocean. Occasionally, tidal effects are noted 161 miles upstream. The channel of the estuary above Jacksonville is capable of storing huge amounts of water past Jacksonville. Most of this water subsequently flows back past Jacksonville as the ocean tide falls. These tidal flows average 87,000 cubic feet per second at Jacksonville, and peak flows exceeding 150,000 cubic feet per second are common. The average tidal flows are more than seven times as large as the average net for fresh-water flow. Fresh water draining from the estuary increases the volume and duration of ebb tidal flows (downstream) and diminishes the volume and duration of flood tidal flows (upstream). About a quarter of the fresh water that flows into the estuary from April through September is released to the ocean from October through March. When evapotranspiration from the estuary above Jacksonville exceeds rainfall and fresh-water inflow into the estuary, the net loss of water tends to cause the volume and duration of the upstream flows to exceed those of the downstream flows. The net flow of the St. Johns River at Main Street Bridge in Jacksonville was downstream about 70 percent of the days of record and upstream about 30 percent of the days of record. Zero net flow occured on 13 of the 4,597 days of record, or 0.3 percent of the time. The greatest number of consecutive days that the net flow was zero or upstream was 14 days. Sea water moving upstream from the mouth of the St. Johns River mixes with the fresher water already in the river channel to form a zone of transition. The chloride concentration in this zone varies from that of sea water to that of the fresh-water input. When the zone of Jacksonville increases with upstream flow and decreases with downstream flow. During a particular tidal cycle, the magnitude and range in chloride concentration in the river at Jacksonville depends on the length and gradient of the zone of transition and on the volume of the tidal flows. About 80 percent of the time the chloride concentration at Main Street Bridge exceeds 250 milligrams per liter. Between Jacksonville and the ocean the river shows stratification between the sea water and overlying river water. However, stratification tends to weaken or disappear in the vicinity of Jacksonville, probably because of increased turbulence caused by channel constriction and bridge piers. The temperature of the river averages less than 15 degree C (Celsius) (59 degree F) in January and February and more than 28 degree C (82 degree F) in summer.

21
Possible Purification of Waste Slurries and Waste Waters During Barium Salt Production

Andreeva, K.; Dimitrova, L.; Mishev, M.; Krusteva, D.; Trayanova, M.; Beloteleva, M.; USSR

God. Nauchnoizsled. Inst. Khim. Prom. (GNKPAG), 11, 249-256; 1973

BARIUM; SALTS; WASTE PURIFICATION; WASTE WATER

22
Methylmercury in Estuarine Sediments

Andren, A.W.; Harriss, R.C.

Nature 246, 256-257; 1973

METHYLMERCURY; MERCURY; SEDIMENTS; ESTUARIES; FISHERIES; INDUSTRIAL EFFLUENTS

Surface sediments were collected from the Mississippi Delta, Mobile Bay, and the Florida Everglades and analyzed for total mercury, methylated mercury and total organic content. The methyl mercury concentration varied from less than 0.02 ng g-1 to 0.19 ng g-1, the high value being in the estuarine sediments from Mobile Bay, which had previously received sufficient quantities of anthropogenic mercury effluents to require a ban on commercial fisheries. The methylmercury content never represents more than 0.07% of the total mercury present; the average is 0.03%.

23
Partition Coefficients for Fe, Mn, Pb, Ni, Zn, Cu Between River Water and Suspended Load, and Mineralogical Composition of Suspended Load of Selected Kansas River Systems: Project Completion Rept. July 69-Dec 70

Andino, E.E.; Magnuson, L.M.; Waugh, T.C.; Evans, T.; Kansas Water Resources Research Inst., Manhattan

Report No. Contrib-80; Contract DI-14-31-3016; Monitoring Agency Rept No. W72-06285, OWRR-A-030-KAN(1); Prof. OWRR-A-030-KAN; PB 207776, 126 p.; 1972, January

PARTITION COEFFICIENTS; WATER ANALYSIS; WATER CHEMISTRY; ADSORPTION; METALS; CLAYS; MINERALS; MONTMORILLONITE; PARTITION MATHEMATICS; GEOCHEMISTRY; RIVERS; IRON; MANGANESE; NICKEL; LEAD; COPPER; ZINC; WATER; TRACE ELEMENTS; SUSPENDED SEDIMENTS; LIMNOLOGY; LEAD; SEDIMENTS

24
Mercury in Lake Sediments. Possible Indicator of Technological Growth

Aston, S.R.; Bruty, D.; Chester, R.; Padgham, R.C.; Appl. Geochem. Res. Group, Imp. Coll., London, England

Nature (London) (NATUAS) 241(5390) 450-1; 1973

MERCURY; LAKES; SEDIMENTS; INDUSTRY; GEOLOGY

Lake sediments, which geologically have a relatively rapid rate of deposition, might produce evidence of man's input of mercury to the environment. A 1-meter undisturbed sediment core form the South Basin, Lake Windermere, England, was obtained and analysed. The vertical distribution of Hg could result from an increasing supply of Hg over the past half millenium, probably due to an enhanced release of Hg by man's activities. These include: denudation of land surfaces; heavy industry, mining and quarrying; burning of fossil fuels; and sewage disposal. Much of the Hg thus released initially enters the atmosphere, although some is introduced directly into natural waters. The authors suggest that the Hg contents of the core reflect, at least in part, this input by man. The deep sediments have an average Hg content of 122 ppb which probably represents the local "background". Since approximately 1800 AD there has been a stepwise increase in Hg contents of the sediments which may correlate with man's activities, for example the change in the core may reflect the onset of the Industrial Revolution. It is likely that the introduction of sewage in recent years will have resulted in an increased supply of Hg in the lake. The combinattion of various factors comprising technological growth has, therefore, resulted in a progressive increase of Hg in the sediments of Lake Windermere.

25
Concentration Effects on Cesium-137, Zinc-65, Cobalt-60, and Ruthenium-106 Sorption by Marine Sediments, with Geochemical Implications

Aston, S.R.; Duursma, E.K.; Int. Lab. Mar. Radioact., IAEA, Monaco

Neth. J. Sea Res. (NJSRBA), 6(1-2), 225-240; 1973

FALLOUT; SEDIMENTS; CESIUM 137; ZINC 65; COBALT 60; RUTHENIUM 106; SALTWATER; GEOCHEMISTRY

26
General Study of Chemical Pollutants Thrown into Sea Water: Inventory and Toxicity Studies: I. Methodology: II. Mediterranean

Aubert, M.J.; Gambarotta, J.P.; Donnier, B.; Barelli, M.; Daniel, S.; Aubert, J.; Inst. Nat. Sante Rech. Med., Nice, France

Rev. Int. Oceanogr. Med., 1(Suppl.), 1-72; 1969

CHEMICALS; SALT WATER; TOXICITY; METHODOLOGY; MARINE BIOLOGY

An inventory of chemical pollution of French coastal waters is presented in 4 volumes: the 1st is dedicated to general considerations and methodology, the others describe present pollution in the Mediterranean, Atlantic, Channel and North Sea regions. The results emphasize the need for classical analytic methodology, new techniques and "biological counters" adapted to this particular problem. Various types of chemical pollutants are surveyed, such as synthetic detergents petroleum products, pesticides and industrial waste. Some particular cases of widespread pollution are studied. The general experimental considerations developed lead, for the study of industrial waste, to the use of a standarized methodology which demonstrates the phenomena of intervening acute toxicity on the constituents of the marine enviornment. The possibility of transmitting these toxic effects to the final consumer in the biological chain is also studied. Techniques used to carry out these biological measurements are described in detail, as well as a method for interpreting the results thus obtained. The results are grouped according to zone: Mediterranean, Channel and Atlantic.

27
Detrimental Effects of Toxic Charge by Heavy Metals or Phenol on Submerged Water Plants

Auerbach, S.; Pruefer, P.; Weise, G.; Sekt. Wasserwes., Tech. Univ. Dresden, Dresden, E. Germany

Int. Gesamten Hydrobiol. (IGHYAZ), 58(1), 19-32; 1973

HEAVY METALS; SUBMERGED WATER PLANTS; PLANTS; AQUATIC PLANTS

TAXONOMY: FONTINALIS ANTIPYRETICA

28

28
Distribution of Mercury in Sediments of the Nooksack River Drainage

Babcock, R.S.; Kolby, W.I.; Dep. Geol., West. Washington State Coll., Bellingham, Wash.

Northwest Sci. (NOSCAX), 47(3), 180-184; 1973

MERCURY; SEDIMENTS; RIVERS; DRAINAGE; DISTRIBUTION

29
Total Mercury Content of Some Fishes of the Monte Amiata Area Rivers

Bacci, E.; Renzoni, A.; Ist. Anat. Comp., Univ. Siena, Siena, Italy

Rass. Med. Sper. (RMSPAY), 20(1), 60-67; 1973

MERCURY; FISH; WATER; CINNABAR; MICROORGANISMS

TAXONOMY: LEUCISEUS CEPHALUS; BARBUS MERIDIONALIS; RUTILUS RUBILIO

GEOGRAPHICAL DESCRIPTION: Italy, Monte Amiata, Siena, Viterbo

Values from 0.027 to 8.03 ppm were found for the mercury content in the white muscle of LEUCISEUS CEPHALUS, BARBUS MERIDIONALIS, and RUTILUS RUBILIO taken from 8 streams of the Monte Amiata Hg (cinnabar)-mining area between Siena and Viterbo, Italy. In general, B. MERIDIONALIS had higher Hg contents than the other 2 species, presumably because its bottom-feeding habits expose it to microorganisms which methylate and concentration Hg. The major part of the Hg present in the water and in the fish is attributed to waste products from the mines rather than to leaching and weathering of the Hg-bearing rocks.

30
Removal of Copper from Waste Water with Ion Exchange Resins

Baisero, G.B.; Callegaro, A.; Melotti, A.; Montecatini Edison, Milan, Italy

Inquinamento (IQAAAW), 15(5), 37-39; 1973

COPPER; RECOVERY; WASTE WATER; IONS; REMOVAL; ION EXCHANGE

31
Methylmercury Poisoning in Iraq: An Interuniversity Report

Bakir, F.; Damluji, L.; Amin-Zaki, L.; Murtadha, M.; Khalidi, A.; Al-Rawi, N.Y.; Tikriti, S.; Dhahir, H.I.; Clarkson, T.W.; Smith, J.C.; Doherty, R.A.; University of Bahgdad, Iraq; University of Rochester, Rochester, N.Y.

Science 181, 230-241; 1973, July 20

METHYLMERCURY; HUMANS; TOXICITY; POISONING; MERCURY; FUNGICIDES

32
Contribution of Atmospheric Chloride in Water from Selected Coastal Streams of Central California

Baldwin, A.D.; Department of Geology, Miami University, Oxford, OH 45056

Water Resources Research, 7(4), 1007; 1971, August

ATMOSPHERE; CHLORIDE; COASTAL WATERS; WATER

GEOGRAPHICAL DESCRIPTION: U.S., California, Santa Cruz, Half Moon Bay

Chemical quality and discharge data were collected and analyzed from five streams draining watersheds between Half Moon Bay and Santa Cruz, California, to determine the contribution of atmospheric chloride to these coastal basins. Fifty-nine percent of the total chloride leaving the basins underlain by Tertiary sedimentary rocks per year is atmospheric in origin. Nineteen percent of this atmospheric chloride contribution is introduced dissolved in rainwater, whereas the remaining 40% is brought into the basins as fine particulate dust, in 'fog drip,' or as an aerosol.

33
Applied Aquatic Studies

Balylock, B.G.; Allen, C.P.; Cosgrove, G.E.; Elwood, J.W.; Eyman, L.D.; Frank, M.; Griffith, N.A.; Jolley, R.L.; Nelson, D.J.; Scott, C.D.; Pitt, W.W.; Trabalka, J.R.; Ulrikson, C.O.; Shugart, H.H.

Part of Environmental Sciences Division Annual Progress Report Period Ending September 30, 1972, ORNL-4848, 79-85; 1973

AQUATIC BIOLOGY; RADIONUCLIDES; SEDIMENTS; TRITIUM; FISH; CYTOGENTICS; RADIATION EFFECTS; CHANNEL CATFISH; NICHE; CHLORINATION; SEWAGE; EFFLUENTS; BLUEGILLS

TAXONOMY: DROSOPHILA; ICTALURUS PUNTATUS; CHIRONOMUS TENTANS; LEPOMIS MACROCHIRUS

34
Ecology and the Concentration and Effect of Pollutants in Nearshore Marine Enviornments

Bartlett, G.A.

Part of International Symposium on Identification and Measurement of Environmental Pollutants, Ottawa, ONtario, Canada; June 14, 15, 16, 17, 1971

SALTWATER; LAGOONS; ESTUARIES; DELTAS; SALT MARSHES; COASTAL WATERS; BIOMASS; BACTERIA; FORAMINIFERA; DIATOMS; MOLLUSCS; SEDIMENTS; TEMPERATURE; PH; EH; OXYGEN; CARBON DIOXIDE; SILICA; NITRATES; NITRITES; IRON; COPPER; MAGNESIUM; PHOSPHATE; SODIUM

Several nearshore marine environments (lagoons, estuaries, deltas, salt marshes, beaches, and inner continental shelves) adjacent to the Atlantic Provinces have been monitored during the past 10 years. Monitoring has been conducted either continusously, diurnally, or on a seasonal basis. Biomass-watermass, biomass-substrate, and watermass-substrate characteristics have been analyzed. The previous history of these environments was investigated by coring. Biomonitoring, utilizing bacteria, foraminifera, diatoms, and molluscs, has indicated major trends in both species and assemblage associations, in specific environments. In addition, the following parameters were measured: 1) Sediment - distribution, total organic content, size, and heavy minerals content, 2) Salinity, 3) Temperature, 4) pH, 5) Eh, 6) Oxygen, 7)CO2, 8) Silica, 9) Nitrate, 10) Nitrite, 11) Iron, 12) Copper, 13) Magnesium, 14) Phosphate, and 15) Sodium. These parameters have shown the quantitative relationships and the distribution and dilution of pollutants as a function of time and distance from point of injection into the watermass. All species investigated are patchily distributed, so that sampling methods play an important role in interpretation. Thus, infrequent sampling and widely-spaced stations only provide a partial environmental picture. Nearshore marine environments are eurybathic and contain extremely tolerant organisms. These living organisms privide the most sensitive and accurate means of monitoring, identifying, and controlling pollutants in nearshore marine environments. It was found that many species are experiencing difficulty establishing new populations or even surviving. Certain species have adapted to sewer effluent areas, while others have moved seaward or disappeared. These distinct environmental changes have occurred in the past 10 years with rapidly increased deterioration occuring from 1967 to the present.

35
Effects of Zinc and Lanthanum on Calcium Uptake by Mitochondria and Fragmented Sarcoplasmic Reticulum of Frog Skeletal Muscle

Batra, S.; Dep. Pharmacol., Univ. Lund, Lund, Sweden

J. Cell. Physiol. (JCLLAX), 82(2), 245-256; 1973

ZINC; MUSCLES; CALCIUM; METABOLISM; LANTHANUM; MITOCHONDRIA; SARCOPLASMIC RETICULUM; FROG

Zinc at 5-10 micro moles had no effect on calcium uptake by mitochondria or fragmented sarcoplasmic reticulum (FSR) from frog skeletal muscle, but 25 micro moles Zn decreased Ca uptake by both fractions. Lanthanum at 5 micro moles lowered mitochondrial Ca uptake by 70%, but did not affect that by FSR; 10 and 25 micro moles La decreased FSR Ca uptake by 12 and 20%, respiration La was unable to release Ca from previously loaded mitochondria, indicating that it interfered only with the Ca binding step. The effects of Zn and La or Ca uptake by the isolated fractions were discussed in relation to the role of Ca in the contractile response of skeletal muscle.

36
Experimental Study of Zinc-65 Uptake and Elimination by Mytilus Galloprovincialis

Baudin, J.P.; Dep. Prot., C.E.N. Cadarache, Saint-Paul-Lez-Durance., France

C.R. Acad. Sci., Ser. D(CHDDAT) 277(1) 113-116; 1973

ZINC 65; MUSSELS; FALLOUT; CLAMS; RADIOACTIVITY; CONCENTRATION FACTOR; BIOLOGICAL HALF-LIFE

TAXONOMY: MYTILUS GALLOPROVINCIALIS

The clams were exposed to zinc 65 in water at 0.58 microcuries per liter. Uptake was rapid during the first 15 days, then slower for 15-40 days and then relatively constant for 40 days. The majority of the radioactivity lost by the water was taken up by the clams; a minor part was adsorbed on the walls. Concentration factors of 57 to 255 were observed for different parts and 79 for the whole clam. The distribution was similar to that of stable zinc, but much higher concentration factors were found for stable zinc. Two biological half lives for elimination were found (in zinc free water) vis 4 and 214 days.

37
Adsorption of Amino Acids at the Mercury-Water Interphase. II. Glycylglycine

Baugh, L.M.; Parsons, R.; Sch. Chem., Univ. Briston, Briston, England

Croat. Chem. Acta(CCACAA), 45(1), 127-135; 1973

GLYCYLGLYCINE; MERCURY; ADSORPTION; AMINO ACIDS; WATER

The adsorption of Gly-Gly (I) from 0.1 M KPF6 was studied by electrocapillary and capacitance measurements. I behaves as a typical organic adsorbate by preferentially adsorbing near the point of zero charge. Studies showed that the molecules of I are oriented with dipoles parallel to the interface at accessible charges. Explanation of the favored adsorption of I at Hg interface involves a model of orientation of neighboring solvent molecules into a 2 dimensional solvation shell.

38
Chemistry of Organomercurials in Aquatic Systems

Baughman, G.L.; Gordon, J.A.; Wolfe, N.L.; Zepp, R.G.

EPA-660/3-73-012 Environmental Protection Agency. National EnvironmentalResearch Center, Corvallis, Oregon; Southeast Environmental Research Lab. Athens,GA; 1973

KINETICS; CHEMISTRY; PHOTOCHEMISTRY; DIMETHYLMERCURY; WATER CHLORIDE; PHENYLMERCURY; DMM; DPM; ORGANOMERCURIAL SALTS; MERCURY; METHYLMERCURY

Kinetics in water of some chemical and photochemical reactions postulated as key transformations in the environmental mercury cycle were investigated. Decomposition of dimethylmercury (DMM) and diphenylmercury (DPM) by acids and mercuric salts was shown to be pH dependent and too slow to be significant under most environmental conditions. Degradation of organomercuric salts by acid is even slower. Theoretical evidence indicates that loss of elemental mercury or DMM at the air-water interface can be important in turbulent systems. Dimethylmercury, methylmercuric chloride, methylmercuric hydroxide, and methylmercuric ion were not decomposed by sunlight, but phenylmercury and sulfur-bonded methylmercuric species were readily decomposed to inorganic mercury. Detailed equilibrium calculations indicate that the sulfur-bonded methylmercuric species are the predominant species in natural waters. Quantum yields for these reactions are presented along with a technique for calculating sunlight photolysis rates from laboratory data. The report also includes a review of the chemical literature concerning the kinetics of chemical and photochemical decomposition of organomercurials.

39
Aquatic Bioenvironmental Studies in the Columbia River at Hanford 1945-1971; A Bibliography with Abstracts

Becker, C.D.; Battelle Pacific Northwest Laboratories, Richland, Washington 99352

BNWL-1734, UC-48; 1973, February

AQUATIC BIOLOGY; RIVERS; BIBLIOGRAPHY; POWER REACTORS

40
Toxicity of Power Plant Chemicals to Aquatic Life

Becker, C.D.; Thatcher, T.O.; United States Atomic Energy Commission

Wash-1249,Uc-11, Battelle Pacific Northwest Laboratories, Richland, Wash. 99352; 1973, June

AQUATIC BIOLOGY; CHEMICALS; POWER PLANTS; TOXICITY

41
Present Levels of Mercury in Man Under Conditions of Occupational Exposure

Berlin, M.; International Atomic Energy Agency, Vienna, 1972

Part of Mercury Contamination in Man and His Environment, A Joint Undertaking by the International Labor Organization, The Food and Agricultural Organization of the United Nations, the World Health Organization, and the International Atomic Energy Agnecy, Technical Report Series No 137, 181p.; 1972

MERCURY; HUMANS; OCCUPATIONAL EXPOSURES; GUIDELINES; BLOOD; ATMOSPHERE; SYMPTOMS; POISONING; URINE; ALKYMERCURY

The problems in connection with mercury analysis in biological material are not fully realized. According to available reports, it seems that a mercury concentration in blood exceeding 0.02 ppm after exposure to mercury vapour is connected with a certain risk of unspecific subjective symptoms in human beings. This value corresponds to about 0.02 mg/m3 of air. At blood levels exceeding 0.1 ppm (0.1 mg/m3 of air), signs of classical mercurialism can be expected. Blood concentrations exceeding 0.03 ppm of mercury can be regarded as signifying a definite exposure to mercury. The same conclusion should be drawn concerning concentrations of mercury in the urine exceeding 0.1 ppm. There is too little quantitative data on which to base conclusions regarding the lowest concentrations in blood and urine from poisoning due to phenylmercury compounds or inorganic mercuric salts, nor is the lowest concentration in the critical organ, the kidney, known at which the clinical signs of poisoning appear. However, there are data indicating that the mercury concentration in urine and blood can be higher without causing clinical signs than with exposure to mercury vapour. More precise data are available in connection with exposure to methylmercury compounds. Concentrations exceeding 0.1 ppm in whole blood are to be regarded as evidence of serious and dangerous exposure. This concnetration in blood corresponds to a daily intake of 2 mg Hg/kg body weight per day or exposure to about 0.01 mg Hg/m3 of air for 8 hous a day. Women should not be occupationally exposed to alkylmercury compounds during their most fertile years.

42
Mercury Content of the Edible Portion of Fish Products on the Belgian Food Market. Probable Mercury Consumption in Belgium from these Products

Bigwood, E.J.; Fouassin, A.; Noirfalise, A.; Fac. Med., Univ. Libre Bruxelles, Brussels, Belgium

Rev. Ferment. Ind. Aliment. (RFIAAQ), 28(1), 5-46; 1973

REVIEW; MERCURY; FISH; DIET; SEA FOOD; HUMANS

GEOGRAPHICAL DESCRIPTION: Belgium

43
Effects of Cadmium and Copper on the Oxidation of Lactate by Rainbow Trout Gills

Bilinski, E.; Jonas, R.E.; Vancouver Lab., Fish. Res. Board Canada, Vancouver, B.C.

J. Fish. Res. Board Can. (JFRBAK), 30(10), 1553-1558; 1973

CADMIUM; LACTATE; METABOLISM; FISH; GILLS; COPPER; RAINBOW TROUT; FRESHWATER

TAXONOMY: SALMO GAIRDNERI

In fish surviving exposure to cadmium chloride (1.12 mg cadmium L.) for 24 hr to copper chloride (0.064 mg copper L.) for 48 hr, the oxidation of lactate by gills was inhibited by more than 50%. The exposure of trout to lower metal ion concentrations resulted in mortalities, but there was no detectable effect on the oxidative activity in gills.

44
Kinetics of Microbially Mediated Methylation of Mercury in Aerobic and Anaerobic Aquatic Environments

Bisogni, J.J., Jr.; Lawrence, A.W.

The Office of Water Resources Research, U.S. Dept. of Interior, Wash., DC report A-038-NY, Agreement Numbers 14-31-001-3532 and 3832.

KINETICS; MICROORGANISMS; MERCURY; METHYLATION; REDOX POTENTIAL; SULFIDES

In this research the microbial transformation of inorganic mercury to organic mercury (monomethyl- and dimethyl-mercury) was studied. This transformation was studied with regard to the effects of the following: (1) redox potential, (2) inorganic mercury concentration, (3) temperature, (4) microbial activity, and (5) sulfide concentration. A kinetic model was proposed to describe the rate of methylation. The model included the following parameters: (1) a coefficient which indicated relative microbial activity, (2) a coefficient which indicated biochemical availability of the inorganic mercury, (3) a parameter whose value was determined by the system redox potenital, and (4) inorganic mercury concentration.

45
Transfer to Man, Through His Food, of the Radioisotopes of Ruthenium, Cobalt, and Zinc Discharged into Continental Waters

Bittel, R.; CEA, Fontenay-Aux-Roses, France

CEA, Fontenay-Aux-Roses, Franc (EUR-4800(Vols. 1 and 2)), pp. 869-890. From International symposium on radioecology applied to the protection of man and his environment; Rome, Italy (7 Sept. 1971).; 1972, May

AQUATIC ECOSYSTEMS; COBALT; ECOSYSTEMS; RADIOISOTOPES; RUTHENIUM; SEAFOOD; TRANSPORT; ZINC; ISOTOPES; HUMANS; FOOD CHAINS

On the basis of certain assumptions, the dose delivered to man by the ingestion of food contaminated by radioactive pollution of water can be evaluated in any situation. The use of a type of standard calculation is described for aquatic food chains in order to establish the consequences for man of the contamination of continental waters by radioruthenium and metallic activation products, in particular, radioisotopes of cobalt and zinc. A study of examples based on the results of food surveys and of experiments performed mainly at Ispra and Mol indicates the doses reaching man in different cases and permits estimation of the incidence of variations of some of their parameters.

46
Significance of Physicochemical Variables in Aquatic Bioassays of Heavy Metals

Black, J.A.; Roberts, R.F.; Johnson, D.M.; Minicucci, D.D.; Nancy, K.H.; Allen, H.E.; School of Public Health, Univ. Michigan, Ann Arbor, Mich.

Bioassay Tech. Environ. Chem.(26YZAG) 259-75; 1973

REVIEW; HEAVY METALS; AQUATIC BIOLOGY; BIOASSAY; PHYSICOCHEMISTRY

A review of temperature, dissolved oxygen, flow or constitution reneval ionic strength, water hardness and the equilibration of species of metal toxicants as physicochemical variables in aquatic bioassays of heavy metals with 29 refs.

47
Polarographic Properties of Complexes of Alkali Metals in Aqueous Solutions

Bobrovski, A.; Zarembski, Y.

Zh. Anal. Khim., 27(8), 1472-1479; 1972, August

CESIUM; LITHIUM; POLAROGRAPHY; POTASSIUM; QUANTITATIVE CHEMICAL ANALYSIS; RUBIDIUM; SODIUM; AQUEOUS SOLUTIONS; WATER

48

48
Geochemical and Vegetation Studies of Trace Substances from Lead Smelting

Bolter, E.; Hemphill, D.D.; Wixson, B.; Butherus, D.; Chen, R.

Part of Hemphill, D.D. (Ed.), Sixth Annual Conference on Trace Substances in Environmental Health, Held at Memorial Union, University of Missouri-Columbia, Columbia, MO, June 13-15, 1972 (p. 79-86) 399p.; 1973

SOILS; PLANTS; LEAD; ZINC; COPPER; CADMIUM; MANGANESE; SULFUR; SMELTERS; LEAVES; GALENA; SPHALERITE; TREES; X-RAY; FLUORESCENCE ANALYSIS; ATOMIC ABSORPTION SPECTROPHOTOMETRY; DEPTH VARIATIONS; ROOTS; TRANSLOCATION; FOLIAR APPLICATION; GEOGRAPHIC VARIATIONS; HUMUS; ANALYSIS; ATMOSPHERE

Several hundred soil and vegetation samples from the "Viburnum Trend" or "New Lead Belt" of Southeast Missouri were analyzed for lead, zinc, copper, cadmium, manganese and total sulfur to determine natural background concentrations and to delineate areas of anomalous high concentrations caused by the mining and lead smelting activity. The area around one lead smelter showed anomalous high heavy metal concentrations for a distance of several miles. Other activities, such as the transport of ore concentrate in open trucks or by railroad, also act as sources of pollution. Elevated heavy metal concentrations in soils were found to be mainly restricted to the humus layer on the surface of the soil and to the top one inch soil layer. Most of the lead found in vegetation samples was thought to be present on the surface of the leaves. Findings should be of technical value for pollution abatement applications.

49
Sorption-Desorption Reactions of Mercury with Suspended Matter in the Columbia River

Bothner, M.; Carpenter, R.

Part of Radioactive Contamination of the Marine Environment. Vienna - International Atomic Energy Agency, 1973, from Symposium on the Interaction of Radioactive Contaminatnts with the Constituents of the Marine Environment, Seattle, Washington, USA, July 10-14, 1972, pp 73-87.; 1973

ADSORPTION; AQUATIC ECOSYSTEMS; COASTAL WATERS; COLUMBIA RIVER; DESORPTION; DIFFUSION; FRESHWATER; MERCURY; PACIFIC OCEAN; PARTICLES; SALTWATER; SEDIMENTS; SILT; TRACER TECHNIQUES; DISSOLUTION

The influence of Columbia River suspended matter on the fate of dissolved mercury in the river and during the transition from the river to the oceanic environment has been investigated. The approach has been to spike natural Columbia River water with Hg 203-labelled mercuric nitrate and methyl mercury chloride under laboratory conditions and to follow the reactions of the radioactive species with the suspended matter during exposure to river water and to seawater. The concentrations of natural mercury in Columbia River water, its suspended matter and bottom sediments were also determined. The partitioning of both natural and radioactive mercury species between the dissolved and suspended phases was very similar. Between 50 and 75% of the natural mercury and the added radioactive species was associated with the particulates. Both inorganic and methyl mercury are fairly rapidly taken up by the natural assemblage of Columbia River particulates. The desorption experiments show that at least half of each of these forms is fairly easily desorbed by filtered river water of lower total mercury content. Subsequent washes with seawater remove little additional mercury from the particulates during roughly one week contact time.

50
Complex Formation Between Lead (II) and Citrate Ions in Alkaline Solution

Bottari, E.; Vicedomini, M.; Ist. Chim. Analitica, Univ. Roma, Roma, Italy

J. Inorg. Nucl. Chem. (JINCAO) 35(7) 2447-53; 1973

LEAD; CITRATE; COMPLEX FORMATION

The complex formation between lead (II) and citrate ions (L) in alkaline solution has been investigated by means of potentiometric measurements by employing a lead amalgam electrode at 25 C and in 2 M Na(ClO4).

51
Mercury Contamination of Marine Life in Peru

Bouroncle, C.A.; Echegaray, R.M.; Chang, S.Y.J.; Min. Salud Peru, Peru

Bol. of Sanit. Panamer. (BOSPA8), 74(4), 290-301; 1973

MERCURY; CONTAMINATION; MARINE BIOTA; FISH; SWORDFISH; ANCHOVETA; SALTWATER

GEOGRAPHICAL DESCRIPTION: Peru

52
Kinetics and Mechanism of the Oxidative Chlorination of Acetylene. V. Kinetic Principles of Trans-1, 2-Dichloroethylene and Vinyl Chloride Synthesis in an Aqueous Solution of Copper(II) and Mercury(II) Chloride Complexes

Brailovskii, S.M.; Bruk, L.G.; Kostyushin, A.S.; Temkin, O.N.; Flid, R.M.; Mosk. Inst. Tonkoi Khim. Tekhnol. Lomonosova, Moscow, USSR

Kinet. Katal. (KNKTA8), 14(5), 1222-1227; 1973

CHLORINATION; ACETYLENE; MERCURY; COPPER; CHLORIDE; VINYL CHLORIDE; SYNTHESIS

53
Methylated Forms of Arsenic in the Environment

Braman, R.S.; Foreback, C.C.

Science, 182, 1247-1249; 1973

ARSENIC; DIMETHYLARSINIC ACID; METHYLARSONIC ACID; NATURAL WATERS; BIRDS; EGGSHELLS; SEASHELLS; HUMANS; URINE

Environmental samples were analyzed for arsenate and arsenite ions and the methylarsonic acids in nanogram amounts. Dimethylarsinic acid and methylarsonic acid were found in natural waters, bird eggshells, seashells, and human urine. Dimethylarsinic acid is a major and ubiquitous form of arsenic in the environment. It is particularly involved in biological systems. Methylarsonic acid was found in smaller concentrations, comparatively, a probable consequence of its being an intermediate in the arsenic methylation sequence. The introduction of arsenic compounds into the environment, principally through pesticides, may result in a general increase in their concentrations in water and air because of the bacterial mobilization of all forms of arsenic.

54
Effect of Zinc on Growth and Development of Larvare of the Pacific Oyster, Crassostrea Gigas

Brereton, A.; Lord, R.; Thornton, I.; Webb, J.S.; Appl. Geochem. Res. Group, Imp. Coll. Sci. Technol., London, Engl.

Mar. Biol. (MBIOAM), 19(2), 96-101; 1973

OYSTERS; ZINC; TOXICITY; GROWTH

TAXONOMY: CRASSOSTREA GIGAS

Exposure of C. Gigas larvae in the lab to 125-500 mu g inc/l., supplied as zinc sulfate, or as zn-rich mine water, for 5 days resulted in growth inhibition, morphol. and developmental abnormalities, und mortality. The severity of the effects increased with increasing zn concn. no effect was shown by 50 mu g zn/l.

55
A Select Bibliography on Pollution of Estuaries and Coastal Waters with Particular Regard to Industrail Effluents

Brinn, D.G.

NTIS PB-212 215; 1972, August

BIBLIOGRAPHY; ESTUARIES; COASTAL WATERS; INDUSTRY; EFFLUENTS

56
Determination of Molecular Hydrocyanic Acid in Water and Studies of the Chemistry and Toxicity to Fish of Metal-Cyanide Complexes

Broderius, S.J.; Oregon State Univ., Corvallis, OR

Univ. Microfilms, Ann Arbor, MI, Order No. 73-21, 299, Diss. Abstr. Int. B 34(3), 1018; 1973

HYDROCYANIC ACID; WATER; TOXICITY; FISH; COMPLEXES; CYANIDE

57
Agents for Combating and Hindering Growth of Algae and Microorganisms in Aqueous Systems

Brost, H.R.; Hentschel, C.; Wacker, H.; Bayer, A.G.

Ger. Offen. (GWXXBX) 2131029 (A 61L, C 07C, A 01N), 11pp.; 1971, June 23

BENZALKONIUM RESIN; ALGAE; INHIBITION; COPPER; BACTERIA; ALGICIDES; BACTERIACIDES

58
Frequency of Fish Tumors Found in a Polluted Watershed as Compared to Nonpolluted Canadian Waters

Brown, E.R.; Hazdra, J.J.; Keith, L.; Greenspan, I.; Kwapinski, J.B.G.; Beamer, P.; Departments of Microbiology (E.R.B.), Obstetrics and Gynecology (L.K.), and Iatnology (P.B.), The Chicago Medical School/University of Health Sciences, Chicago, IL 60612; Department of Chemistry and Biochemistry, Illinois-Benedictine College, Lisle, IL 60532 (J.J.H.); and Department of Medical Microbiology, University of Manitoba, School of Medicine, Winnipeg, Manitoba, Canada (J.B.G.K.)

Cancer Research, 33(2), 189-198; 1973, February

FISH; TUMORS; WATER; CONTAMINATION; MERCURY; LEAD; ARSENIC; TOLUENE; BENZANTHRACENE; CRUDE OIL; CHLORINATED HYDROCARBONS; GASOLINE; PHOSPHATE; SULFATES; COLIFORM BACTERIA; TEMPERATURE; DISSOLVED OXYGEN; NUTRIENTS

Data are presented on the incidence of tumors found in 2121 fish examined from the Fox River watershed (8.38%) as compared to 4639 fish examined in Canada (1.03%). The water systems were compared as to pollution potentials, and the Fox River was found to be a highly polluted system. Among the pollutants found were mercury, lead, arsenic, toluene, crude oil, gasoline, benzanthracene, chlorinated hydrocarbons, phosphates, sulfates, and coliform bacteria. Factors such as dissolved oxygen content, temperature, and nutritional variation were considered similar in both water systems. It is concluded that these pollutants were responsible for the greater frequency of tumors. No attempts were made to determine the effects of pollution on the long-term human users of the water or to determine the virus contents of the water system under study. Plans are now being made to study the water system under study. Plans are now being made to study the waters for fish viruses and, incidently, those enteric viruses that one might expect in a river system that is termed "a floating sewer."

59
Efficiency of Heavy Metals Removal in Municipal Sewage Treatment Plants

Brown, K.G.; Hensley, C.P.; McKinney, G.L.; Robinson, J.L.

Environ. Letters, 5(2), 103; 1973

SEWAGE TREATMENT; HEAVY METALS REMOVAL; SLUDGE; DIGESTION; FILTRATION; CERIUM; COPPER; LEAD; CHROMIUM; ZINC; HEAVY METALS

From January to July 1972, six municipal sewage treatment plants were routinely monitored for the efficiency of heavy metals removal. The municipalities served ranged from small agricultural communities to an industrialized city. Four basic plant types were studied: (1) primary with sludge digestion; (2) primary with sludge filtration; (3) trickling filter with sludge digestion; (4) activated sludge with sludge digestion; Ce, Cu, and Pb were more efficiently removed in secondary than in primary. Cr is reduced during aeration. Cu is strongly adsorbed by microbial floc. Pb is removed efficiently due to increased settling time and larger particle size in the secondary treatment. Zn is equally efficiently removed by all plant types. Increased suspended solids removal yields an exponentially increased metals removal.

60
Acute and Long-Term Accumulation of Copper by the Brown Bullhead, Ictalurus Nebulosus

Brungs, W.A.; Leonard, E.N.; McKim, J.M.; Natl. Water Qual. Lab., U.S. Environ. Prot. Agency, Duluth, Minn.

J. Fish. Res. Board Can. (JFRBAK), 30(4), 583-6; 1973

COPPER; BIOACCUMULATION; BULLHEAD; FISH

TAXONOMY: ICTALURUS NEBULOSUS

Cu concns. in gill, opercle, liver, and kidney tissues of live brown bullhead (I. Nebulosus) fish exposed to const. concns. of 6.5-822 mu g copper sulfate/l. did not differ from those that died during the acute exposure. Exposure of the fish to sublethal concns. for 20 days before exposure to lethal concns. resulted in higher tissue cu levels in the dead fish than in fish not previously exposed. There was a distinct increase in liver and gill tissue cu concns. at exposure levels geq. 27 mu g/l. Equil. tissue levels of cu in the liver and gill were reached within 30 days. Cu levels in red blood cells and plasma after 20 months exposure did not differ from the controls.

61
Trace Elements in Ancient Atlantic Deep-Sea Sediments

Bruty, D.; Chester, R.; Aston, S.R.; Dep. Oceanogr., Univ. Liverp., Liverpool, England

Nature (London), Phys. Sci. (NPSCA6), 245(144), 73-74; 1973

TRACE ELEMENTS; SEDIMENTS; CLAYS; ZEOLITE

62
Brown Seaweed as an Indicator of Heavy Metals in Estuaries in Southwest England

Bryan, G.W.; Hummerstone, L.G.; Plymouth Lab., Plymouth, England

J. Mar. Biol. Ass. U.K. (JMBAAK), 53(3), 705-720; 1973

METALS; SEAWEEDS; WATER; FUCUS; ALGAE; ESTUARIES; BIOINDICATOR

63
Contamination of Soil and Vegetation Near a Zinc Smelter by Zinc, Cadmium, Copper, and Lead

Buchauer, M.J.; Institute of Microbiology, Rutgers--The State University, New Brunswick, N.J. 08903

Environ. Sci. Technol., 7(2), 131-135; 1973

SOILS; VEGETATION; PLANTS; METALS; SMELTERS; ZINC; LEAD; COPPER; CADMIUM; OXYGEN; AEROSOLS; ATMOSPHERE

Metal oxide fumes escaping from two zinc smelters in Palmerton, Pa, have contaminated soil and vegetation with zinc, cadmium, copper and lead. Within 1 km of the smelters, 135,000 ppm zinc, 1750 ppm cadmium, 2000 ppm copper and 2000 ppm lead have been measured in the 02 horizon. Approximately 90% of metals deposited on the soil surface have been retained in the top 15 cm of the soil profile. Depauperate trees within 2 km of the smelters contained up to 8500 ppm zinc and 70 ppm cadmium by weight in washed, oven-dried foliage. Metal aerosols may enter the leaves directly, presumably through open stomates.

64
Device for Demonstrating the Interaction of Metals with Water Vapor

Bulavin, V.I.; Pedagog. Inst., Arzamas, USSR

Khim. Shk. (KHSHAY), (3) 69; 1973

METALS; WATER; INTERACTIONS

65
Metal Dynamics in Municipal Stabilization Ponds

Bulthuis, D.A.; Craig, J.R.; McNabb, C.D.

Part of Hemphill, D.D. (Ed.), Seventh Annual Conference on Trace Substances in Environmental Health, Held at Memorial Union, University of Missouri-Columbia, Columbia, MO, June 12-14, 1973; 1973

SEDIMENTS; AQUATIC VASCULAR PLANTS; STABILIZATION PONDS; BIOMASS; CHROMIUM; COPPER; IRON; MANGANESE; ZINC; CADMIUM; COBALT; NICKEL; ABSORPTION; SEDIMENTATION; AEROBIC PONDS; ALGAE; MACROPHYTES; ANAEROBIC PONDS; FACULTATIVE PONDS; HYDROPHYTES; EFFLUENTS; PERCOLATION; PLANTS; COONTAIL; DUCKWEED; MUNICIPAL WASTE TREATMENT; SEASONAL VARIATIONS; SINKS; WASTEWATER; CONCENTRATION; SINKS

Sediments and aquatic vascular plants are potential sinks for contaminating elements in stabilization ponds as they are operated in Michigan. The accumulation of several heavy metals in these sinks was studied during the growing season in an existing series of stabilization ponds. Using inflow and outflow data, an approximation of the accrual was made for each element in bottom sediments. Biomass estimates of the hydrophyte communities were used to determine the quantities of metals removable from a system by harvest of a season's crop. The ambient concentrations of chromium, copper, iron, manganese and zinc were reduced in the ponds through accumulation in these sinks. The ambient concentrations of cadmium, cobalt, and nickel were not reduced in the ponds. Estimates were made of the relative efficiencies of removal by plant absorption and by sedimentation in aerobic ponds during the growing season. Plant absorption was more efficient than sedimentation for chromium, copper, and zinc. Sedimentation and aquatic plants were equally inefficient for removal of cadmium, cobalt, and nickel. These moved through facultative and aerobic ponds without reduction.

66
Effect of Some Trace Elements on the Development of the Alga SCENEDESMUS QUADRICAUDA

Rumhu, Y.V.; Mokryak, A.S.; USSR

Izv. Akad, Nauk Mold. SSR, Ser. Biol. Khim. Nauk (IMBKB6), (1), 82-83; 1973

LITHIUM; CADMIUM; NICKEL; BICARBONATE; ZINC; TRACE ELEMENTS; ALGAE; DEVELOPMENT

TAXONOMY: SCENEDESMUS QUADRICAUDA

Algae were grown in media containing Li, Ni, Cd, and Zn salts at 23-26, 2000-2500 lux. After 3 months pH of the medium, concentration of HCO3-, and the amount of biomass were determined. Lithium (plus) in low concentration (0.01 mg/l.) stimulated algal growth while higher concentrations (0.1/mg/l.) reduced growth of the algae. Zn and Cd ions in concentrations of 0.05-0.5 mg/l. inhibited growth of the alga. Inhibition of growth was accompanied by a decrease of HCO3-concentration.

67
Kinetics of Aquation of Chloro- and (Thiocyanato) Chromium (III) Complexes in Mixed Aqueous Solvents

Burgess, J.; Chem. Dep., Univ. Leicester, Leicester, Engl.

J. Chem. Soc., Dalton Trans. (JCDTBT), (8), 825-828; 1973

KINETICS; AQUATION; CHROMIUM; COMPLEXES; THIOCYANATO; CHLORINE

Rate constants are reported fro spontaneous thermal aquation of the complexes (Cr(NH3)5Cl)2+, cis-(Cr(en)2Cl2)+ (en=ethylenediamine), trans-(Cr(OH2)4Cl2)+, and (Cr(NCS)6)3- in a range of solvents, including methanol-, ethanol-, acetone-, dioxan-, and t-butyl alcohol-water binary mixtures. These results, and previously published results on similar chromium (III) complexes, are discussed in terms of the Grunwald-Winstein treatment of solvolyses in mixed aqueous solvents. Although this empirical approach can usefully be employed in discussing the aquation of chlorochromium(III) complexes, its extension to thiocyanatochromium (III) complexes does not seem profitable.

68
Distribution Patterns for Some Particulate and Dissolved Trace Metals within an Active Glacial Fiord

Burrell, D.C.

Part of Radioactive Contamination of the Marine Environment, Proceedings of Symposium held by the International Atomic Energy Agency, Seattle, WA July 10-18, 1972 (89-103) 786p.; 1973

DISTRIBUTION PATTERNS; TRACE METALS; PARTICULATES; GLACIAL FJORD; FLOCCULATION; ZINC; COPPER; LEAD; NICKEL; RUNOFF; SALTWATER; ESTUARIES

The distribution patterns of some trace metals between water and both suspended and deposited sediment has been studied in a non-iceberg fjord-estuary in S.E. Alaska. The hydrography of this type of fjord is such that, during the summer, glacial melt-water runoff enters the marine fjord initially as a concentrated sediment-plume on the surface. This sediment subsequently flocculates and settles through the subhalocline (essentially non-turbulent) portion of the marine column. The soluble zinc content of the glacial fresh water is slightly lower than that of the marine water (around 0.5 and 1.1 microgram per liter respectively), and the total fresh-water particulate zinc (around 65 mg/kg) is predominantly structural. In this environment there appears to be adsorption of zinc across the halocline, and copper, lead and nickel are covariant with iron and the suspended sediment load. The sediment deposition rates in this fjord-type are very high and the sediment texture, composition and chemistry is uniform through the surface metre or so. The organic carbon content is around 0.1% only. The interstitial water contents of both zinc and copper approximate those in the overlying water.

69
Studies on Uptake of Methylmercury-203 by Bluegills (Lepomis macrochirus)

Burrows, W.D.; Krenkel, P.A.; Associated Water and Air Resources Engineers, Inc., Nashville, TN 37204//Environmental and Water Resources Engineering Porgram, Nashville, TN 37235

Env. Sci. Technol., 7(13), 1127-1130; 1973

TRACERS; HALF-TIME; BLUEGILLS; UPTAKE; METHYLMERCURY; RADIONUCLIDES; LIVER; KIDNEYS; MERCURY 203; MERCURY

TAXONOMY: LEPOMIS MACROCHIRUS

The uptake of methylmercury-203 directly from water by bluegills was found to be nearly constant after five days at about 20% per gram of fish per liter of water. Transferred to mercury-free water at 24 degrees C, bluegills exhibited a rapid loss of about 40% of the mercury, followed by a slow loss iwth a half-time of about five months. Mercury levels in the liver and kidneys were two to seven times higher than whole fish levels, but there was no discernible trend in this ratio with time. The proportion of mercury present as methylmercury in the whole fish remained at 73+/-10% throughout the course of the experiment. The proportion of methylmercury in the liver and kidneys, however, fell rapidly in the first few weeks after exposure, ultimately leveling off at about 10%. This suggests that biochemical demethylation is taking place in these organs.

70
Continuous Culture of Rhodotorula rubra. Kinetics of Phosphate Arsenate Uptake, Inhibition, and Posphate-Limited Growth

Button, D.K.; Dunker, S.S.; Morse, M.L.; Inst. Mar. Scil. Univ. Alaska, College, Alaska

J. Bacteriol. (JOBAAY) 113(2), 599-611; 1973

PHOSPHATE; TRANSPORT; KINETICS; ARSENATES; UPTAKE; GROWTH INHIBITION; CONTINUOUS CULTURE; PH

TAXONOMY: RHODOTORULA RUBRA

The pink yeast RHODOTORULA ROBRA of marine origin was found to capable of extended growth at very low phosphate concentrations (K 0.5 = 10.8 nM). Average intracellular phosphate concentrations, based on isotope exchange techniques, were 15 to 200 mM. giving concentration gradients across the cell envelope of about 106. Sensitivity to metabolic inhibitors occurred at micromolar concentrations. Inability of the phosphate transport system, KS = 0.5 to 2.8MM, V max = 55 M moles per g of cells per min, to discriminate against arsenate transport led to arsenate toxicity at 1 to 10 nM, whereas environmental arsenate levels are reportedly much higher. Phosphate competitively prevented arsenate toxicity. The KI for phosphate inhibition of arsenate uptake was 0.7 to 1.2 MM. Phosphate uptake experiments showed that maximal growth rates could be achieved with approximately 4% of the total phosphate -arsenate transport system. Organisms adapted to a range both of concentration of NaCl and of pH. Maximal affinity for phosphate occurred at pH 4 and at low concentrations of NaCl; however, V max for phosphate transport was little affected. Maximal specific growth rates on minimal medium were consistent in batch culture but gradually increased to the much higher rates found with yeast extract media when the population was subjected to long-term continuous culture with gradually increasing dilution rates. Phosphate initial uptake rates that were in agreement with steady-state flux in continuous culture were obtained by using organisms and medium directly from continuous culture were obtained by using organisms and medium directly from continuous culture. This procedure resulted in rates about 500 times greater than one in which harvested batch-grown cells were used. Discrepancies between values found and those reported in the literature for other organisms were even larger. Growth could not be sustained below a threshold phosphate concentration of 3.4 nM. Such thresholds are explained in terms of a system where growth rate is set by intracellular nutrient concentrations. Threshold concentrations occur in response to nutrient sinks not realted to growth, such as efflux and endogenous metabolism. Equations are presented for evaluation of growth rate-limiting substrate concentrations in the presence of background substrate and for evaluating low inhibitor concentration inhibition mechanisms by substrate prevention of inhibitor flux.

71
Removal of Soluble Mercury Residues from Aqueous Process Streams

Cadmus, E.L.; Ventron Corp.

U.S. Patent (USXXAM) 3764528 (210/50; C 02BC), 2pp.; 1971, November

MERCURY; REMOVAL; WATER; RESIDUES; WASTE WATER

72
The Effects of pH, Solubility and Temperature Upon the Acute Toxicity of Zinc to the Bluegill Sunfish (Lepomis macrochirus Raf.)

Cairns, J., Jr.; Mahns, T.K.; Burton, D.T.; Dickson, K.L.; Sparks, R.E.; Waller, W.T.

Kansas Academy of Science, 74(1), 81-92; 1972, January 7

FISH; TOXICITY; PH; SOLUBILITY; TEMPERATURE; ZINC; BIOASSAY; MORTALITY; TLH; LETHAL TOLERANCE MEDIAN

TAXONOMY: LEPOMIS MACROCHIRUS

Bluegill sunfish were exposed for 96 hours under static test conditions to water soluble zinc sulfate hydrate and water insoluble zinc phosphate hydrate at two temperature ranges (21-24 degrees C; 7-9 degrees C) and two pH ranges (6.7-7.0; 7.3-8.0). Control fish were maintained in water containing no zinc. No bluegills died in water containing insoluble zinc in amounts comparable to the amounts of soluble zinc (13.50, 18.00, 24.00, and 32.00 milligrams zinc 2 plus per liter) which produced mortalities of 90 to 100 percent. Bluegill mortalities in concentrations of soluble zinc ranging from 10 to 32 milligrams zinc 2 plus per liter were 0 to 10 percent at the high pH, while at the low pH mortalities were 100 percent. Bluegills at the low temperatures died at a much slower rate, and the time-to-death of the first fish was considerably delayed, in comparison to bluegills at the warmer temperature. Continuous flow bioassay tests in which two types of test containers were used showed differences in 96-hour TLM values. The particle replacement time in 190 liter bioassay jars was considerably longer than in 1.8-liter plexiglass containers; hence bluegills survived longer in the jars. Ninety-six-hour TLM concentrations for fish exposed to a continuous flow of zinc 2 plus in two types of test containers were estimated in four ways: using statistically pooled measured and calculated concentrations, and by pooling calculated and measured concentrations on the basis of the nominal concentrations alone. There were small differences in the resulting TLM values, a result which should be of interest to other workers using bioassays.

73
Rapid Biological Monitoring System for Determining Aquatic Community Structure in Receiving Systems

Cairns, J., Jr.; Dickson, K.L.; Lanza, G.

Part of Biological Methods for the Assessment of Water Quality, ASTM STP 528, American Society for Testing and Materials, 1973, pp. 148-163

WATER; LASERS; HOLOGRAPHY; AQUATIC BIOLOGY; ENVIRONMENTAL SURVEYS; MONITORS; ANALYSIS; SPECIES DIVERSITY; SAPROBIC SYSTEM; COMPARISON INDEX; COMMUNITY STRUCTURE ANALYSIS

Biological monitoring plays an important role in a pollution monitoring program providing information not available through conventional physical and chemical monitoring. The saprobic system and the use of structural and functional changes in aquatic communities are two approaches utilized in assessing the effects of pollutants on aquatic communities. The feedback of information from conventional instream biological monitoring has been too slow for the most effective management of an aquatic system. Two rapid biological monitoring systems (the SEQUENTIAL COMPARISON INDEX, and an automated community structure analysis using laser holography) have been developed to increase the speed of data collection and data analysis.

74
The Development of an Automated Biological Monitoring System for Water Quality Management

Cairns, J., Jr.; Hall, J.W.; Morgan, E.L.; Sparks, R.E.; Waller, W.T.; Westlake, G.F.

Part of Hemphill, D.D. (Ed.), Seventh Annual Conference on Trace Substances in Environmental Health, Held at Memorial Union, University of Missouri-Columbia, Columbia, MO, June 12-14, 1973; 1973

RESPIRATION; FISH; BLUEGILLS; ZINC; BEHAVIOR; CHLORINE; WATER QUALITY; WATER; BIOLOGICAL MONITORING; MONITORING; AQUATIC ECOSYSTEMS

The time has come to go beyond merely responding to one environmental crisis after another and to manage all ecosystems on a regional basis. Proper management will insure that benefits are optimized and that each system serves a variety of uses. Management of aquatic ecosystems requires a clear understanding of the goals to be achieved, appropriate information and the means to achieve the goals. Control measures applied to aquatic ecosystems, in the absence of information on the condition of the system, are apt to be inappropriate and thus may overprotect the receiving system at times and underprotect it at other times since the ability of ecosystems to receive wastes is not constant. A major determinant of the effectiveness and efficiency of ecological quality control is the lag time in the feedback of information. If the lag is too great, the control measures may repeatedly overshoot or undershoot the desired goal. Present techniques for measuring the responses of aquatic organisms and communities require days or weeks, whereas information for ecosystem quality control and prevention of ecological crises should be generated in minutes or hours as is the case for other quality control systems. A biological monitoring system has been developed to generate information rapidly. The system measured changes in the movement and breathing of fish in order to provide an early warning of developing toxicity in the wastes of an industrial plant. The method of automation of data collection from this sytem and its development into an "on-line" system for monitoring water quality is described. The special statistical techniques necessary for analyzing this data is able to detect low concentration of zinc and other toxicants and that the responses are sufficiently rapid to make the system useful for water quality management.

75

75
The Design of a Continuous Flow Biological Early Warning System for Industrial Use

Cairns, J., Jr.; Sparks, R.E.; Waller, W.T.

Presented at the 27th Purdue Industrial Waste Conference, May 2-4, 1972 at Purdue University - to be published in the Purdue University Engineering Bulletin, 21 p. plus table and figures; 1972

GOALS; AQUATIC ECOSYSTEMS; FEEDBACK; LAG; CONTROL MEASURES; BIOLOGICAL MONITORING; MOVEMENT; BREATHING; FISH; EARLY WARNING; TOXICITY; INDUSTRIAL WASTES; RESPONSE TIME; POLYGRAPH; TOXICANT; BLUEGILLS; DIURNAL VARIATION; ZINC SULFATE; STRESS DETECTION

The time has come to go beyond merely responding to one environmental crisis after another and to manage all ecosystems on a regional basis. Proper management will insure that benefits are optimized and that each system serves a variety of uses. Management of aquatic ecosystems requires a clear understanding of the goals to be achieved, appropriate information and the means to achieve the goals. Control measures applied to aquatic ecosystems, in the absence of information on the condition of the system, are apt to be inappropriate and thus may overprotect the receiving system at times and underprotect it at other times since the ability of ecosystems to receive wastes is not constant. A major determinant of the effectiveness and efficiency of ecological quality control is the lag time in the feedback of information. If the lag is too great, the control measures may repeatedly overshoot or undershoot the desired goal. Present techniques for measuring the responses of aquatic organisms and communities require days of weeks, whereas information for ecosystem quality control and prevention of ecological crises should be generated in minutes or hours as is the case for other quality control systems. A biological monitoring system has been developed to generate information rapidly. The system measures changes in the movement and breathing of fish in order to provide an early warning of developing toxicity in the wastes of an industrial plant.

76
Use of Fish as Sensors in Industrial Waste Lines to prevent Fish Kills

Cairns, J., Jr.; Sparks, R.E.; Waller, W.T.; Dep. Biol., Virginia Polytech. Inst., Blacksburg, VA

Hydrobiologia (HYDRB8) 1973, 81(2), 151-67; 1973

ZINC; TOXICITY; FISH; INDUSTRIAL WASTES; FISH KILLS

Paper suggests a method of detecting stress in fish used for monitoring. The breathing rate of fish exposed in test areas was detected by platinum electrodes in the water and connected to a computer which flashed a warning when the breathing rate sufficiently exceeded normal values for the time of day. The environment of the fish could then be changed so that they survived after giving the warning in this way. Fish movements might also be used. Various details are given to modify the criteria for fast or slow acting, reversible or irreversible poisons. In this way, the actual biological stress is measured.

77
Relation Between Continuous Biological Monitoring and Water Quality Standards for Chronic Exposure

Cairns, J., Jr.; Sparks, R.E.; Waller, W.T.; Cent. Environ. Stud., Virginia Polytech. Inst., Blacksburg, VA

Bioassay Tech. Environ. Chem. 383-402; 1973

FISH; ZINC; WATER QUALITY STANDARDS; CHRONIC EXPOSURES; BIOLOGICAL MONITORING; WATER

Bluegill sunfish detected potentially lethal zinc (7440-66-6) concns. (8 mg/l.), and also sublethal concns. (2-3 mg/l.), in their environment rapidly enough to survive if the Zn was removed at the time of detection. Monitoring systems for fish movement patterns, using light beam interruption, and for fish breathing, using polygraphy recordings, were used to detect the stress responses of the fish to Zn exposure. A reproduction study showed, however, that 0.235 mg/l. (1/10 the lowest concn. used to monitor breathing) was not safe for chronic exposure. Both systems may be plausible for detecting acutely toxic conditions resulting from industrial or municipal spills. Both systems should be used in conjunction to prevent monitor failure due to the effects of excessive turbidity on movement monitors, and of excess electrolyte concn. on breathing monitors.

78
Incorporation of Radiostrontium by Marine Organisms

Cancio, D.; Llauro, J.A.; Ciallella, M.R.; Beninson, D.J.

Part of Radioactive Contamination of the Marine Environment, Proceedings of Symposium held by the International Atomic Energy Agency, Seattle, WA, July 10-14, 1972 (347-357), 786 p.; 1973

STRONTIUM; CALCIUM; FISH; TRACERS; CRUSTACEA; COASTAL WATERS; MOLLUSCS; DISCRIMINATION FACTORS

TAXONOMY: MICROPOGON OPERCULARIS

Determination of the discrimination factors for strontium and calcium and of the corresponding strontium concentration factors aretdiscussed. Results of laboratory experiments using double tracer techniques and of determinations based on systematic measurements of stable strontium and calcium are presented The organisms studied are common along the Atlantic coastline of Argentina and consist of various species of fish, crustaceans, molluscs and marine algae. From the laboratory experiments it is concluded that, with the double tracer technique, it is possible to determine the discriminate against strontium; the discrimination factor values fluctuation between 0.10 and 0.92 depending on the species in question. In the cases of fish (MICROPOGON OPERCULARIS) and crustaceae (including exoskeleton) it was found that the Sr/Ca ratios were the same throughout the animal. In the case of the molluscs, different values were obtained for the shells and the soft parts. In general, discrimination factors obtained in the field on the basis of stable strontium and calcium determinations agree reasonably well with the values obtained in the laboratory for the fish and mollusc species in question, but are lower for the crustacean and algal species. Obtaining the concentration factors from discrimination parameters has the advantage of representing limiting situations where the equilibrium state is ensured. In this way, the experimental results can be extrapolated to natural conditions with less uncertainty. The resulting strontium concentration factors fluctuate between 2 and 10 for fish, 13 and 70 for crustaceans and molluscs, and 0.2 and 70 for algae.

79
Mercury Pollution of Fish and Other Food Products

Canuti, A.; Lab. Chim. Prov., Cremona, Italy

Ind. Aliment. (Pinerolo, Italy)(INALBB), 12(9), 109-111; 1973

REVIEW; MERCURY; FOOD; FISH

80
Study of the Role of Scirpus Americanus in Depolluting Waters Contaminated with Heavy Metals

Carbonneau, M.; Tremblay, J-L.; Dept. Biol., Univ. Laval, Quebec 10E, Que., Can.)

Nat. Can. (Que) 99(5), 1972 (Recd. 1973) 523-532; 1972

MERCURY; LEAD; CADMIUM; HEAVY METALS; BIOACCUMULATION; PLANTS; WATER; DEPOLLUTING AGENTS

TAXONOMY: CYPERACEAE; SCIRPUS AMERICANUS; ELEOCHARIS SMALLII; BIDENS CERNUA

The capacity for S. AMERICANUS, a Cyperaceae, to concentrate the heavy metals, mercury, lead and cadmium, from its environment was studied. This plant has the capacity to act as a natural depolluting agent. Two other plants which may do the same: ELEOCHARIS SMALLII Britt. and BIDENS CERNUA L. were also studied.

81
Zinc-65 Specific Activities from Oregon and Washington Continental Shelf Sediments and Benthic Invertebrate Fauna

Carey, A.G., Jr.; Cutshall, N.H.

Part of Radioactive Contamination of the Marine Environment, Proceedings of Symposium held by the International Atomic Energy Agency, Seattle, WA, July 10-14, 1972 (307-329) 786 p.; 1973

ZINC; ZINC 65; SPECIFIC ACTIVITY; SEDIMENTS; BENTHOS; INVERTEBRATES; COASTAL WATERS; POWER REACTORS; FAUNA

Relationships between the benthic fauna and sediments on the continental shelf of Oregon and Washington have been investigated by determining specific activities of zinc-65. Zinc-65, induced by neutron activation in Columbia River water used to cool plutonium production reactors at Richland, Washington, was carried down the river and into the marine environment. Sediment from the Columbia River moves northward. Zinc-65 specific activities in sediment and benthic invertebrates decrease northward with distance from the river and westward with depth have higher zinc-65 specific activities than the sediments in, or on which they live. Other sources of zinc-65 via the food web are suspected as the cause for the difference in specific activity between the sediment and benthic fauna. Long-term decline in zinc-65 specific activities have been noted. Many species from a range of trophic levels have been included in the study.

82
Trace Metals in Sediments of New York Bight

Carmody, D.J.; Pearce, J.B.; Yasso, W.E.; Dep. Chem., Westchester Community Coll., Valhalla, NY

Mar. Pollut. Bull. (MPNBAZ), 4(9), 132-135; 1973

SEDIMENTS; WATER; TRACE METALS; COASTAL WATERS

GEOGRAPHICAL DESCRIPTION: U.S., New York (Coast)

83
Mercury in the Greenland Ice Sheet: Further Data

Carr, P.A.; Wilkniss, P.E.; U.S. Naval Research Laboratory, Washington, DC 20375

Science 181, 843; 1973

MERCURY; ICE SHEET; DISTRIBUTION

New data support the contention that the mercury content of Greenland glacial ices has not increased dramatically in recent years but rather is distributed nonhomogeneously through the ice sheet.

84
Mercury. Short-Term Storage of Natural Waters

Carr, R.A.; Wilkniss, P.E.; Nav. Res. Lab., Washington, DC

Environ. Sci. Technol. (ESTHAG) 1973, 7(1), 62-3; 1973

MERCURY; WATER; STORAGE; LOSS; VAPORIZATION;

Analysis of natural waters for mercury requires an understanding of changes occurring during storage, such as losses to container walls, association with particulate phases, and vaporization. Use of carrier-free Hg-197 and improved flameless atomic absorption techniques show negligible losses to sample containers upon 9-day storage at pH 1. At the time of sampling, 80% of the total mercury was associated with particulates, while at the end of the storage period only 10-15% was associated with particulates. No vaporization losses were observed under these conditions.

85
Toxicity Bioassay of Heavy Metals in Water Using Tetrahymena pyriformis

Carter, J.W.; Cameron, I.L.; Med. Sch., Univ. Texas, San Antonio, TX

Water Res. (WATRAG) 7(7), 951-961; 1973

HEAVY METALS; PROTOZOA; TOXICITY; CADMIUM; SULFATES; COBALT; ZINC

TAXONOMY: TETRAHYMENA PYRIFORMIS

On a weight basis, cadmium sulfate was most toxic to the ciliated protozoan TETRAHYMENA PYRIFORMIS, followed in decreasing order by mercuric chloride, cobalt sulfate, zinc sulfate, and lead nitrate PB(NO3) 2 was 7-fold more toxic in soft water (20 MG CACO3/L.) than in hard water (500 MG CACO3/L.); an antagonistic calcium carbonate effect. HGCL2 was 2-fold more toxic in hard than in soft water; a synergistic CACO3 effect. T. PYRIFORMIS may be a more sensitive indicator of heavy metal contamination in water than fish.

86
Effect of Sodium Arsenite on Glucose-U-14C and Aspartate-U-14C Metabolism in PHASEOLUS VULGARIS

Cavalie, G.; Cent. Physiol. Veg., Univ. Paul-Sabatier, Toulouse, FR

C.R. Acad. Sci., Ser. D(CHDDAT), 277(18) 1877-1880

SODIUM; SODIUM ARSENITE; GLUCOSE; CARBON 14; ASPARTATE; METABOLISM

TAXONOMY: PHASEOLUS VULGARIS

87
Cadmium Toxicity and Accumulation in Southern Naiad

Cearley, J.E.; Coleman, R.L.; Department of Environmental Health, University of Oklahoma Health Sciences Center, Oklahoma City, Okla. 73190

Bulletin of Environmental Contamination and Toxicology 9(2), 100-101; 1973

TOXICITY; NAIAD; CADMIUM; BIOACCUMULATION; PHYSIOLOGY; RATE INHIBITION; AQUATIC PLANTS

Toxic reactions and cadmium accumulation in NAJAS QUADALUPENSIS Spreng. (a pondweed) increased as the exposure levels increased, which suggested that (a) cadmium accumulation, ca.1000 fold, was direct function of the exposure level, and that (b) the detoxifying mechanism was overtaxed at a more rapid rate at the higher levels resulting in an earlier impairment of physiological function. This physiological impairment resulted in the inhibition of additional cadmium accumulation at the higher levels; significant additional accumulation and only slight toxic effects at the lower levels suggested that tissue damage was not sufficient to significantly inhibit further cadmium accumulation. Thus, it is evident that this common aquatic plant is capable of introducing potentially toxic quantities of cadmium into the food of higher organisms, e.g. sunfish and waterfowl.

88
Conservation Problems in the Metal-Finishing Industry

Chalmers, R.K.; Bostock Hill and Rigby Ltd., Birmingham, England

Chem. Ind. (London)(CHINAG), (12), 556-557; 1973

REVIEW; METAL FINISHING; EFFLUENTS; WASTE WATER; CONSERVATION

89
Complexing Properties of Nitrilo Tri Acetic-Acid in the Lake Environment

Chau, Y.K.; Shiomi, M.T.

Water, Air, Soil Pollut., 1(2), 189-168; 1972

NITRILOTRIACETICACID; COPPER; NICKEL; CADMIUM; MERCURY; CHELATES; LAKES

At concentrations above 1 ppm NTA can react with sparingly soluble compounds to release the metal and associated anions through complexation. It also interacts with sediment to release certain metals depending on the abundance of the metals in the sediment. In situ and laboratory experiments have been carried out to study such interactions and also to follow the fate of these released metals after NTA has degraded. Degradation of certain NTA-metal complexes in lake water medium has also been studied. It was found that certain NTA complexes (Cu, Ni, Cd, Hg) are very resistent to degradation.

90
Effect of Chelating Agents on Chromium Absorption in Rats

Chen, W.S.; Tsai, A.; Dyer, I.A.; Anim. Sci. Dep., Washington State Univ., Pullman, Washington

J. Nutr. (JONUAI), 103(8), 1182-1186; 1973

CHROMIUM; ABSORPTION; INTESTINES; CHELATION; PHYTATE; OXALATE; EDTA; CITRATE

The effect of chelating agents on chromium absorption by rats was measured in vitro and in vivo. Four chelating agents: oxalate, phytate, citrate, and EDTA were used to determine their effect on chromium transport through the rat intestine in vitro. Oxalate significantly increased and phytate significantly decreased chromium transport through the rat intestine, while the other two chelating agents showed no significant effect. In an in vivo study oxalate and phytate had the same effects on trivalent chromium absorption in rats as that observed in vitro. The midsection of the rat intestine appears to be in the most diffusible segment for chromium, followed by the ileum and duodenum. Under in vitro conditions, ^{51}Cr is also more highly absorbed in the midsection than in either of the other two segments. Fasted rats absorb chromium at a significantly faster rate than nonfasted ones.

91
Effect of Copper on the Heart Rate of BIOMPHALARIA GLABRATA (Mollusca: Pulmonata)

Cheng, T.C.; Sullivan, J.T.; Inst. Pathobiol., Lehigh Univ., Bethlehem, PA

Comp. Gen. Pharmacol. 4(13), 38-8; 1973

SNAILS; COPPER; HEART RATE; MOLLUSCICIDES; BIOASSAY

TAXONOMY; BIOMPHALARIA GLABRATA; MOLLUSCA PULMONATA

Copper sulfate,, which has long been used as a molluscicide, decreased the heart rate of B. GLABRATA when present in concentrations that produce the so-called distress syndrome. The effect was maximal at all concentrations above 1 ppm copper, but was proportional to concentration below this. The decreased heart rate could be due either to the toxic effect of Cu or the retraction of the snail into its shell under these conditions,but was probably a combination of both. Nevertheless, the sensitivity of the B. GLABRATA heart rate to Cu may be of some value in the bioassay of potential molluscicides.

92
Cadmium, Chromium, Lead, and Mercury- Plenary Account for Water Pollution. I. Occurence, Toxicity, and Detection

Cheremisinoff, P.; Habib, Y.

Water Sewage Works- 119(7), 73-74 78- 80-86; 1972

CADMIUM; CHROMIUM; LEAD; MERCURY; WATER; PUBLIC WATER SUPPLIES; WASTES; EFFLUENTS; FISH; DRINKING WATER; STANDARDS; SALMICIDES; SYNERGISM; CONCENTRATION; LETHAL LIMIT; TOXIGRAMS; TOXICITY; GILLS; INTAKE; POISONING; ACUTE; METHYLMERCURY; METHYLATION; BRAIN; SYMPTOMS; PREGNANCY; FETUS; BIOLOGICAL HALF-LIFE; ATOMIC ABSROPRITON SPECTROPHOTOMETRY; COLORIMETRY; POLAROGRAPHY; NEUTRON ACTIVATION ANALYSIS; PRECONCENTRATION; ELECTROPLATIN WASTES; COOLING TOWER BLOW DOWN WATER; PIGMENTS; PAINTS; CHLOR-ALKALI PLANTS; CORROSION INHIBITORS; TETRAETHYL LEAD; BATTERIES

Considerable interest in currently being shown in heavy metals concentration in the nation's surface waters, and particularly as they occur in water sources and waste effluents. (See Water & Sewage Works, pp 174-175, June 1971). In a U.S. Geological Survey Report mandatory maximum cocentrations for public water supplies were determined from seven metals (mercury, arsenic cadmium, lead, chromium cobalt, zinc). According to the report, small amounts of these metals are widely distributed in streams and lakes throughout the United States. For four of these metals (cadmium, chromium lead and mercury), four of the seven metals in the report are particularly significant because of widespread industrial use, possible frequent occurrence in waste stream effluents and their toxicity. A plenary account of these four metals, cadmium, chromium, lead and mercury, in respect to water pollution follows. The discussion includes information on I-Nature, sources and use, II-Toxicity and toxic effects, III-Analytic methods for detection and IV-Removal techniques.

93
Mercury in Some Surface Waters of the World Ocean

Chester, R.; Gardner, D.; Riley, J.P.; Stoner, J.; Dep. Oceanogr., Univ. Liverpool, Liverpool, England

Mar. Pollut. Bull. (MPNBAZ), 4(2), 28-29; 1973

MERCURY; SALTWATER; SURFACE WATERS

94
Mercury Pollution of Basse-Seine (From Recq to Tancarville)

Chesterikoff, A.; Carru, A.M.; Garban, B.; Ollivon, D.; Chesterikoff, C.; Lab. Chim. Anal., Inst. Hydrol. Climatol., Paris, FR

Trib. Cebedeau (Cent. Belge Etude Doc. Eaux Air) (TCEDAA), 26(355-356), 269-276; 1973

MERCURY; WATER; RIVERS

GEOGRAPHICAL DESCRIPTION: France, Basse-Seine Rivers

95
Kinetic Studies of the Formation, Acid-Catalyzed Solvolysis, and Cupric Ion Displacement of a Zinc Porphyrin in Aqueous Solutions

Cheung, S.K.; Dixon, F.L.; Fleischer, E.B.; Jeter, D.Y.; Krishnamurthy, M.; Chem. Dep., Univ. California, Irvine, CA

Bioinorg. Chem. (BICHBX), 2(4), 281-90; 1973

ZINC; CHELATION; SOLUBLE; PORPHYRIN; COPPER; KINETICS; IONS

The rates of Zn (2 plus) incorporation Zn (2 plus) demetallation, and Cu (2 plus) displacement of Zn (2 plus) in a H2O-sol. porphyrin were investigated. A tetra-sulfonated tetraphenylporphine TPPS was employed in the studies. The rate of Zn (2 plus) incorporation was equal to (k1)(Zn(2 plus)(TPPS) where k1 = 4.76 X 10E-1 ME-1 sec E-1 at 30 degrees; the rate of Zn-TPPS demetallation is equal to kd (Zn-TPPS)-(H plus)2 where kd = 10.9 E-2 sec E-1 at 30 degrees C; the rate of Cu (2 plus) replacement in Zn-TPPS is equal to kCu (Zn-TPPS)(Cu(2 plus)) where kCu = 5.1 X 10E-3 ME-1 sec E-1 at 30 degrees. These rate laws are discussed in terms of the possible mechanisms for the reactions studied.

96
Mercury Content of Oregon Groundfish

Childs, E.A.; Gaffke, J.W.; Dep. Food Sci. Technol., Oregon State Univ., Astoria, OR

NOAA Fish. Bull. (FSYBAY), 71(3), 713-717; 1973

FISH; MERCURY; GROUNDFISH

GEOGRAPHICAL DESCRIPTION: U.S., Oregon (Coast)

97
Exposure of Dogfish Shark Feti to Mercury

Childs, E.A.; Gaffke, J.W.; Crawford, D.L.; Seafoods Laboratory, Department of Food Science and Technology, Oregon State University, Astoria, Ore. 97103

Bull. Env. Contam. Tox. 9(5), 276-280; 1973

DOGFISH SHARK; FETUS; MATERNAL LOAD; MERCURY; BIOACCUMULATION; FISH

TAXONOMY: SQUALUS SUCKLEYI

The relationship of maternal mercury load to fetal mercury was examined in the Pacific spiny dogfish shark (SQUALUS SUCKLEYI) which accumulates mercury IN SITU to concentrations of 0.3-1.2 ppm. The level of mercury in the fetus was significantly lower than in the mother. Maternal muscle samples had a mean mercury content of 0.66 ppm with a range of 0.332-0.999 ppm. Mercury concentrations in the uterine wall were consistently 10% the concentrations in muscle. There was no apparent relationship between the concentration of mercury in the maternal tissue. No fetal sample taken from undamaged uteri contained greater than 0.058 ppm mercury, and no follicle greater than 0.119 ppm mercury. The mean of all follicle samples was 0.048 ppm mercury, and of all fetal samples, 0.024 ppm mercury). These data clearly demonstrate that mercury is not concentrated in S. SUCKLEYI feti IN SITU. The great difference in mercury content of maternal and fetal samples suggests that mercury may be excluded from the fetus.

98
Lead Pollution: Records in California Coastal Sediments

Chow, T.H.; Bruland, K.W.; Bertine, K.; Soutar, A.; Koide, M.; Goldberg, E.D.

Science, 181 (4099), 551-552; 1973, August 10

LEAD; WATER; SEDIMENTS; AUTOMOBILE; EMISSIONS; MASS SPECTROMETRY; ATOMIC ABSORPTION SPECTROPHOTOMETRY; ISOTOPIC ABUNDANCE; HISTORICAL TRENDS; SEWAGE; INDUSTRIAL WASTES; DUST FALL; ADSORPTION; GEOGRAPHIC VARIATIONS

The present anthropogenic lead fluxes into sediments from the Santa Monica, San Pedro, and Santa Barbara basins of Southern California are, respectively, 0.9, 1.7, and 2.1 micrograms of lead per square centimeter of sea bottom per year; the natural (prepollution) rates for these three basins were, respectively, 0.24, 0.26, and 1.0 microgram of lead per square centimeter per year. Studies of isotopic composition indicate that lead pollutants in coastal sediments are derived mainly from the combustion of lead additives in gasoline.

99
Chow, T.J.; Scripps Institution of Oceanography, La Jolla, Calif.

Chemistry in Britain 9(6), 258-263; 1973

LEAD; DISTRIBUTION; ATMOSPHERE; FLORA; FAUNA; PLANTS; ANIMALS; OCEANS; WATER

A review of the distribution of lead in the earth, sea, air, flora, and fauna around the world with special emphasis on the U.S. and U.K.

100
Water and Water Pollution Handbook. Volume 4

Ciaccio, L.L. (Ed.)

New York; Marcel Dekker, Inc.; 681 p.; 1973

AUTOMATION; CHEMICAL ANALYSIS; GAS CHROMATOGRAPHY; INFRARED SPECTRA; HANDBOOK; LUMINESCENCE; QUANTITATIVE CHEMICAL ANALYSIS; WATER

101
Environmental Dynamics of Mercury (Discussion)

Clarkson, T.W.; Coble, A.J.; D'Itri, F.M.; Gage, J.C.; Goldwater, L.; Hartung, R.; Hinman, A.; Jernelov, A.; Jervis, R.E.

Part of Hartung, R. (ed.), Environmental Mercury Contamination, International Conference, 1970, Ann Arbor Science Publishing, Inc. Ann Arbor, Michigan (p. 198-201); 1972

REVIEW; MERCURY; METHYLATION; WATER; AQUATIC ENVIRONMENTS

102
Mercury Concentrations in Fish, Plankton and Water from 3 Western Atlantic Esutaries

Cocordas, G.; Cahn, P.H.; Univ. Dept. Marine Sci., Greenvale, NY

J. Fish. Biol., 5(6), 641-647; 1973

MERCURY; CLUPEID; ESTUARIES; PLANKTON; FOOD CHAINS; ZOOPLANKTON; FISH

TAXONOMY: BREVOORTIA TYRANNUS

Total mercury concentrations were determined in the clupeid, BREVOORTIA TYRANNUS, from three estuaries of the Western Atlantic, and in the plankton on which they feed, as well as in the water sampled from the same localities. Although there was some indication that the food chain is a likely source of mercury contamination in these fish, as seen by the very much higher levels found in viscera compared with the rest of the fish, there was no evidence of strong food chain intensification. Fish mercury levels (0.3 to 0.5 part/10^6 dry wt) were about twice that for plankton (0.1-0.2 part/10^6 dry wt), with higher levels in phyto- than in zooplankton.

103
Trace Elements in Bottom Sediments from Upper Peoria Lake, Middle Illinois River

Collinson, C.; Shimp, Neil F.

Environmental Geology Notes, Sept., 1972, No. 56

TRACE ELEMENTS; SEDIMENTS; LAKES; X-RAY FLUORESCENCE; NEUTRON ACTIVATION ANALYSIS; OPTICAL EMISSION; ATOMIC ABSORPTION; RADIOCHEMISTRY; CHEMISTRY; SILICON; ALUMINUM; IRON; MAGNESIUM; CALCIUM; POTASSIUM; CARBON; TITANIUM; MANGANESE; SODIUM; PHOSPHORUS; SULFUR; LEAD; ZINC; CADMIUM; COPPER; NICKEL; BORON; CHROMIUM; BERYLLIUM; VANADIUM; COBALT; MERCURY; ARSENIC; BROMINE; LANTHANUM; SCANDIUM

A preliminary study of the chemical composition of bottom sediments from Upper Peoria Lake was made on samples taken from eight sites in the lake which is an impoundment of the Illinois River near Peoria. The samples were subjected to analysis by X-ray fluorescence, neutron activation, optical emission, atomic absorption, radiochemical preparation techniques, and wet chemical methods. Major constituents determined were silicon, aluminum, iron, magnesium, calcium, potassium, inorganic carbon, and organic carbon. Titanium, manganese, sodium, phosphorus, and sulfur were found in smaller amounts. Trace elements measured were lead, zinc, cadmium, copper, nickel, boron, chromium, beryllium, vanadium, cobalt, mercury, arsenic, bromine, lanthanum, and scandium. Sieve and pipette analyses revealed that the sediments are sandy and clayey silts. X-ray diffraction indicated an illite-kaolinite-chlorite mixed-lattice clay fraction. The results showed that Upper Peoria Lake bottom sediments contain more lead, zinc, and chromium than previously studied studied surficial sediments from southern Lake Michigan, but that they have lower levels of arsenic and bromine. Concentrations are directly related to organic carbon content and, to some extent, to the less than 2-micron clay fraction. Both organic carbon and clay fractions increase southward in Upper Lake Peoria and are larger in the navigation channel than in the shallows. Turbidity appears to have an inverse relation to trace element concentration.

104
Molybdenum Toxicity: Abnormal Cell Division of Teratogenic Appearance in EUGLENA GRACILIS

Colmano, G.; Department of Veternary Science, Virginia Polytechnic Institute and State University, Blacksburg, VA 24061

Bull. Contam., Bull. Environ. Contam. Tox. 9(6), 361-368; 1973

CELL DIVISION; MITOSIS; TERATOGENESIS; ANOMALIES; MOLYBDENUM; KARYOKINESIS; NEOPLASIA

TAXONOMY: EUGLENA GRACILIS

Euglena cells were grown axenically in continuous light at 24-26 degrees C. Normal molybdenum concentration of the growth medium was found to be 108 ppm. An increase in Mo concentration of 96, 480, and 960 ppm was shown to produce abnormal cell division and aborrant cell types. Molybdenum may be considered toxic and may be an inhibitor of cellular fission with resultant nuclear and chromosomal polyploidy and abnormal mitoses. It is hypothesized that a similar toxicity of molybdenum may activate the uncontrolled growth patterns observed in some neoplastic growths.

105
Trace Element Distribution in Water, Sediment, Phytoplankton, Zooplankton and Benthos of Lake Michigan: A Baseline Study With Calculations of Concentration Factors and Buildup of Radioisotopes in the Food Web

Copeland, B.A.; Ayers, J.C.; Environmental Research Group, Inc., University of Michigan, Ann Arbor, MI, 2710p.

ERG Special Report No. 1; 1972, May

TRACE ELEMENTS; WATER; PHYTOPLANKTON; ZOOPLANKTON; BENTHOS; LAKES; CONCENTRATION FACTOR; BIOACCUMULATION; FOOD WEBS; CHROMIUM; ZINC; SEDIMENTS; RADIOISOTOPES; INVERTEBRATES

GEOGRAPHICAL DESCRIPTION: U.S. (N), Great Lakes, Lake Michigan

Environmental Research Group, Inc. has conducted an environmental study on samples of phytoplankton, zooplankton, benthos, water and sediment collected from Lake Michigan by the Great Lakes Research Division of the University of Michigan. These samples, collected in 1969-70 prior to the operation of all nuclear plants except Big Rock Point, were analyzed for major and trace elements by ERG. The results of these analyses indicate Lake Michigan is typical of other world environments in its chemical make-up although certain elements (selenium in zooplankton and chromium and zinc in water) show significant variation in distribution within the area surveyed. Many of the biological samples were found to have become contaminated with sediment during the collecting process. ERG created a method, using scandium concentrations, by which this contamination could be corrected for after the analyses were made. Biological investigation of the data indicate that conditions in the southern basin of Lake Michigan are rapidly changing. Major changes in the species make-up of the phytoplankton are being discovered and further changes are expected in the near future. Calculations of concentration factors were made for the biota with respect to both water and sediment. It was found that concentration factors calculated with respect to water were most representative. One of the most important findings was that there is no stepwise increase in concentration factors as one analyses higher and higher members of the food web. This is not surprising since all of the organisms are equilibrating with the same system (Lake Michigan water). Using design data supplied by the utilities and proposed government regulations, ERG calculated the concentrations of radioactivity that could be expected in the invertebrates of Lake Michigan under the proposed title 10 C.F.R. Part 50 Appendix I operating conditions. These calculations indicate that for the invertebrates no radioisotope will exceed 8% of the upper limiting concentration normally applied to fish.

106
Trace Element Distributions in Lake Michigan Fish: A Baseline Study with Calculations of Concentration Factors and Equilibrium Radioisotope Distributions

Copeland, B.A.; Beethe, R.H.; Prater, W.W.

Ann Arbor, MI; Environmental Research Group, Inc., Ann Arbor, Michigan PP. 143; (1973); 1973

ACTIVATION ANALYSIS; BARIUM 140; CERIUM 144; CESIUM 134; CESIUM 136; CESIUM 137; CHROMIUM 51; COBALT 58; ELEMENTS; FISH; IODINE 131; IRON 59; ISOMERIC NUCLEI; MANGANESE 54; NEUTRONS; RADIOACTIVE WASTE DISPOSAL; RADIOECOLOGICAL CONCENTRATION; RADIONUCLIDES; KINETICS; SILVER 110; STRONTIUM 89; STRONTIUM 90; TELLURIUM 129; YTTRIUM 91; ZINC 65; ZIRCONIUM 95

107
Cadmium in the Environment, An Annotated Bibliography

Copenhaver, E.D.; Ulrikson, G.U.; Newman, L.T.; Fulkerson, W.; Oak Ridge National Laboratory, Oak Ridge, Tenn.

ORNL-EIS-73-17; 1973, April

CADMIUM; BIBLIOGRAPHY

108
Arsenic in the Environment, an Annotated Bibliography

Copenhaver, E.D.; Ulrikson, G.U.; Newman, L.T.; Van Hook, R.I., Jr.; Oak Ridge National Laboratory, Oak Ridge, Tenn. 37830

ORNL-EIS-73-16; 1973, July

ARSENIC; BIBLIOGRAPHY

109
Production of Trimethylarsine Gas from Various Arsenic Compounds by Three Sewage Fungi

Cox, D.P.; Alexander, M.; Laboratory of Soil Microbiology, Department of Agronomy, Cornell University, Ithaca, NY 14850

Bull. Environ. Contam. Tox. 9(2) 84-88; 1973

TRIMETHYLARSINE; ARSENIC; SEWAGE; FUNGI; INDUSTRIAL SEWAGE; AGRICULTURAL RUNOFF; MICROORGANISMS; METABOLIC CONVERSION; SODIUM ARSENATE; SODIUM ARSENITE; MONOMETHYLARSONIC ACID; PH; SOILS; TMA; MMA;

TAXONOMY; PENICILLIUM SP; CANDIDA HUMICOLA; GLIOCLADIUM ROSEUM; SCOPULARIOPSIS BREVICAULIS; TRICHOPHYTON SP; METHANOBACTERIUM

A potential source of toxic gases is posed by the release of arsenic compounds in industrial and agricultural wastes into the environment, assuming that microorganisms capable of this metabolic conversion(s) are widespread. Microorganisms commonly present in sewage and soil were tested as to their capacity in the formation of trimethylarsine when cultured in the presence of sodium arsenate, sodium arsenite, monomethylarsonic acid (MMA) and dimethylarsinic acid (DMA). CANDIDA HUMICOLA (Dazewka) is able to produce TMA from all sources tested when growing at pH 5. GLIOCLADIUM ROSEUM Bain produced TMA in the presence of MMA and DMA, but not in the presence of sodium arsenate or sodium arsenite; a PENICILLIUM produced TMA under similar conditions.

110
Lead-210-Radium-226. Radioactive Disequilibrium in the Deep Sea

Craig, H.; Krishnaswami, S.; Somayajulu, B.L.; Scripps Inst. Oceanogr., Univ. California, San Diego, Calif.

Earth Planet. Sci. Lett. (EPSLA2), 17(2), 295-305; 1973

LEAD 210; SALTWATER; RADIUM 226; RADIOACTIVITY

Pb 210 and Ra 226 profiles have been measured in the North Atlantic and North Pacific Deep Water. The Pb 210 activity is 25% to 80% of that of Ra 226, averages about 50% in each profile, and is lowest in the bottom water. This deficiency of Pb 210 relative to Ra 226 shows that Pb 210 is rapidly and continually scavenged from deep water, probably by adsorption on particulate material sinking from the surface. A method is developed for simultaneous application of the vertical diffusion-advection model to Ra 226 and Pb 210 deep-water profiles, and the in-situ source terms for both isotopes are obtained as a function of the parametric upwelling velocity. For a positive source term for Ra 226 in deep water, the parametric velocity is limited to a small range (9-12 m/y) and the deep-Pacific residence time of lead is 54 yr, a value two orders of magnitude smaller than residence times estimated from stable lead concentrations. The model calculations show that an in-situ scavenging process, acting throughout the water column, is required to remove the Pb. Box model calculations yield a similar short residence time for lead in North Atlantic Deep Water, indicating that radioactive disequilibrium for Pb 210, due to fast scavenging, is a general phenomenon through the deep sea.

111
Mercury Pathways in a River and Estuary

Cranston, R.E.; Buckley, D.E.

Environmental Science and Technology, 6(3), 274-280; 1972, March

MERCURY; WATER; SUSPENDED PARTICULATES; SEDIMENTS; RIVERS; ESTUARIES; DILUTION; ADSORPTION; INDUSTRY; EFFLUENTS; TRANSPORT; FORMULATION; CHEMISTRY; MOBILITY; BIOLOGICAL UPTAKE; AMALGAMATION; SILVER; GOLD; PLUTONIUM; IRON; MANGANESE; COPPER; CHLORINE; BLEACHES; FLOCCULATION; DEPOSITION; METHYLMERCURY; FERTILIZER PLANTS; PAPER MILLS; CHLOR-ALKALI PLANTS; SETTLING PONDS; UPTAKE; SMELTERS; TRANSPORT

A method for measuring total mercury in water, suspended particulate matter, and bottom sediments has been evaluated. Some data have been applied to a study of the geochemical pathways of mercury in a rural river and estuary system. Concentrations of mercury in the LaHave River (Nova Scotia) are related to the proximity of a small rural town. The dissipation of mercury in solution appears to be through dilution, as well as by adsorption on suspended particulate matter which raises the level in particulate matter to the range of 2.04-34.4 ppm. Bottom sediments in the LaHave River are affected by sedimentation of particulate matter containing high levels of mercury, but the mercury concentration in the bottom sediments ranges from 0.09 to 1.06 ppm. Mercury released to the natural environment from industrial waste effluents appears to be discharged mostly in the dissolved form but may be quite rapidly adsorbed as shown by analyses of suspended particulate matter and bottom sediments.

112
Particulate Lead Contamination Recorded in Sedimentary Cores from Lake Washington, Seattle

Crecelius, E.A.; Piper, David Z.

Environmental Science and Technology, 7(11), 1053-1055; 1973

SEDIMENT CORES; SEDIMENTS; LEAD; HUMANS; POPULATIONS; PARTICULATES; LEADED GASOLINE; SMELTERS; LAKES

GEOGRAPHICAL DESCRIPTION: U.S. (W), Washington, Seattle, Lake Washington

Examination of two sedimentary cores from Lake Washington reveals a sharp increase in the lead content (from 3--400 ppm) during the past 80 years. The increase in lead parallels the increase in population of the surrounding land. The two major sources of lead are believed to be particulate lead from the Tacoma smelter (from 1890 to 1913) and automobile gasoline additives (from 1920's to the present).

113
Gamma-Emitting Radionuclides in Chesapeake Bay Sediments Near Calvert Cliffs

Cressy, P.J., Jr.; Natural Resources Inst., Goddard Space Flight Center, Greenbelt, MD

Part of Ecological Effects of Nuclear Steam Electric Station Operation on Estuarine Systems. Volume I. Mihursky, J.A. Natural Resources Inst., ORO--4328-1 (9-15); 1973, August

BISMUTH 214; CESIUM 134; CESIUM 137; CHESAPEAKE BAY; COBALT 60; PH; RADIATION MONITORING; RADIONUCLIDE MIGRATION; RUTHENIUM 106; SALINITY; SEDIMENTS; TEMPERATURE DEPENDENCE; THALLIUM 208

GEOGRAPHICAL DESCRIPTION: U.S. (E), Maryland, Chesapeake Bay

114
Concentrations of Manganese, Iron, and Zinc in Juveniles of Five Estuarine-Dependent Fishes

Cross, F.; Brooks, J.

Conf-710501--P2, pp 769-775; 1971

ESTUARIES; FISH; IRON; MANGANESE; QUANTITY RATIO; ZINC

115
Relation Between Total Body Weight and Concentrations of Manganese, Iron, Copper, Zinc, and Mercury in White Muscle of Bluefish (POMATOMUS SALTRATRIX) and a Bathyl-Demersal Fish ANTIMORA ROSTRATA

Cross, F.A.

Fisheries Research Board of Canada J., 30(9), 1287

BODY WEIGHT; MANGANESE; IRON; COPPER; ZINC; MERCURY; MUSCLES; BLUEFISH; FISH; SALTWATER; BATHYL-DEMERSAL FISH

TAXONOMY: ANTIMORA ROSTRATA; POMATOMUS SALTRATRIX

Concentrations of mercury increased significantly with size in white muscle of bluefish and a bathyl-demersal fish, but concentrations of manganese, iron, copper, and zinc either remained constant or decreased. Fish residing in two different ecosystems in the Atlantic Ocean may therefore be in a steady state with their environment with respect to the latter elements, but not to mercury. Variations in accumulation patterns of trace metals as a function of size in these species are discussed.

116
Organomercurials in the Environment

Cross, R.J.; Dep. Chem., Univ. Glascow, Glasgow, Scot.

Chem. Ind. (London) (CHINAG), (15), 719-21; 1973

REVIEW; MERCURY; WATER; ORGANOMERCURIALS

117
Mercury Accumulation in An Aquatic Ecosystem

Cumont, G.; Montiel, A.; Lab. Cent. Rech. Vet., Maison-Alfort, Fr.

Trip. Cebedeau (Cent. Belge Etude Doc. Eaux Air) 26(352), 12a-6; 1973

MERCURY; ACCUMULATION; AQUATIC ECOSYSTEMS; MERCURY; BIOACCUMULATION

118
The Effects of Mercuric Acetate on Adult Juvenile and Larval Oysters CRASSOSTREA VIRGINICA

Cunningham, P.A.

Am. Zool. 12(3), XXIX; 1972

TISSUES; SHELLFISH; DEPOSITION; RESPIRATION; OXYGEN; VELIGER; LARVAE; MORTALITY; OYSTERS; MERCURIC ACETATE

TAXONOMY: CRASSOSTREA VIRGINICA

119
Trace Element Analyses of Whitefish

Cushing, C.; Watson, D.

BNWL--1750 (Pt.2) 6.14-6.15; 1973, March

ACTIVATION ANALYSIS; AQUATIC ECOSYSTEMS; CHEMISTRY; RIVERS; FISHES; FOOD CHAINS; INSECTS; PLANKTON; TISSUES; TRACE AMOUNTS

120
Possible Screening of Surface Charges on Crayfish Axons by Polyvalent Metal Ions

D'Arrigo, J.S.; Med. Cent., Univ. California, Los Angeles, Calif.

J. Physiol. (London) (JPHYA7), 231(1), 117-28; 1973

CRAYFISH; AXON POTENTIAL; CATIONS; NERVES; METALS; IONS

The effects of different polyvalent metal ions in the external solution on the threshold membrane potential for spike initiation in crayfish axons was studied by means of intracellular microelectrodes. Metal ions tested included 6 divalent (Ca^{2+}, Mg^{2+}, Sr^{2+}, Ba^{2+}, Co^{2+}, Ni^{2+}) and 3 trivalent cations (La^{3+}, Y^{3+}, Pu^{3+}). Identical extracellular concentrations of different cations with the same valence had essentially the same effect on threshold membrane potential. However, a very low concentration of trivalent cations (approximately 225 mM) was equivalent to a much higher divalent cation concentration (13.5 mM) as measured by their effects on threshold potential. Upon a 10-fold increase in concentration, the threshold potential for spike initiation was shifted in a positive direction by 30.6 mV with divalent cations and by 20.8 mV with trivalent cations. A hypothesis involving screening of negative charges at the axonal membrane surface, based on Gouy-Chapman theory, predicts these various experimental results rather closely. Evidently a high negative charged, sufficientto render a screening mechanism possible, exists at the surface of crayfish axons in the region of the Na gates. This is discussed in connection with the possible molecular identity of the Na gates.

121
Mercury in the Aquatic Ecosystems

D'Itri, J.M.; Inst. Water Res., Michigan State Univ., East Lansing, MI

Bioassay Tech. Environ. Chem.(26YZAG), 3-70; 1973

REVIEW; MERCURY; FRESHWATER ECOSYSTEM; SEDIMENTS; RADIOACTIVITY; TRACERS; MARINE ECOSYSTEM; IONS

A review of the occurrence, distribution, accumulation in sediment, biological methylation, microbial conversion, and biological concentrations of mercury in the aquatic ecosystem, including use of preserved museum fish as Hg pollution indicators, Hg distribution studies with radioactive tracers, the toxicity of Hg in the freshwater ecosystem, and the effects of Hg and mercuric ion in the marine ecosystem, with 235 refs.

122
Variation in the Toxicity of Arsenic Compounds to Microorganisms and the Suppression of the Inhibitory Effects by Phosphate

Da Costa, E.W.B.

Appl. Microbiol., 23(1), 46-53; 1972

FUNGICIDES; OXIDATIVE PHOSPHORYLATION; INTERFERENCE; GROWTH; POTASSIUM ARSENATE; INHIBITOR

TAXONOMY: PORIA MONTICOLA; CLADOSPORIUM HERBARUM

The toxicity of potassium arsenate, as measured by retardation or inhibition of growth on solid nutrient media, showed wide variation among different fungi but was consistently reduced by the addition of large amounts of potassium phosphate, with both arsenic-sensitive and arsenic-tolerant fungi. PORIA MONTICOLA was completely inhibited by 0.0025 M arsenate but was progressively less inhibited as the phosphate content of the medium increased and grew slowly at 0.04 M arsenate when 0.16 M KH(2)PO(4) was added. CLADOSPORIUM HERBARUM showed 36% reduction in growth at 0.08 M arsenate in a low-phosphate medium, but when 0.01 M KH(2)PO(4) was added, arsenate concentrations up to 0.64 M (at which the medium contains 4.8% As) caused no reduction in growth rate. Addition of phosphate also reduced the toxicity of potassium arsenite but not that of dimethyl sodium arsonate (sodium cacodylate). The counteracting effect of phosphate on arsenate toxicity was found to occur with every one of a wide variety of microorganisms tested. The author interprets the results as supporting the thesis that the fungitoxicity of arsenate is due to its competitive interference with phosphorus in oxidative phosphorylation and not to a reaction with the -SH groups of essential proteins. The latter mechanism is, however, probably operative with dimethyl sodium arsonate. The practical implications of the counter-inhibition phenomenon in laboratory investigations and standard tests of arsenical fungicides, in biochemical research, and in the commercial use of arsenical biocides are set out.

123
Effects of Dieldrin on Brown Trout in Field and Laboratory Studies

Dacre, J.C.; Scott, D.; Med. Sch., Univ. Otago, Dunedin, N.Z.

New Zealand Journal of Marine and Freshwater Res. (NZJMES), 7(3), 235-246; 1973

DIELDRIN; TOXICITY; BROWN TROUT; WATER; FISH

TAXONOMY: SALMO TRUTTA

GEOGRAPHICAL DESCRIPTION: New Zealand, Otago, Silver Stream

The 24 hr LC50 for dieldrin (I) in brown trout (SALMO TRUTTA) and bottom fauna of Silver Stream, Otago, New Zealand, after an accidental discharge of 55 l. of a I spray, was 0.016 ppm. The minimum lethal levels of I found in the skeletal muscles, liver, and brain were 1.0-2.0 ppm.

124
Waste Water from Electroplating Plants and Precipitation of Heavy Metals

Daester, H.H.; Jola, M.; Daester-Fairtec A.G., Basel, Switzerland

Korros, Ytskydd (KOYTAD), 8(9), 28-29; 1973

REVIEW; HEAVY METALS; WASTE WATER; ELECTROPLATING; INDUSTRY

125
The Neuro Toxicity of Alkyl Mercury Compounds

Dales, L.G.

Am. J. Med. 53(2), 1972 219-232; 1972

HUMANS; RESPIRATORY TRACT; GASTROINTESTINAL TRACT; CENTRAL NERVOUS SYSTEM; INHALATION; FUNGICIDES; SEEDS; FISH; FOOD CHAINS; BLOOD; FETUS

The alkyl compounds of mercury present a significant human health hazard. These compounds, which are readily absorbed through the respiratory or gastrointestinal routes and only slowly eliminated from the body, can cause serious damage to the central nervous system, and may lead to death or permanent major disability. Harmful exposure by inhalation has occurred in industrial and agricultural settings, where alkyl mercury compounds are used primarily as fungicides. Serious illness has also resulted from ingestion of both seed treated with alkyl mercury fungicides and of fish from contaminated waters. The latter form of poisoning may occur after the discharge of several forms of mercury into natural bodies of water, since aquatic microorganisms can convert inorganic mercury to alkyl mercury which then accumulates to dangerous concentrations in the higher rungs of biologic food chains. Although variation in exposure rates makes it difficult to set precise limits for safe environmental concentrations of these compounds, air levels of 0.01 mg/M(2) and food concentrations of 0.5 to 1.0 mg/kg of mercury as alkyl mercury have found fairly widespread acceptance as the current critical values. A concentration of 10 mg/100 ml of blood has been proposed as the maximum permissible for mercury (as alkyl mercury) in exposed persons. The possibility that exposure to very small doses, heretofore regarded as harmless, may have subtle and yet still significant chronic health effects in the adult and not so subtle effects in the human fetus requires exploration.

126
The Bio Transformation of Organo Mercury Compounds

Daniel, J.W.

Biochem. J., 130(2), 64-65; 1972

BIOTRANSFORMATION; ORGANOMERCURY; MICROORGANISMS; RATS; LIVER; FUNGICIDES; SOILS; MERCURY

127
The Kinetics of and a Preliminary Model for the Uptake of Radio-Zinc by PHAEDACTYLUM TRICORNUTUM in Culture

Davies, A.G.

Part of Radioactive Contamination of the Marine Environment, Proceedings of Symposium held by the International Atomic Energy Agency, Seattle, WA, July 10-14, 1972 (A03-A19) 786 p.; 1973

KINETICS; MODELS; UPTAKE; RADIONUCLIDES; ZINC; TRACERS; CHELATION; GROWTH; METALS

TAXONOMY: PHAEDACTYLUM TRICORNUTUM

Using zinc 65-labelling, measurements of the rate of uptake of zinc ions by initially zinc-free cells have been made. Treatment of a suspension of cells, containing zinc with a chelating agent indicates that a portion of the metal associated with the cells is loosely bound and probably adsorbed on to the cell surface. The remainder of the metal in the cell is more firmly based; in the early stages of uptake, it increases linearly with the square root of time and this has been taken to indicate that the uptake of the metal is passive and diffusion controlled. The metabolic zinc content of the cells later passes through a maximum despite the availability of further zinc for uptake and then gradually decreases. This has been interpreted as being due to a reduction in the number of zinc-binding sites (probably protein) within the cells, as they progress through their growth cycle. A simplified model of these events, capable of computerization, has been developed and tested against the experimental observations.

128
Effects of Chemical Variations in Aquatic Environments. III. Lead Toxicity to Rainbow Trout and Testing Application Factor Concept

Davies, P.H.; Everhart, W.H.; Dep. Fish. Wildl. Biol., Colorado State Univ., Fort Collins, Colo.

GPO, 1.25 dollars, Govt. Rep. Announce. (U.S.) 73(18), 55; 1973

LEAD; POISONING; FISH; WATER; RAINBOW TROUT; APPLICATION FACTOR

129
Effects of Methylmercury Chloride on the Survival and Behavior of the Three-Spined Stickleback (GASTEROSTEUS ACULEATUS)

Deakins, D.E.; Univ. South. California, Los Angeles, CA

Univ. Microfilms, Ann Arbor, MI, Order No. 73-18, 805, Diss. Abstr. Int. B, 33(2), 533-538; 1973

MERCURY; TOXICITY; FISH; BEHAVIOR; STICKLEBACK; SURVIVAL; METHYLMERCURY

TAXONOMY: GASTEROSTEUS ACULEATUS

130
Case Against Mercury

Dean, R.B.; Natl. Environ. Res. Cent., Environ. Prot. Agency, Cincinnati, Ohio

AICHE Symp. Ser. 69(129), 279-83; 1973

REVIEW; MERCURY; FISH; TOXICITY

The occurrence of mercury intoxication by exposure to inorganic Hg compounds. In pesticides, consumption of Hg-poisoned fish, exposure to Hg-containing chemical effluents, and legislation to prevent or reduce hazards of Hg are reviewed with 23 refs.

131
Study of Selected Parameters Affecting the Radiation Dose from Drinking Water Downstream of Nuclear Facilities

Denham, D.; Soldat, J.; Battelle Pacific Northwest Labs., Richland, Wash.

BNWL-SA--4585; 1973

NEPTUNIUM; ANTIMONY 122; ARSENIC 76; CHROMIUM 51; DIFFUSION; DRINKING WATER; GASTROINTESTINAL TRACT; MAN; NEPTUNIUM 239; RADIATION DOSES; RADIOECOLOGICAL CONCENTRATION; RADIONUCLIDE MIGRATION; SODIUM 24; ANTIMONY; ARSENIC; SODIUM;

This paper describes a study of some parameters affecting radiation doses received from consumption of water derived from the Columbia River downstream of the Hanford production reactors. Included were studies of relative concentrations of radionuclides in water entering and leaving the water treatment plants at Richland and Pasco, Washington; sanitary water at a number of points in Richland; and coffee brewed from sanitary water. The removal efficiencies for the alum-floc water treatment plants studied ranged from 80% for rare-earth nuclides to 10% for Cr 51. The relative concentration of radionuclides (principally Na 24, As 76, Sb 122, Np 239) found within the Richland distribution system was used to estimate the average dose to residents consuming the water. Average GI Tract doses calculated for persons residing at each of six locations within the city were 1/3 to 1/2 of those calculated for consumption of water leaving the treatment plant. The average dose received, calculated by weighting these six individual doses by the population distribution, yielded 45% of that calculated for consumption of water leaving the treatment plant. Since coffee represents a major liquid intake mode for adults, the potential removal of radionuclides during coffee brewing was studied. The concentrations of radionuclides in the water and coffee brewed from it were not significantly different for those radionuclides contributing the most to the GI Tract dose, and hence those doses were not significantly reduced.

132
Experimental Data on Contamination of Anguilla anguilla by Chromium-51 and it Excretion

Descamps, M.; Foulquier, L.; Aquesse, P.; Grauby, A.

C.R. Acad. Sc. Paris, t. 276 (12 fevrier 1973) Series D - pp. 1193-1196; 1973

FISH; CHROMIUM; CHROMIUM 51; INTESTINES; DIGESTIVE TRACT; LIVER; KIDNEYS; BLOOD; BIOLOGICAL HALF-LIFE; EXCRETION; CONCENTRATION FACTOR; RADIOTRACER TECHNIQUES; ADSORPTION; UPTAKE; TRACERS; INDIVIDUAL VARIATIONS

TAXONOMY: ANGUILLA ANGUILLA

The Anguilles were kept in soft water contaminated with chromium 51. The fixation of the radionuclide in the fish proceeded rapidly to a state of equilibrium at about the 20th day. The specific activity of the digestive tract was particularly high, representing about 70 percent of the total activity. The radionuclide penetrated the intestine and was carried throughout the organism by the blood. The liver seems to play a storage role. Excretion is rapid during the first few days and then much slower. Thus one determines two effective periods of 8 and 19 days for the whole animal and 3 and 17 days for the intestines. By the 85th day duration of the experiment, the specific activity of the digestive system decreased rapidly, that of the blood slowly, that of the liver remained stable and that of the kidneys increased slowly. Studies are continuing on the transfer mechanism, effects of the chromium compound on the mechanism and level of contamination, and the effect of the content of stable chromium on the fixing of the radionuclide. Most of the chromium was adsorbed on the walls of the aquarium and only 0.5 percent taken up by the Anguilles after 85 days. (Note that there appears to be a discrepancy in the biological half lives: 8 and 19 days are mentioned in one place, 8 and 65 on the figures and 20 and a longer time in another place).

133
The Enrichment of Heavy Metals in Submerged Plants

Dietz, F.

Proc. 6th International Water Pollution Research June 18-23, 1972, Session 2, Paper 08, 8pp.

ENRICHMENT; BIOACCUMULATION; POTASSIUM; COPPER; LEAD; NICKEL; ZINC; MANGANESE; IRON; PLANTS; AQUATIC BIOLOGY

TAXONOMY: SPERMATOPHYTA; BRYOPHYTA; RANUNCULUS FLUITANS; NUPHAR/LOTPUM; SAGITTARIA SAGITTIFOLIA; FONTINALIS ANTIPYRETICA; HYGROAMBLYSTEGIUM

138
Aquatic-Biotic Community Structure as an Indicator of Pollution

Dills, G.G.; Rogers, D.T., Jr.; Geological Survey, Division of Water Resources, Circular 80, Project A-022-ALA, University, Alabama

; 1972

PHYSICOCHEMISTRY; BENTHOS; COMMUNITY STRUCTURE; MINES; MINE DRAINAGE; TURBIDITY; HARDNESS; IRON; MANGANESE; PH; CONDUCTANCE; SULFUR; DISSOLVED OXYGEN; PHOSPHATE; SPECIES DIVERSITY

Physicochemical conditions and benthic macroinvertebrate community structure were quantitatively related to varying degrees of acid mine drainage in a small stream system. Tributaries exposed to acid effluents were characterized by lack of a natural buffering capacity, a reduction in turbidity, a decrease in lead, and an increase in mineral content. Strong positive correlation existed between hardness, iron, manganese, lead, conductance, and sulfur, while dissolved-oxygen content and temperature values were strongly negatively correlated. A step-wise regression analysis showed lead, phosphate, and turbidity to be highly correlated (P is less than .01) with species diversity. Significant differences (P is less than .01) in species diversity existed between acidic and nonpolluted tributaries. Stations located near areas of acid production were consistently lowest in diversity. Species diversity values for the unpolluted stations showed temporal variations with highest values occurring during late March and December. The polluted stations showed random fluctuations in diversity values. A regression line, calculated to show the relationship between lead and species diversity, could be used to predict species diversity on the basis of periodic measurement of stream lead. Varying degrees of acid mine pollution were reflected by changes in the macroinvertebrate community structure.

135
Possible Inter-Relationship Between Selenium Toxicity and the Biochemical Function of Trace Amounts of Selenium

Diplock, A.T.

Presented at the Seventh Annual Conference on Trace Substances in Environmental Health, University of Missouri-Columbia, Columbia, MO 65201; 1973, June 12-14

SELENIUM; TOXICITY; BIOCHEMISTRY; OXIDATION; DIMETHYL SELENIDE; RATS; ANIMALS; VITAMIN E

Studies with trace amounts of selenium 75 in rats have indicated that a part of a dose of Na(2)-75 SeO(3) becomes converted in the liver to a protein-bound acid-volatile form of the element which is susceptible to oxidation, and appears to be protected from oxidation IN VIVO by dietary vitamin E. Model experiments are described designed to distinguish hydrogen selenide from dimethyl selenide. It is shown, using the model system, that the tissue acid-volatile selenium is not an alkyl selenide and that it is most likely to be a hydrogen selenide. The major route of detoxication of large amounts of selenium is by formation of volatile dimethyl selenide, which is exhaled. The sequence of reactions by which selenium compounds may be converted to dimethyl selenide has been described by Ganther. The possibility is discussed that a similar metabolic sequence may account for the conversion of trace amounts of Na(2)-75 SeO(3) to the protein-bound selenide of rat liver subcellular organelles.

136
Radiosensitization of Blue-Green Alga ANACYSTIS NIDULANS by Chemical Compounds

Dmitriev, A.; Grodzinskii, D.

Stud. Biophys. 35(3), 157-163; 1973

ALGAE; ANOXIA; BENZOIC ACID; RADIATION EFFECTS; GAMMA RADIATION; MERCURY COMPOUNDS; MONOCARBOXYLIC ACIDS; NITROFURIN; ORGANIC CHLORINE COMPOUNDS; ORGANIC IODINE COMPOUNDS; ORGANOMETALLIC COMPOUNDS; OXYGEN; PROTON BEAMS; RADIOSENSITIVITY

137
Influence of Copper and Zinc Ions on Toxicity of Sodium N-Methyldithiocarbamate to Fusarium Oxysporum F. Specialis lycopersici

Domsch, K.H.; Corden, M.E.; Dep. Bot. Plant Pathol., Oregon State Univ., Corvallis, Oreg.

Arch. Mikrobiol. (ARMKA7), 88(4), 345-52; 1973

METHYLDITHIOCARBAMATE; COPPER; ZINC; SYNERGISM; FUNGICIDES

TAXONOMY: FUSARIUM OXYSPORUM

The interactions between the fungicide, sodium N-methyldithiocarbamate (NaMDC), and fungitoxic or non-toxic levels of copper or zinc ions were reevaluated. It was shown that non-toxic levels of NaMDC generally reduce the fungitoxicity of copper sulfate solutions, while copper sulfate solutions of low toxicity, when combined with NaMDC solutions of low toxicity, yielded a highly toxic mixture with an UV spectrum similar to that of dimethylthiuram disulfide, a fungicide which is about 100 times more toxic to the test organism, Fusarium oxysporum f. sp. lycopersici, as is the compound NaMDC. Fungi with a high sensitivity to copper ions are not suitable for demonstrating a toxic 1:1 complex between copper ions and the dithiocarbamate. In high concentrations NaMDC proved to be stable even in the presence of copper ions. In these cases, the significantly increased NaMDC toxicity, when combined with copper or zinc sulfate, was attributed to the synergistic action of the metal ions on the semipermeability of cytoplasmatic membranes. Since bimodal dosage response curves were obtained for NaMDC in the absence of copper or zinc ions in the test medium, the "inversion phenomenon" is probably limited to reactions inside the cell.

138
Study of Lead, Copper, Zinc, and Cadmium Contamination of Food Chains of Man

Dorn, C.R.; Pierce, J.O., II; Chase, G.R.

University of Missouri-Columbia, U.S. Department of Commerce PB-223 018, 121 p.; 1972

LEAD; COPPER; ZINC; CADMIUM; SMELTERS; HUMANS; FOOD CHAINS

Results of studies on soil, vegetation, meat and milk contamination in a new lead producing region.

139
Sorption Behaviour of Trace Nuclides in Sea Water on Manganese Dioxide

Doshi, G.; Krishnamoorthy, T.; Sastry, V.; Sarma, T.

Indian J. Chem., 11(2), 158-161; 1973, February

ACTIVATION ANALYSIS; ADSORPTION; ANTIMONY; ARSENIC; CERIUM; CESIUM; CHEMICAL ANALYSIS; COBALT; HAFNIUM; MANGANESE OXIDES; RADIATION MONITORING; RUTHENIUM; SALTWATER; SELENIUM; SEPARATION PROCESSES; SILVER; STRONTIUM; TIN; TRACE AMOUNTS; URANIUM; ZINC; ZIRCONIUM; SORPTIVE PROPERTIES

Adsorption behavior of 14 radionuclides, viz. Co, Zr, Ru, Cs, Sr, Hf, Ag, Se, Zn, Cr, As, Sb, Sn and U, from sea water is studied on manganese dioxide precipitated in situ. Quantitative capture is found for Co, Ru, Zr, Hf, Cr and Zn. Comparisons are made with the sorption capacity of ferric hydroxide for the same nuclides. The application of the in situ precipitation in the field of activation analysis and monitoring of radioisotopes released from nuclear installations is discussed. The adsorption on powdered manganese dioxide was not nearly so good, so much larger quantities were required. Anionic complexes were not adsorbed strongly. Isotopes of silver, selenium, antimony and tin were not carried quantitatively. In situ precipitation can be used as a preconcentration step with seawater, for neutron activation analysis, but uranium should, but uranium should be removed first to avoid fission product formation during irradiation. Detection limits of several fission products in seawater are given.

140
Interaction Between Water, Trace Elements, and Different Components in the Danube River

Draskovic, R.; Radosavljevic, R.; Tasovac, T.; Zaric, T.

Eur--4800 (Vols. 1 and 2), Boris Kidric Inst. of Nuclear Science, Vinca, Yugoslavia, p. 1167-78; 1972, May

RIVERS; ELEMENTS; RADIOISOTOPES; REACTION KINETICS; TRACE ELEMENTS; WATER

From International symposium on radioecology applied to the protection of man and his environment; Rome, Italy (7 Sept 1973). The environment is a complex system of interacting physical, chemical and biological components. The fate of radioactive and nonradioactive pollutants introduced into rivers and their influence on existing equilibria depend on specific characteristics of the aquatic environment. Temporal variations in ambient trace element concnetrations may affect the accuracy of the predictions but these variations are functions of the biological half time of the element in ecosystems. Results of an eleven-year research program are presented concerning the Yugoslav section of the Danube river which included study of the characteristics of the river and its environment; interaction between water and dispersed inorganic and organic matter, and dispersion ability of the river as well as behavior of different trace and radioactive elements in the river and its components including biological and other environmental materials. The analyses show regularities on the large scale.

101
Short-Term Indicators of Sublethal Effects of Copper on Brook Trout, Salvelinus Fontinalis

Drummond, R.A.; Spoor, W.A.; Olson, G.F.; Natl. Water Qual. Lab., U.S. Environ. Prot. Agency, Duluth, Minn.

J. Fish. Res. Board Can. (JFRBAK), 30(5), 698-701; 1973

COPPER; TOXICITY; TROUT; FISH BEHAVIOUR

TAXONOMY: SALVELINUS FONTINALIS

Changes in cough frequency, locomotor activity, and feeding behaviour of yearling brook trout were observed within 2-24 hr after exposure to copper sulfate ($CuSO_4$) concentrations as low as 6-15 mu g Cu/l. each of these responses showed promise as a short-term predicator of the concentration range at which chronic exposure to Cu might have no permanent effect.

102
Distribution of Trace Metals in the Pore Waters of Shallow Water Marine Sediments

Duchart, P.; University of Edinburgh, Scotland

Limnology & Oceanography, 18(5), 605; 1973, July

DISTRIBUTION; TRACE METALS; SALTWATER; SEDIMENTS; PHYSICOCHEMISTRY; COPPER; NICKEL; ZINC; LEAD; ATOMIC ABSORPTION SPECTROPHOTOMETRY

GEOGRAPHICAL DESCRIPTION: Scotland, Loch Fyne

Concentrations of seven trace metals in the pore waters of marine sediments from Loch Fyne, Scotland, were analyzed by atomic absorption spectrophotometry following solvent extraction. Dissolved iron either decreases or increases down the core depending on the type of sediment. Copper, nickel, zinc, and lead also showed variable concentrations profiles. This indicates control by different postdepositional reactions in the sediment, which in turn depend on different physiochemical environments generated by variable amounts of contained organic material and different accumulation rates.

103
Radionuclide Uptake by Some Freshwater Hydrobionts

Dushauskene, Duzh, N.; Marchyulenene, E.D.P.; Nyanishkene, V.B.; Shuliene, R.I.; Polikarpov, G.A.

Liet. TSR Mokslu Akad. Darbai, Ser. C- 3- No. 59, 201-212; 1972

CERIUM 144; CESIUM 137; FISH; FLIES; LARVAE; LEAD 210; PLANKTON; RADIOISOTOPES; RADIONUCLIDES; KINETICS; RUTHENIUM 106; SILT; STRONTIUM 90; UPTAKE; WATER

104
Specific Activity of Radionuclides Sorbed by Marine Sediments in Relation to the Stable Element Composition

Duursma, E.K.

Part of Radioactive Contamination of the Marine Environment, Proceedings of Symposium held at the International Atomic Energy Agency, Seattle, WA, July 10-14, 1972 (47-70), 786 p. ; 1973

RADIONUCLIDES; SORPTION; SEDIMENTS; ELEMENTS; DISTRIBUTION COEFFICIENTS; SALT WATER

The problem investigated is whether the binding of radionuclides to marine sediments in a waste disposal area can be predicted from studies of the trace metal contents of the sediments. To evaluate this, the experimentally determined distribution coefficients of various radionuclides and the existing corresponding stable isotope distribution were compared for different marine sediments of the major ocean basins. The ratio of the distribution coefficient of the radionuclide to that of its stable counterpart was considered to be a measure of the amount of the stable isotope available for exchange with the radionuclide in seawater. The ratios were normally low, but ranged from about 0.1 to 100% for the different elements and sediments tested. The practical application for waste disposal evaluations is that the ratios estimated for a particular area might be used for a first approximation of the maximum amount of radionuclides that might be held by the sediment at a given specific activity in the seawater.

105
Determination of Mercury Content in Austrian Surface Waters. I. Danube Water and Sediments

Dworsky, R.; Ebner, F.; Gans, H.; Ottendorfer, L.J.; Bundesanst. Wasser Biol. Abwasserforsch., Vienna, Austria

Oesterr. Abwasser-Rundsch., 18(2), 22-27; 1973

MERCURY; RIVERS; SEDIMENTS; ATOMIC ABSORPTION SPECTROPHOTOMETRY; INTERNATIONAL STANDARDS

GEOGRAPHICAL DESCRIPTION: Austria, Danube River

The mercury content in water and sediments from the Danube River and its tributaries was determined by atomic absorption spectrophotometry. The water samples were taken from the Austrian stretch of the river. The mercury was constant approximately 0.1 microgram/l corresponding to an estimated average for surface waters unaffected by external sources. Analyses of sediments from the Danube tributaries gave 0.00 to 1.16 mg/kg in wet mud. Their analyses were below the limit 0.5 mg/kg which is permitted by an international standard.

146
Chronic Toxicity of the Copper, Cadmium and Zinc Mixture to the Flathead Minnow (Pimephales Promelas Rafinesque)

Eaton, J.G.

Water Research, 7, 1723-1736; 1973

FLATHEAD MINNOWS; TOXICITY; CADMIUM; ZINC; COPPER; FISH

TAXONOMY: PIMEPHALES PROMELAS

Fathead minnows were exposed to a series or concentrations of a copper, cadmium and zinc mixture during as 12.5 month chronic test in water of 200 mg l-1 total hardness. The metal concentrations in the mixture were selected on the basis of results obtained during previous chronic exposures to each of the meals individually in the same water. Strict summation of the chronic toxicities of the metals was not indicated when they were tested in combination. Toxic effects of the mixture attributable to copper appeared to be increased, but that attributable to cadmium was reduced. The effects thought to be due to zinc were similar in degree to those observed in the single chronic exposure. Summation of effects resulting from a mixture containing about the same proportions of copper, cadmium and zinc occurred at a much higher, acutely lethal concentration. A lethal threshold was attained in the mixture when each metal was present at a concentration of 0.4 or less of its individual lethal threshold.

147
Annotated Bibliography on Biological Effects of Metals in Aquatic Environments (No. 1-567)

Eisler, R.; National Marine Water Quality Laboratory, U.S. Environmental Protection Agency, West Kingston, Rhode Island 02892

Environmental Protection Agency Report number, EPA-R3-73---7; 1973, February

BIBLIOGRAPHY; BIOLOGICAL EFFECTS; METALS; AQUATIC ENVIRONMENTS

148
Acute Toxicology to an Estuarine Teleost of Mixtures of Cadmium, Copper, and Zinc Salts

Eisler, R.; Gardner, G.R.; Natl. Mar. Water Qual. Lab., U. S. Environ. Prot. Agency, West Kingston, R. I.

J. Fish Biol. (JFIBA9), 5(2), 131 -42; 1973

CADMIUM; TOXICITY; MUMMICHOG; COPPER; ZINC; KIDNEYS

TAXONOMY: FUNDULUS HETEROCLITUS

Mixtures of cupric chloride and zinc chloride produced more deaths among mummichogs (FUNDULUS HETEROCLITUS) in synthetic seawater at 20% salinity and 20 degrees than was expected based on the toxicities of the individual salts, and concentrations of cadmium chloride not ordinarily lethal has a negative effect on the survival of fish intoxicated by salts of copper, zinc, or both. Cadmium, copper, and zinc residues for survivors held in mixtures, especially cadmium and zinc mixtures did not conform to patterns observed for single elements. Atomic absorption determinations of cadmium, copper, and zinc residues from mummichogs surviving 96 hour exposures provided useful indices of total body burdens for these metals but whole body aggregates of cadmium, copper, and zinc from dead mummichogs were of limited value because of accumulation of the metals after death. Renal and lateral line canal lesions were observed in all fish subjected to copper concentrations greater or equal to 1 MG/L. Renal lesions in fish immersed in mixtures of CuCl2 and CdCl2 showed a damage pattern characteristic of cadmium, and with mixtures of CuCl2 and ZnCl2 the lesions were typical of copper-induced damage. Epithelia lining the oral cavity were necrotized by the caustic action of ZnCl2 (60 MG/L) and CuCl2 (8 mg/l).

149
Elemental Composition of the Estuarine Teleost FUNDULUS HETEROCLITUS (L.)

Fisler, R.; LaRoche, G.

J. Exp. Mar. Biol. Ecol., 9, 29-42; 1972

MUMMICHOG; SALINITY; PH; DISSOLVED OXYGEN; SALT WATER; ATOMIC ABSORPTION SPECTROPHOTOMETRY; FISH; CALCIUM; COPPER; IRON; POTASSIUM; MAGNESIUM; MANGANESE; SODIUM; STRONTIUM; ZINC; SILVER; GOLD; ALUMINUM; BARIUM; BERYLLIUM; CADMIUM; COBALT; CHROMIUM; CESIUM; LITHIUM; NICKEL; LEAD; RUBIDIUM; THALLIUM; SIZE EFFECTS; AGE EFFECTS; SEASONAL VARIATIONS; TEMPERATURE EFFECTS

Elements that were consistently present in whole ashed FUNDULUS HETEROCLITUS (L.) as determined by atomic absorption sepctroscopy were calcium, copper, iron, potassium, magnesium manganese, sodium, strontium, and zinc; not measurable were silver, aluminum, gold, barium, beryllium, cadmium, cobalt, chromium, cesium, lithium, nickel, lead, rubidium, and thallium. This pattern was not affected by the age of the fish, its sexual condition, or the season of collection. Changes in whole body content of selected elements were observed with increasing age: in the range between 46 and 118 millimeters total body length, large fish contained more calcium and strontium and less potassium, magnesium, sodium, and zinc than small fish; Fundulus intermediate in size exhibited intermediate values for these elements. On an ash weight basis, heads were comparatively low in potassium, iron, magnesium, zinc, and strontium and carcasses comparatively high in potassium and low in copper, iron, strontium, and sodium. Viscera contained high concentrations of most elements when compared with heads and carcasses, especially iron, zinc, strontium, and copper. In a study of the effect on whole body elemental content of two size ranges of Fundulus, at two water temperatures, two salinities, and two acclimatization periods, we found that Fundulus 84 millimeters in length container more calcium, and less copper, potassium magnesium, sodium, and zinc per unit weight than those measuring 47 millimeters. Within each size group, fish kept at 5 or 20 degrees C at salinities of 9 0/00 or 27 0/00 exhibited essentially the same elemental composition after 30 days; however, fish held for 30 days when compared with those held for only three days contained significantly less calcium, sodium, potassium, magnesium, zinc, copper, and manganese. In another study on effects of three sea-water formulations, two feeding frequencies, and two medium replacement rates on whole body elemental composition, changes were least pronounced during a 30-day period among fish that were fed daily as compared with weekly, that were held in a sea-water formulation developed by our laboratory as compared with natural sea water or a commercial preparation, and among groups with the medium replaced twice weekly compared with no replacement. Selected data on the elemental composition of other species of teleosts and elasmobranchs are presented and discussed.

150
Pesticide Study Series 1: A Catalog of Research in Aquatic Pest Control and Pesticide Residues in Aquatic Environments

Environmental Protection Agency; Office of Water Programs

Contract No. 68-01-0349 (Office of Water Programs), GPO No. 5501-0355, Project Officer, Charles D. Reese, Agronomist; 1972, May

PESTICIDES; AQUATIC BIOLOGY; PEST CONTROL; RESIDUES;

151
Concentrations of Zinc-65 in Marine Foodstuffs and Pacific Coastal Residents

Essig, T.H.; Endres, G.W.R.; Soldat, J.K.; Honstead, J.F.

Part of Radioactive Contamination of the Marine Environment, Proceedings of Symposium held by the International Atomic Energy Agency, Seattle, WA, July 10-14, 1972, 651-668

ZINC; ZINC 65; RIVERS; MARINE FOODSTUFFS; NEUTRON ACTIVATION; RADIOACTIVITY; FOOD CHAINS; METABOLISM; SHELLFISH; PRODUCTION REACTOR; EFFLUENTS; HUMANS; HALF-LIFE

GEOGRAPHICAL DESCRIPTION: U.S. (NW), Washington, Hanford, Columbia River

Hanford production reactors and released to the Columbia River in effluent cooling water prior to February 1971 was zinc-65. This nuclide has a relatively long radioactive half-life (245 days) and is an isotope of an element utilized in metabolic processes by most shellfish and other aquatic life forms. Consequently, zinc-65 is found in fish and shellfish in the Columbia River and in the Pacific Ocean near the mouth of the river. The transfer of zinc-65 through various food chains to man has been studied at Hanford for a number of years. In the present study, consumption rates of four seafoods were obtained for residents of two coastal communities. These consumption rates were used, together with concentrations of zinc-65 in the foods of interest, to estimate body burdens of zinc-65. The estimated body burdens were then compared with body burdens determined by whole-body counting techniques. The distributions of the ratios between the measured and calculated zinc-65 body burdens are somewhat flat and not centered on 1.0. However, they could well be typical of data of this type obtained from the general population. Some of the scatter is undoubtedly due to inaccuracies in recalling seafood consumption, and some is quite likely due to real variations in uptake and retention of zinc-65 between individuals. Particularly, the retention of zinc-65 may be a function of the amount of stable zinc already in the body. Persons [illegible] low body burdens of stable zinc may pick [illegible] retain higher levels of radioactive zinc, and vice versa. The effective half-life of any radionuclide certainly varies from one person to another because of differences in body metabolism. Considering the many variables, agreement within a factor of two between the measurements and calculations is a reasonable result. Further studies are planned for autumn 1972.

152
Mercury in Public Sewer Systems

Evans , R.L.; Sullivan, W.T.; Lin, S.; Water Qual. Sect., Illinois State Water Surv., Peoria, Ill.

Water Sewage Works(WSWOAC), 120(2), 74-6; 1973

MERCURY; SEWAGE; FISH; PAPER; FISH PRODUCTS

GEOGRAPHICAL DESCRIPTION: U.S., Illinois

The geometric mean of total mercury concentrations in five public sewer systems in central Illinois ranged from 1.3 to 1.8 ppb. Illinois standards stipulate a maximum concentration of 0.5 ppb of mercury in public sewer systems. Without lowering the existing tolerance guidelines for mercury in foodstuffs, paper products, drinking water, etc, it would appear difficult to comply with Illinois standards. There appears to be a background concentration of mercury in public sewer systems solely devoid of industrial waste influence.

153
Effects of Ocean Water on the Soluble-Suspended Distribution of Columbia River Radionuclides

Evans, D.W.; Cutshall, N.H.

Part of Radioactive Contamination of the Marine Environment, Proceedings of Symposium held by the International Atomic Energy Agency, Seattle, WA, July 10-18, 1972 (125-139) 786 p.; 1973

ZINC; ZINC 65; ANTIMONY; SCANDIUM; MANGANESE; MANGANESE 54; RADIONUCLIDES; SOLUBLE-SUSPENSION DISTRIBUTION; FLOCCULATION; PRECIPITATION; ADSORPTION; SALTWATER; RIVERS; SALINITY

GEOGRAPHICAL DESCRIPTION: U.S. (NW), Washington, Hanford, Columbia River

The relationships of dissolved concentrations of Hanford radionuclides with salinity in the Columbia River estuary were interpreted in terms of the exchange of the radionuclides between dissolved and suspended particulate matter upon mixing with ocean water in the estuary. Experiments in which ocean water was added to Columbia River water and to suspended particulate matter collected on filters confirmed the partial desorption of zinc-65 and manganese-54 from the particulate phase. The percentage of zinc-65 and manganese-desorbed varied with experimental approach but desorption of zinc-65 seemed to lie in the range 15 - 45% and manganese-54 in the range 30 - 60%. None of the experiments revealed any effect of salinity upon the soluble-suspended particle distribution of chromium-51, antimony-120 or scandium-46. Dissolved concentrations of these nuclides varied inversely with salinity. There was no evidence that any of the radionuclides studied was removed from solution by flocculation, precipitation or adsorption as the result of mixing with ocean water. Ocean water contact partially removed manganese-54 but not zinc-65 scandium-46 or cobalt-60 from Columbia River bottom sediments transferred to the marine environment. The inability of ocean water to desorb zinc-65 from bottom sediment contrasts with its action with suspended particulate zinc-65.

154
Structural and Physiological Studies on the Parasitic Red Alga Holmsella-Pachyderma

Evans, L.V.; Callow, J.A.; Callow, M.E.

New Phytol, 72(2), 393-402; 1973

FLORIDOSIDE; MANNITOL; STARCH; PHOTOSYNTHESIS; PRODUCT; CHROMATOGRAPHY; AUTORADIOGRAPHY; ACCUMULATION; PARASITES; ALGAE; RED ALGAE; CARBON 14

TAXONOMY: GRACILARIA; GRACILARIA-VERRUCOSA

A study has been made of the structural and physiological relationship between the autotrophic red algae, GRACILARIA VERRUCOSA, and the parasitic, chlorophast-free, red alga, HOLMSELLA PACHYDERMA. By means of carbon-14-labelling experiments, the major product of photosynthesis in the GRACILARIA was found to be the alcohol glycoside, floridoside. Chromatography and autoradiography showed that carbon-14 was transferred to HOLMSELLA and accumulated there as floridoside, mannitol and starch. This transfer probably occurred through endophytic filaments which arise from the base of the parasite and penetrate between the cells of the GRACILARIA.

155
Methyl Mercury Accumulation in an Aquatic Food Chain. A Model and Some Implications for Research Planning.

Fagerstrom, T.; Asell, B.

Ambio, 2(5), 164-71; 1973

METHYLMERCURY; BIOACCUMULATION; MATHEMATICAL MODEL; FOOD CHAINS; INTAKE; FOOD; OXYGEN; AQUATIC ECOSYSTEMS

Methyl mercury accumulation in fish is theoretically studied by means of a mathematical model for a three-step food chain. The model assumes gain of methyl mercury in proportion to intake of oxygen and food, these in turn being size-dependent. Some properties of the model are analyzed with the specific aim of getting guidance for further research activities. This analysis lends, qualitatively, support to the belief that direct uptake of methyl mercury from water is the most important subject for further study.

156
Some Aspects of the Quantitative Ecology of Mercury

Fagerstrom, T.; Jernelov, A.; Swed. Water-Air Pollut. Res. Lab., Stockholm, Sweden

Water Res. 6, 1193-1202

TRANSFORMATION; AQUATIC ECOSYSTEMS; FIELD EXPERIMENTS; QUANTITATIVE ECOLOGY; MERCURY; LABORATORY STUDIES

TAXONOMY: METANOBACTERIUM AMELIANSKII; PSEUDOMONAS

This paper outlines some of the most important ecological properties of mercury and describes a sub-model constructed for computer simulation. Mercury sulfide, HgS, a low solubility compound, is formed whenever mercury (+2) and sulfur (-2) are present and mercury may also take over sulfide ions from other sulfides. HgS may also be formed monomethyl mercury in the presence of sulfide ions. HgS, upon oxidation, yields mercury ions and sulfate (SO_4) ions. Elemental mercury results from the physico-chemical or biochemical reduction (PSEUDOMONAS) of divalent mercury. Oxidation of elemental mercury has been shown to occur in an aquatic environment when organic substances and oxygen are present. Complexes between divalent mercury and organic substances are readily formed in water. Mercury shows a particular affinity for sulph-hydryl organic substances. Resolubilization of divalent mercury in the form of soluble organic complexes may occur occur but reformation of soluble inorganic complexes are probably not very significant. Formation of divalent mercury inorganic complexes can be formed with silica type or ferro-manganese type compounds. Methyl mercury is formed along one of two biochemical pathways: a nonenzymatic and an enzymatic transfer of methyl groups from methyl cobalamin to inorganic mercury in METANOBACTERIUM AMELIANSKII; enzymatic methylation of mercury bound to homocystein has been shown to occur in Neurospora. Biologic decomposition of methyl mercury occurs in Pseudomonas as well as some higher organisms. Dimethyl mercury is formed from inorganic mercury or monomethyl mercury in connection with microbiological activity. UV light mediates the conversion back to elemental mercury. Quantification of the translocation of methyl mercury (and its breakdown products) is presented.

157
Uptake and Biotransformation of Phenylmercuric Acetate by Aquatic Organisms

Fang, S.C.; Dep. Agric. Chem., Oregon State Univ., Corvallis, OR

Arch. Environ. Contam. Toxicol.(AECTCV), 1(1), 18-26; 1973

PHENYLMERCURIC ACETATE; METABOLISM; FISH; SNAILS; MERCURY; PLANTS; ELODEA; GUPPY; COONTAIL; BIOLOGICAL HALF-LIFE; FRESHWATER

TAXONOMY: ELODEA CANADENSIS; CERATOPHYLLUM DEMERSUM; LEBISTES RETICULATUS; HELISOMA CAMPAN ULATA

Guppy (LEBISTES RETICULATUS), snail (HELISOMA CAMPANULATA), Elodea (ELODEA CANADENSIS), and coon tail (CERATOPHYLLUM DEMERSUM), when exposed to water containing 203 Hg-labeled phenylmercuric acetate, readily absorbed this compound. The rate of absorption was related to the time of exposure and the compound concentration; the absorbed phenylmercuric acetate was mainly coverted to inorganic mercury ethylmercuric chloride was a minor metabolic product. The radioactive Hg was not rapidly eliminated from the guppy, elodea, and coontail when the organisms were placed in fresh water, the biological half-life of 203 Hg residues ranging between 83 to 58 days.

158
Effects of Some Chelating Agents and Their Copper Complexes on Photosynthesis in SCENEDESMUS QUADRICAUDA

Fangstrom, I.; Inst. Physiol., Univ. Uppsala, Uppsala, Sweden

Physiol. Plant. (PHPLAI), 27(3), 389-97; 1972

CHELATION; COPPER; ALGAE; PHOTOSYNTHESIS; HYDROXYQUINOLINE; TROPOLONE; ISOPROPHY DIMETHYLDITHIOCARBAMATE

TAXONOMY: SCENEDESMUS QUADRICAUDA

The effects on apparent photosynthesis in the green algae SCENEDESMUS QUADRICAUDA of four chelating substances, 8-hydroxyquinoline (= oxine), beta-isopropyltropolone (= beta-thujaplicin), sodium dimethyldithiocarbamate and 3-(beta-hydroxy-ethyl)-C-pentamethylene-3-aza-dithiocarbamate have been investigated. The first three compounds mentioned all had an inhibitory effect on photosynthesis, measured as oxygen production with a manometric, a volumetric or a polarographic method. In combination certain concentrations of $CuSO_4$ bimodal dose response curves were observed, similar to those obtained on the growth of different microorganisms. Calculations of the amounts of different complexes that appeared in the nutrient solutions duri ng the experiments are compared with the recorded degrees of inhibition. The r esults strongly indicate that the 1:1-complexes between copper(2+) and the chela ting substances are the most toxic agents at low concentrations of these compoun ds.

159
Investigation of Dispersion and Dilution of Suspended Species in River Flow by Radio-Tracer Techniques

Filip, A.; Boris Kidric Institute of Nuclear Sciences, Vinca-Beograd, Yugoslavia

International Journal of Applied Radiation and Isotopes, 22, 331-337; 1971

DISPERSION; DILUTION; SEDIMENTS; RIVERS; TRACERS; RADIOACTIVITY; TRANSPORT; SORPTION; BROMINE 82; LANTHANUM 140; DISTRIBUTION; FRESHWATER; FLOW DYNAMICS

Interconnection between soluble and suspended material in a river arises through the process of sorption. This implies that a significant part of the soluble effluent is carried by the suspended material. As a result, even in the case of extensive sorption, the transport of effluent is influenced by mechanisms having different velocities in the fluid. Attention is paid to the transport phenomena of natural suspended material and to suspended material which can appear in river streams as an effluent. Their behaviour is compared with water soluble material which has negligible sorption. Natural suspended material and cellulose fibers have been labeled by radioisotope lanthanum-140, and bromine-82 is used as the water soluble tracer. In each test 0.1-1.0 kg of the above mentioned material was released virtually instantaneously as a point source of total activity of approximately 1 Ci. The flow-rate during the experiments was about 3500 m3/sec. Distribution of tracer materials was followed to a distance of 11 km downstream from the injection point. From the concentration-time distribution the dispersion coefficients have been determined.

160
Mercury Accumulation by the Fresh Water Algae SELENASTRUM CAPRICORNUTUM

Filip, D.S.; Lynn, R.T.

Chemosphere No. 6, 251-258; 1972

MERCURY; BIOACCUMULATION; FRESHWATER; ALGAE; ABSORPTION

TAXONOMY: SELENASTRUM CAPRICORNUTUM

SELENASTRUM CAPRICORNUTUM, a unicellular, fresh water, green algae, was selected for these experiments as a widely distributed representative of low trophic level aquatic plants. Algae cultured in a modified Bristol solution in which 0.1 ppm mercury was maintained were exposed to either light, darkness, or were formalin-killed. Analysis for mercury content was made of a hydrolysate of algae cultured under these conditions. Results showed no si gnificant difference in mercury content among the three types indicating that th e rapid absorption of organic mercury is solely a passive process.

161
Mercury Contamination of Fish in Northwestern Ontario

Pimentel, R.; Reynolds, L.M.; J. Wildl. Manage. (JWMAA 9), 37(1), 62-8

J. Wildl. Manage. (JWMAA 9) 37(1); 62-8; 1973

MERCURY; FISH; MUSCLES; PIKE; CHLORINE PLANTS; LAKES; WALLEYE; BURBOT

TAXONOMY: ESOX LUCIUS; LOTA LOTA; STIZOSTEDION VITREUM

GEOGRAPHICAL DESCRIPTION: Canada, Ontario (NW)

The maximum mercury levels in lateral muscles of northern pike (ESOX LUCIUS), burbot (LOTA LOTA), and walleye (STIZOSTEDION VITREUM) from northwestern Ontario were 27.8, 24.8, and 19.6 ppm, respiration measured in specimens taken 50-60 miles downstream from a chlorine plant. They decreased proportionally to the distance from the plant but were increased even 200 miles downstream. The levels in specimens from suspected uncontaminated lakes were generally less than 1 ppm but frequently greater than 0.2 ppm which is consid ered as the maximum background concentrations.

162
Effects of Regulatory Guidelines on the Intake of Mercury from Fish. Mecca (Model for the Estimation of the Consumption of Contaminants) Project

Finch, R.; Fish. Prod. Res. Insp. Div., Natl. Mar. Fish. Serv., Washington, DC

Fish. Bull. (FSYBAY), 71(3), 615-626; 1973

MERCURY; FISH; MODELS; INTAKE; REGULATION

From a computer model, which uses known levels of microconstituents in 52 kinds of fish to predict the distribution of the daily intake of the microconstituents, it was estimated that intakes of mercury from fish would remain safe if the guidelines for Hg in fish were raised from the present level of 0.5 ppm to 1.5 ppm. The model can be used to predict the distribution of consumer intakes from fish of any constituent present in fish for which the levels in the edible portion of the 52 kinds of fish used in the model are known.

163
Organic Mercury Compounds in Coastal Waters

Fitzgerald, W.F.; Lyons, W.B.; Mar. Sci. Inst., U niv. Connecticut, Groton, Conn.

Nature (London) (Natuas), 242(5398), 452-3; 1973

MERCURY; COASTAL WATERS; ORGANIC MERCURY

GEOGRAPHICAL DESCRIPTION: U.S., New York, Connecticut, Long Island Sound, Connecticut River

Water samples from coastal waters and adjacent river waters in the vicinity of Long Island Sound were analyzed for inorganic and total mercury. Particulate matter was not analyzed. A modified flameless atomic absorption technique was used. The precision of analysis for mercury is 15% based on re peats of a standard sample. As nigh as 50-60% of the mercury present in the sam ples may exist either as organic compounds or in association with organic matter. Total mercury concentrations ((1.E-1 micrograms) for the four sampling sites are: Con necticut River, 0.045; Avery Point Dock, 0.067; Fishers Island Sound, 0.078; Rac e, Long Island Sound, 0.087.

168
Some Trace Element Concentration Variations Observed in Marine Organisms That Suggest Caution in Sampling

Folson, T.P.; Hodge, V.F.; Wong, K.M.; Kishore, P.; Guinn, V.P.; Scripps Institution of Oceanography, La Jolla, Calif. Soledad Lab.

TID--26198 Report for the IDOP Workshop on Baseline Measurements at Brookhaven National Laboratory, Upton, NY, May 24-26, 1972; 1973

ANIMALS; AQUATIC ECOSYSTEMS; BIOLOGICAL VARIABILITY; ELEMENTS; GEOGRAPHY; PLANTS; QUANTITY RATIO; TRACE AMOUNTS; SEAWATER

This report presents examples to emphasize how greatly concentrati ons of certain trace elements may vary within a given organism and suggests that importance must be given to sampling tissues consistently. Relatively little is known about how the several trace elements are distributed between the vario us organs, and still less about how the concentrations vary in different tissue s within the organ. Variations also occur with size and age. Thus, heavy avera ge concentrations of zinc in organs of albacore occur in the tail fin while low average concentrations of selenium occur in the tail fin. A striking example of high specific local concentration occurs in the outer layers of Pik kelp; almos t 1000 times higher concentrations of polonium-210 have been found in the outer layers than in the inner layers.

165
Sources and Inventory of Radioactivity in the Aquatic Environment

Foster, R.; Battelle Pacific Northwest Labs., Richland, Wash.

Battelle Pacific Northwest Labs., Richland, Wash. Contract AT(45-1)-1830, BNWL--SA--4614; CONF-730603--7; 1973, June

ANTIMONY; AQUATIC ECOSYSTEMS; BARIUM 140; BERYLLIUM 7; CARBON 14; CERIUM 144; CESIUM 134; CESIUM 137; CHROMIUM 51; RIVERS; COBALT 58; COBALT 60; CONTAMINATION; DAUGHTER PRODUCTS; DIFFUSION; REACTORS; FALLOUT; FUEL REPROCESSING; IODINE 131; IRON 55; LIQUID WASTES; MANGANESE 54; MARINE DISPOSAL; NATURAL RADIOACTIVITY; NIOBIUM 95; NUCLEAR INDUSTRY; NUCLEAR SHIPS; PHOSPHORUS 32; POTASSIUM 40; RADIOACTIVE WASTE DISPOSAL; RADIOACTIVE WASTES; RADIOACTIVITY; RADIONUCLIDE MIGRATION; RADIUM 226; RIVERS; SCANDIUM 46; SNAP BATTERIES; STRONTIUM 87; RUTHENIUM 106; STRONTIUM 89; STRONTIUM 90; SURFACE WATERS; TECHNETIUM 99; THORIUM 232; TRACERS; TRITIUM; URANIUM 235; URANIUM 238; YTTRIUM 91; ZINC 65; ZIRCONIUM 95

166
Mercury in Fish and Crustaceans Consumed in Belgium

Foussin, A.; Fontaine, A.; Noirfaline, A.; Lab. Anal. Denrees Aliment., Univ. Liege, Leige, Belg.

Arch. Belg. Med. Trav. Med. Leg. (ABMHAH), 31(3), 85-92; 1973

MERCURY; CONTAMINATION; FISH; TUNNY; PIKE; RAY; SHARK; CRUSTACEA

GEOGRAPHICAL DESCRIPTION: Belgium

167
Factors Affecting Plant Uptake and Distribution of Cadmium in Plants

Francis, C.W.; Bush, S.G.

Presented at the Seventh Annual Conference on Trace Substances in Environmental Health, University of Missouri-Columbia Colum bia, MO 65201; June 12-14, 1973

CADMIUM; UPTAKE; DISTRIBUTION ; PLANTS; BUSH BEANS; JAPANESE MILLET; IRON; CHELATION; NUTRIENTS; NITROGEN; PH; SELENIUM; DTPA; TOXICITY

TAXONOMY: PHASEOLUS VULGARIS (VAR. KENTUCKY WONDER) ECHINO CHLOA FRUMENTACIA

Conditions regulating cadmium uptake by plants are no t well understood. Bush beans (PHASEOLUS VULGARIS, var, Kentucky Wonder) grown in nutrient solutions were used to evaluate the effects of nitrogen, lead, and selenium on plant uptake of cadmium. Japanese millet (ECHINOCHLOA FRUMENTACIA) was grown in soil under greenhouse conditions to evaluate the plant availability of cadmium from two chemical forms of cadmium (cdCl(2) and CdO). Plant uptake o f cadmium was nearly tenfold greater from nutrient solutions [[[[containing an iron chelate (FeDTPA) at lead 8.6 than at 6.5. In nutrient solutions not conta ining the iron chelate, cadmium uptake was equal at both lead's. Zinc amendment s significantly (P is less than 0.05) decreased root cadmium-109 concentrations; however, significantly greater cadmium-109 concentrations (P is less than 0.05) were found in leaves of bush beans growing in 5 ppm than 1 ppm zinc with no a pparent zinc toxicity. Bush beans grown in nutrient solutions containing 0.1 pp m selenium contained lower concentrations of applied cadmium 109 than those grow n at selenium concentrations of 0.001 ppm. Cadmium-109 concentrations in Japanes e millet were significantly (P is less than 0.05) lower in plants grown in soil amended with calcium carbonate soil lead is greater than 7) than those grown at lead 5.1. This was true for soil applications of both the chloride and the oxid e form of cadmium-109. In the first harvest of Japanese millet, cadmium foliar concentrations were significantly (P is less than 0.05) higher for the chloride form than the oxide, but in the second harvest, only plants grown in the unlime d treatments showed significantly different cocentrations between the two forms. In neutral to alkaline soils three months after application, the forms of cadm ium appear to affect cadmium uptake by plants only to a small degree. Thus, it appears that soil reaction products play a dominant role in cadmium availability to plants.

168
Mercury Content of Sediments from Two Lakes in Dalarna, Sweden

Fredriksson, I.; Qvarfort, U.; Dep. Quaternary Geol., Inst. Geol., Uppsala, Swed.

Geol. Foeren. Stockholm Foerh. (GFSFA4), 95(Pt. 2), 237-42; 1973

MERCURY; SEDIMENTS; LAKES

GEOGRAPHICAL DESCRIPTION: Sweden, Dalarna

169
Mercury in Canadian Seals

Freeman, H.C.; Horne, D.A.; Fisheries Research Board of Canada, Halifax Laboratory, 1707 Lower Water Street, Halifax, Nova Scotia, Canada

Bull. Environ. Contam. Tox. 10 (3), 172-180; 1973

MERCURY; SEALS; FETUS; METHYLMERCURY

The mercury concentration was determined in ringed and bearded seal claws, tissues from a harbor seal, tissues obtained from 6 gray seals of different sizes and ages, tissues from ten female harp seals and their pups, and a female gray seal and her fetus. It was suggested that the mercury concentration of the fur and claws could be used as indicators of the degree of the seals' mercury contamination. Preliminary results indicate that mercury contamination in these species, from the same location, increases with size. The methylmercury concentration of seal pups was lower than that of their mothers. The fetus of the seal did not show a preference for mercury over that of the mother's tissues. It was suggested that seals may possess enzyme systems that demethylate mercury.

170
Total Mercury and Methylmercury Content of the American Eel (ANGUILLA ROSTRATA)

Freeman, H.C.; Horne, D.A.; Halifax Lab., Fish. Res. Board Canada, Halifax, Nova Scotia

J. Fish. Res. Board Can. (JFRBAK) 1973, 30(3) 456-6

MERCURY; AMERICAN EEL; METHYLMERCURY; SEX

TAXONOMY: ANGUILLA ROSTRATA

The total mercury content of american eels (ANGUILLA ROSTRATA) caught in Nova Scotia was 0.72 ppm, and the methylmercury content was 0.40 ppm. There was no correlation between the levels of mercury and the sex or weights of the eels. These eels may be fit for human consumption, as they contain less than 0.5 ppm methylmercury and less than 1.0 ppm total mercury.

171
Sampling the Edible Muscle of the Swordfish (XIPHIAS GLADIUS) For Total Mercury Analysis

Freeman, H.C.; Horne, D.A.; Halifax Lab., Fish. Res. Board Canada, Halifax, Nova Scotia

J. Fish. Res. Board Can. (JFRBAK), 30(8), 1251-2; 1973

SWORDFISH; MERCURY; FISH; ANALYSIS; MUSCLES

TAXONOMY: XIPHIAS GLADIUS

Total mercury was uniformly distributed in the edible muscle tissue of three swordfish, demonstrating that a sample of muscle tissue taken from any region is representative of the whole muscle tissue when used for mercury analysis. The mean plus or minus Standard Error total mercury concentrations of longitudinal, depth, and transverse muscle sections from three swordfish were: 1.07 plus or minus 0.04, 1.03 plus or minus 0.04, and 0.99 plus or minus 0.08 microgram/gram; 0.15 plus or minus 0.01, 0.15 plus or minus 0.03, and 0.14 plus or minus 0.02 microgram/gram; and 0.55 plus or minus 0.01, 0.61 plus or minus 0.04, and 0.58 plus or minus 0.06 microgram/gram, respectively.

172
Recovery of Rainbow Trout From Aluminum Poisoning

Freeman, R.A.; Dep. Fish. Wildl. Biol., Colorado State Univ., Fort Collins, Colo.

Trans. Amer. Fish.Soc. (TAFSAI), 102(1), 152-4; 1973

ALUMINUM; POISONING; FISH; METALS; RAINBOW TROUT

173
Chemical Element Balances and Identification of Air Pollution Sources

Friedlander, S.K.; W. M. Keck Engineering Laboratories, California Institute of Technology, Pasadena, Calif. 91109

Environ. Sci. Tech. 7(3), 235-240; 1973

PARTICULATES; HYDROCARBONS; EMISSIONS; POINT SOURCES; ATMOSPHERE; AIR

Air pollution sources of given types, whether natural or man-made, emit a characteristic set of chemical elements in approximately fixed proportions. If the sources in a polluted region are known, the contributions from each source can be estimated by measuring elemental concentrations at a given point and solving a set of simultaneous linear algebraic equations. The method has been applied over an 11-hr. period and averaged over particle size. For the period in question, about 15% of the particulate matter resulted from primary natural sources and 25% from primary man-made sources. About 40% of the total results from atmospheric reactions with one quarter produced by the conversion of gas phase hydrocarbons to particulate form. The estimate for this figure is based on a carbon balance. Altogether, about 70% of the total particulate burden has been accounted for with water probably making up a significant proportion of the missing 30%. Improvement and extensions of the method are discussed.

174
Accumulation of Mercury by Fresh Water Planktonic Diatom

Fujita, M.; Hashizume, K.; Natl. Inst. Public Health, Tokyo, Japan

Chemosphere (CMSHAG), 1(5), 203-7; 1972

DIATOMS; MERCURY UPTAKE; UPTAKE; MERCURY ACCUMULATION; PLANKTON; ACCUMULATION; MERCURY; FRESHWATER

TAXONOMY: SYNEDRA ULNA

The accumulation of mercury in SYNEDRA ULNA, a freshwater diatom, grown in a medium containing radioactive mercury was examined. The uptake of mercury from the medium by SYNEDRA occured rapidly after addition of mercuric chloride and attained a maximum during the first 7 hours. The uptake was mainly due to adsorption on the surface of cells. The concentration of mercury in the SYNEDRA was 1.8 - 6.1 x 10(-8) times its concentration in freshwater. This concentration of mercury in SYNEDRA was found to vary, it being influenced by the concentration of mercury or inorganic ions in the culture medium.

175
Accumulation of Mercury in the Food Chain. River Model.

Fujita, M.; Hashizume, K.; Inst. Public Health, Minist. Health Welfare, Japan

Soda to Enso (STOKB8), 24(9), 303-315; 1973

REVIEW; MERCURY; FOOD CHAINS; RIVERS; ALGAE; INSECTS

A review with 3 references. Mercury accumulation in nature is discussed using the experimental river food chain (algae, insects, and fish).

176
Biological Impact of Combined Metallic and Organic Pollution in the Coeur D'Alene-Spokane River Drainage System

Funk, W.H.; Rabe, F.W.; Filby, R.; Parker, J.I.; Winner, J.P.; Washington State Water Res. Cent., Pullman, WA

PB Report No. 222946/6, 202p.; 1973

METALS; RIVERS; BIOTA; ORGANIC COMPOUNDS; CONTAMINATION

GEOGRAPHICAL DESCRIPTION: U.S., Spokane River, Coeur D'Alene River

177
Trace Metals and Organisms

Fuwa, K.; Fac. Agric., Univ. Tokyo, Tokyo, Japan

Bussei (BUSIBU), 1973, 14(6) 396-401

REVIEW; TRACE METALS; COPPER; EUGLENA; ZINC; CARBOXYPEPTIDASE; CADMIUM; METALLOCYANEIN; MICROORGANISMS

178
Trace Metals and Organisms

Fuwa, K.; Fac. Agric., Univ. Tokyo, Tokyo, Japan

Bussei (BUSIBU) 14(6), 396-401; 1973

REVIEW; TRACE METALS; COPPER; EUGLENA; ZINC; CARBOXYPEPTIDASE; CADMIUM; METALLOCYANEIN; AQUATIC BIOTA

A review with 5 references on the influence of trace metals on organisms. Experimental results of traces of Cu on EUGLENA, the effect of traces of Zn on carboxypeptidase and traces of Cd in metallocyanein are discussed.

179
Migration and Leaching of Metals from Old Mine Tailings Deposits

Galbraith, J.H.; Williams, R.E.; Siems, P.L.

Ground Water, 10(3), 33-44; 1972

MIGRATION; LEACHING; METALS; MINES; TAILINGS; TRANSPORT; BACTERIA; MICROORGANISMS

Leaching of heavy metals by ground water passing through mine tailings is caused by the oxidation of sulfides through the action of microorganisms. The pH of the ground water entering the tailings system is reduced by mechanisms within the tailings system itself. Action of sulfide-oxidizing and sulfur-oxidizing bacteria causes the formation of sulfuric acid, thereby increasing the H and SO(4)2 concentration within the system. Metal ions go into solution as metal sulfates, and the concentration of H2S increases by the interaction of H and S2. Increase in H2S creates an environment suitable for the growth of sulfate-reducing bacteria which converts SO(4)2 to S2 and simultaneously precipitates metal sulfides at a pH near 6.6. Decrease in pH with depth destroys sulfate-reducing bacteria, and dissolution and leaching of the tailings increase. Four lines of evidence demonstrate the presence of microorganisms in the tailings system: (1) Fe-Mn concretions below the water table at Cataldo Mission Flats, (2) fixation of Na and K below the water table, (3) precipitation of sulfate salts on the surface of Cataldo Mission Flats, and (4) experiments on two sets of tailings samples, one from the surface which showed predominant aerobic acitivity and one from below the water table which showed predominant anerobic activity. Where oxygen is sufficient, iron oxidizing bacteria oxidize Fe^{2+} to Fe^{3+} which forms an insoluble hydroxide. Consequenly, very little iron is found in the ground water coming from the system. The combination of these mechanisms produces poor-quality ground water with respect to metals.

180
Transport of Trace Pollutants in Lead Mining Wastewaters

Gale, N.L.; Hardie, M.G.; Jennett, J.C.; Aleti, A.

Part of Hemphill, D.D. (Ed.), Sixth Annual Conference on Trace Substances in Environmental Health, Held at Memorial Union, University of Missouri-Columbia, Columbia, MO, June 13-15, 1972 (p. 95-106) 399p.; 1973

LEAD; COPPER; ZINC; MINING; PARTICULATES; MILLS; EFFLUENTS; NUTRIENTS; ALGAE; SILVER; ALGAL GROWTH; ACCUMULATORS; HEAVY METALS; UPTAKE; CADMIUM; PH; DISSOLVED OXYGEN; WATER HARDNESS; FLUORIDES; SUSPENDED SOLIDS; PHOSPHATE; NITRATES; NITRITE; AMMONIA; WATER QUALITY STANDARDS; WATER; RIVERS; BACTERIA; PROTOZOA; ROTIFERS; NEMATODES; MINE WASTES

The New Lead Belt region of southeastern Missouri, Located in a rural heavily wooded region of the Ozarks became the world's largest lead mining district in 1970. A comprehensive study of the water quality in receiving streams has been made during the past year as part of a continuing interdisciplinary effort to define and quantify the effects of the lead mining industry on the surrounding area. Prior to the full development of the mines, the heavy metals content of area streams was insignificant with background values for lead, copper, and zinc in the range of 1 to 20 parts per billion. Because of natural conditions present in the New Lead Belt, there is little problem with dissolved heavy metals in regional streams. Results indicate, however, that considerable quantities of finely ground mineral particles may escape flotation and tailings reservoirs and be transported through the aquatic environment, especially during periods of turbulence. In addition to escaping minerals, mine and particularly mill effluents sometimes contain nutrients which encourage the development of complex algal and microconsumer communities. These aquatic forms have been found to trap and assimilate lead in significant quantities. In streams receiving mine and mill effluent, there is an inverse relationship between the content of lead in the organisms of the first trophic level and distance downstream from the sources of contamination. We can conclude from these studies that because of stream and geochemical factors in this part of Missouri, under present water quality conditions, no significant problem of dissolved heavy metals being released from the lead mining industry is apparent. There is, however, the possibility and in some cases the evidence that large amounts of lead and zinc can be released in particulate form, and this is trapped and assimilated by local members of the biological community, particularly those in the lower trophic levels. Further studies are in progress to determine the extent of transferring heavy metals to higher trophic levels, but whether by consumption of contaminated algae and resultant food chain dissemination, or by dislodgement of the contaminated algae and passive dispersion during storm turbulence, or by sediment transport, the aquatic environment of the New Lead Belt is a major vehicle for present and potential dessemination of heavy metals from the mines and mills.

181
The Impact of Lead Mine and Mill Effluent on Aquatic Life

Gale, N.L.; Hardie, M.G.; Whitfield, J.; Marcellus, P.

Presented at the Environmental Session of the University of Minnesota Mining Symposium, Duluth, Minnesota; 1974, January 17

LEAD; MINES; MILLS; SMELTERS; AQUATIC BIOLOGY; ALGAE; ALGAL BLOOMS; ZINC; NUTRIENTS; HEAVY METALS

182
Photosynthetic Organisms and the Nutritional Impact of Mine and Mill Effluents in the New Lead Belt of Southeastern Missouri

Gale, N.L.; Wixson, B.G.; Hardie, M.G.; Jennett, C.J.; Dept. of Civil Engineering, Environmental Research Center

NSF-(RANN) New Lead Belt Project, University of Missouri-Rolla, 28p.

PHOTOSYNTHESIS; PLANTS; ALGAE; NUTRIENTS; MINES; MILLS; EFFLUENTS; LEAD; ZINC; HEAVY METALS; COPPER; ALGAL BLOOMS

183
Algal Growth Problems and Trace Metals Dissemination in Water Resource Studies in the New Lead Belt of S. E. Missouri

Gale, N.L.; Wixson, B.G.; Hardie, M.G.; Jennett, C.J.; Dept. of Civil Engineering, Environmental Research Center

NSF-(RANN) New Lead Belt Project, University of Missouri-Rolla, 36p.

ALGAE; ALGAL BLOOMS; NUTRIENTS; TRACE METALS; EUTROPHICATION; SMELTERS; LEAD; ZINC; CADMIUM; COPPER

184
Distribution of Dissolved Mercury in the Irish Sea

Gardner, D.; Riley, J.P.; Dep. Oceanogr., Univ. Liverpool, Liverpool, England

Nature (London) (NATURAS) 241(5391), 526-527; 1973

MERCURY; SALT WATER; DISTRIBUTION; SEWAGE; SLUDGE

This study of the distribution pattern of dissolved Hg in the Irish Sea shows that significant pollution occurs in the eastern coastal strip. There are two areas offshore in which the dissolved Hg concentration exceeds 200 ng l. -1; one of these is an area used for the dumping of sewage sludge from Manchester. Dried sludges are known to contain up to 150 ppm of Hg and, in fact, concentrations of particulate Hg of up to approximately 900 ng l. -1 were observed in the area. The authors suggest that the observed high concentrations of dissolved Hg found at this station were liberated during bacterial decomposition of the sludge. The dissolved Hg content is also relatively high (up to 443 ng l.-1) in an elongated patch to the west of the Ribble Estuary. The very low levels of dissolved mercury to the north indicates that the Hg does not originate from the effluents from the chlorine-alkali plant on the River Wyre. These two areas lie within that part of the Irish Sea yielding fish which have an average Hg content (0.53 ppm dry weight) more than double those from the rest of this sea (average 0.21 ppm).

185
Copper Induced Lesions in Estuarine Teleosts

Gardner, G.R.; LaRoche, G.; Natl. Mar. Water Qual. Lab., U.S. Environ. Prot. Agency, West Kingston, R.I.

J. Fish. Res. Board Can. (JFRBAK), 30(3), 363-368; 1973

COPPER; POISONING; FISH; MUMMICHOG; SILVERSIDE; MECHANORECEPTORS; TOXICITY; ZYGOTES; ESTUARIES

TAXONOMY: FUNDULUS HETEROCLITUS; MENIDIA MENIDIA

Cellular changes attributable to copper were observed in the mechanoreceptors of the lateral line canals in the head of adult mummichog (Fundulus heteroclitus) and Atlantic silverside (Menidia menidia), and the canal epithelium was altered in F. heteroclitus. In both species, lesions were observed in the olfactory organs, which included the chemoreceptive sites. These evidences of Cu poisoning were observed at 0.5, 1.0, and 5 mg/l. Concentrations of cu. renal changes were seen in F. heteroclitus exposed to 1.0 and 5 mg/l., and high cu concentrations administered i.p. to F. heteroclitus induced liver damage. Fry of F. heteroclitus were more sensitive to cu than the adults or their zygotes, and lesions were not evident in developing sensory areas of the lateral line or the olfactory systems in these immature forms.

186
Biological Effects of Cooling Tower Blowdown

Garton, R.B.; Natl. Environ. Res. Cent., Corvallis, Oreg.

AICHE Symp. Ser. (ACSSCQ), 69(129), 288-92; 1973

ZINC; BLOWDOWN; TOXICITY; CHROMATE; TROUT; ALGAE; POWER PLANTS; COOLING TOWERS

TAXONOMY: SELENASTRUM CAPRICORNUTUM

Both the zinc phosphate and sodium chromate components of a synthetic blowdown mixture duplicating the blowdown discharge from a proposed power company cooling tower were toxic to juvenile steelhead trout and to the green algae, SELENASTRUM CAPRICORNUTUM. The blowdown mixture was not toxic when the zinc and CrO4 components were removed.

187
Mercury DDT and PCB in Harbor Seals Phoca-vitulina from the Bay of Fundy and Gulf of Maine

Gaskin, D.E.; Frank, R.; Holdrinet, M.; Ishida, K.; Walton, C.J.; Smith, M.

J. Fish Res. Board Can., 30(3), 471-475; 1973

DIELDRIN; FAT; LIVER; DDT; PCB; SEALS; PORPOISES

TAXONOMY: PHOCA VITLINA; PHOCOENA PHOCOENA

Samples of blubber, longissimus muscle, liver, and cerebrum from 12 harbour seals (Phoca vitulina) were analyzed for DDT, dieldrin, PCBs, and total mercury content. The results were compared with those obtained previously for harbour porpoises (Phocoena phocoena). DDT and PCB levels appear to be of the same magnitude in the fat of seals from both southern New Brunswick and southern Maine, being lowest in a lactating female. Virtually no o,p'-DDT and relatively little dieldrin were found in seal fat, in contrast to porpoises, which contained significant amounts of both in the depot fat. Mercury levels were generally similar to those found for porpoises, but total liver Hg was considerably greater in adults frm the New Brunswick islands than in those from the southern Maine ledges.

188
The Cycling of Mercury Through the Environment

Gavis, J.; Ferguson, J.F.

Water Res., 6(9), 989-1008; 1972

CYCLING; MERCURY

189
Ground-Water Contamination. An Explanation of its Causes and Effects

Geraghty & Miller

A Special Report by Geraghty and Miller, Inc. Consulting Ground Water Geologists, Port Washington, NY; 1972, May

GROUND WATER; CONTAMINATION; CESSPOOLS; SEPTIC TANKS; STORM SEWERS; WATER SUPPLIES

Groundwater quality has only recently been seen to have deteriorated as a result of many years of dumping liquid wastes into the ground. Eventually this pollution will enter man's water supplies. Common sources of groundwater pollution are: cesspools and septic tanks; leaky sanitary and storm sewers. The expense and technical problems involved in reclaiming a contaminated aquifer are far greater than for surface waters. Inorganic chemicals are relatively indestructible, are persistent, and are difficult to remove from water. USPHS has set minimum standards for concentrations of substances acceptable in drinking water. Permeability of geologic formations depends on the rock and the nature of the bedding and fracturing. Geologic units are often underlain by a series of layers of rocks each with its own hydraulic characteristics. Waste fluid movement, both rate and direction, are influenced by the configuration and slope of the water table. The greater the slope, the more rapid the spread of contaminants. Normal ground water movement is to river or stream, never the reverse. However, when pumping of the aquifer occurs near a stream, ground water levels are lowered and the hydraulic gradient may be reversed. Saline aquifers may contaminate fresh water aquifers if the two zones are connected by abandoned or improperly sealed wells. There is now no Federal law prohibiting dumping of dangerous wastes on the land, and though most states do have such laws, enforcement is lax.

190
Water Atlas of the United States

Geraghty, J.J.; Miller, D.W.; Van der Leeden, F.; Troise, F.L.

Water Information Center, Inc., Water Research Bldg., Manhasset Isle, Port Washington, NY 11050 Inc., Water Research Bldg., Manhasset Isle, Port Washington, NY 11050 N.Y. ISBN: 0-912394-03-X; 1973

WATER; ATLAS; GEOGRAPHY; MAPS; LAKES; RIVERS

191
Toxic Effects of Mercury on the Activated Sludge Process

Ghosh, M.M.; Zugger, P.D.; Dep. Civ. Eng., Univ. Maine, Orono, Maine

J. Water Pollut. Contr. Fed. (JWPFA5), 45(3) 424-33; 1973

MERCURY; ACTIVATED SLUDGE PROCESS; WATER TREATMENT; SLUDGE; MICROORGANISMS; INHIBITION

A preliminary study was conducted to determine the effect of mercury dosed as HgCl2 on a batch-fed system of microorganisms similar to that found in the activated sludge process. The results of this investigation indicate that mercury at concentrations less than 2.5 mg/l as Hg2 + has little effect on the activity of a mixed aerobic biomass. However, at a dosage of 5.0 mg/l or higher, aerobic biological processes are definitely inhibited. The inhibitory effect of mercury is temporary. It is possible for an aerobic biological process to acclimate to a moderately high dosage of mercury. The time required for acclimation increases with the dosage of mercury applied to the system. At a dosage of 5.0 mg/l, a maximum COD removal of 86 percent was accomplished within 5 hours, and that at a dosage of 10.0 mg/l was 82 percent, accomplished in 9 hours. The maximum COD removal in the control was 93 percent, occurring within 3 hours.

192
Pharmacodynamics of Methyl Mercury in the Rainbow Trout (Salmo gairdneri). Tissue Uptake, Distribution, and Excretion

Giblin, F.J.; Massaro, E.J.; Dep. Biochem., State Univ. New York, Buffalo, NY

Toxicol. Appl. Pharmacol. (TXAPA9), 24(1), 81-91; 1973

MERCURY; RETENTION; RAINBOW TROUT; DIMETHYLMERCURY; FISH; ELIMINATION; PHARMACODYNAMICS; METHYLMERCURY; UPTAKE; DISTRIBUTION; EXCRETION; BIOACCUMULATION

TAXONOMY: SALMO GAIRDNERI

The tissue distribution, rate of uptake and concentration of 203Hg-labeled methylmercury was investigated in 20 different tissues organs over a period of 100 days following a single intragastric dose of 0.5 mg Hg/kg body weight. Mercury content was analyzed by gamma scintillation spectrometry. After 1 hr, mercury concentration factors >0.1 were detected in the blood, heart, liver, spleen and kidney (a concentration factor (CF) of 1.0 equals mercury concentration in dose). Highest mercury concentrations (CF>7.0) were observed in the blood (at 7 days) and spleen (art 14 days). After 100 days, the CF of the blood was >2.0 and the CF values of the spleen, kidney and liver were >1.0. Maximum CF values were reached in the skeletal muscle, brain and lens after 34, 56 and >90 days, respectively. Maximum values were reached in most other tissues/organs at approximately 7 days. Skeletal muscle appeared to function as a reservoir for methylmercury and accumulated 50% of the dose from 34 to 100 days post administration. Methyl mercury accumulation in the brain was limited to 0.1% of the dose. The rate of mercury excretion appeared to be biphasic as a result of a slow elimination from the skeletal muscle relative to the other tissues/organs. Employing both and the slow and fast rate, the half-retention time for methyl mercury in rainbow trout was estimated to be >200 days.

193
Prevalence of Human Dental Caries and Water-Borne Trace Metals

Glass, R.L.; Rothman, K.J.; Espinal, F.; Velez, H.; Smith, M.J.; Forsyth Dent. Cent., Boston, Mass

Arch. Oral Biol. (AOBIAN), 18(9) 10099-10104; 1973

MAGNESIUM; DENTAL CARIES; MOLYBDENUM; VANADIUM; FLUORIDE; COPPER; MANGANESE; CALCIUM

Marked differences in the prevalence of dental caries have been observed in two isolated villages in Colombia, South America. These differences approximate those observed between areas of minimal and optimal fluoride ingestion, although each village has less than 0.1 ppm fluoride in the drinking water. Dietary histories reveal remarkedly similar dietary practices. Samples of drinking water were collected from these villages, and analyzed by emission spectroscopy for the concentrations of 21 trace elements. In the case of 13 elements, concentrations were at or below the threshold of detection or showed minimal variability. Concentrations of calcium, magnesium, molybdenum and vanadium were higher in the water samples from the village with the low caries prevalence, while concentrations of copper, iron and manganese were higher in the samples from the village with the higher prevalence. These differences were highly significant. The caries prevalence in the high caries village was typical of the country as a whole.

194
Solution of Waste Water Problems in Metal Cutting Work

Goehgen, H.G.; Cologne, Germany

Werkstatt Betr. (WRGBA9), 106(5) 321-8; 1973

REVIEW; METALS; LUBRICATION; WASTEWATER; OIL EMULSION; SEWAGE

195
Mercury

Goldwater, L.J.; Clarkson, T.W.

Part of Lee, D.H.K., Metallic Contaminants and Human Health, Academic Press, New York, Chapter 2 (p. 17-55), 281p.; 1972

MERCURY; CINNABAR; CIRCULATION; LITHOSPHERE; HYDROSPHERE; ATMOSPHERE; WATER; BIOSPHERE; SOILS; PESTICIDES; MERCURIC CHLORIDE; MERCUROUS CHLORIDE; FISH; SHELLFISH; FUNGICIDES; ALKYLMERCURY; ARYLMERCURY; ALKOXYALKYLMERCURY; PHENYLMERCURY; METHYLMERCURY; SLIMICIDES; TUNA; SWORDFISH; FOOD CHAINS; FEATHERS; BIRDS; METHYLATION; BRAIN; TOXICITY; ENZIMES; BLOOD BRAIN BARRIER; KIDNEYS; EXCRETION; FECES; INHALATION; PNEUMONITIS; ACUTE; CHRONIC; SYMPTOMS; CONGENITAL DEFECTS; CEREBRAL PALSY; MENTAL RETARDATION; POISONING; DOSE-RESPONSE RELATIONSHIP; FOOD; BLOOD; BIOLOGICAL HALF-LIFE; MICE; RATS; SEALS; MONKEYS; POULTRY; CRAB; PIKE; FLOUNDER; EELS; DRINKING WATER; BLOOD LEVELS; BLOOD PLASMA; OCCUPATIONAL EXPOSURES; ANIMALS

Mercury is one of the least abundanct elements, namely about 2.7E-6 percent in the earth's crust. The only commercial ore is the sulfide, cinnabar. Usually the concentration in natural waters is less than 0.1 micrograms per liter but occasionally values up to several micrograms per liter and infrequently higher values. In the lithosphere the range is 3 parts per billion to 1) parts per million. In the atmosphere normal values are 1 to 10 nanograms per cubic meter. There is some circulation of natural mercury, with it evaporating into the atmosphere, being washed out with rain and flowing into the ocean, etc. Man has affected this natural circulation, in some ways and places seriously. Mercury compounds have been used as slimicides in pulp and paper plants, organic mercury compounds have been used as fungicides on seed grain and large quantities of mercury and its compounds have been lost and discharged to streams. Some mercury ahs evaporated and more has been emitted into the atmosphere as a result of burning coal. Within the last 5 years, it has been found that some of this mercury is methylated, is concentrated in little fish, and even more so in large predator fish and in fish--eating birds, to the point that there is a hazard to man, which has resulted in serious pathological effects in Minamata, Japan. Almost all the methyl mercury is absorbed in both fish and man and has a long biological half life in both, so that with a small steady intake, the level builds up. Graphs of build up and excretion are given. Severe cases of organic mercury poisoning have resulted from eating seed grain treated by mercury fungicides or from eating pork fed on such grain. The predominant feature is persanent organic injury to the brain resulting in weakness, paralysis, loss of vision and disturbed cerebral function. Severe cases become comatose and end fatally. In Minimata, Japan, the problems arose from eating mercury contaminated fish and shellfsih, apparently over several years. In both the above cases females without obvious symptoms gave birth to infants with congenital defects such as cerebral palsy, mental retardation, etc. Goldberg points out that various factors have complicated dose-response relationship and that minimal response has often been found with exposures greatly in excess of the accepted threshold value. He points out that the nature of the compound has a considerable effect on the absorption metabolism, excretion, and ability to pass barriers within the body. He says plasma concentrations of mercury are more significant than whole blood values.

196
Effect of Copper on Hematological Indices and Oxidase Activity of Serum Ceruloplasmin in Carp

Govorova, M.P.

Ref. Zh. Biol, 18, 43-45; 1971

COPPER; HEMATOLOGY; CARP; TOXICITY; OXIDASE ACTIVITY; SERUM CERULOPLASMIN; MILK

The effect of different amounts of Cu obtained from dry milk on hematological indices and the oxidase activity of the serum cerulolplasmin were studied in carp yearlings. The results confirmed conclusions obtained from work on mammals and suggested the desirable and toxic norms of Cu for carp. The ceruloplasmin oxidase activity was proportional to the amount of Cu in the food.

197
Growth Rates of Sediment-Living Marine Protozoan as a Toxicity Indicator for Heavy Metals

Gray, J.S.; Ventilla, R.J.; Wellcome Marine Laboratory, University of Leeds, Robin Hood's Bay, Yorkshire, England

Ambio, 2(4), 118-121; 1973

GROWTH; TOXICITY; LEAD; ZINC; MERCURY; TEMPERATURE SALINITY; FISH; SHELLFISH; EFFLUENTS; LC 50); MARINE ORGANISMS

The classical method for measuring the toxicity of a chemical to a marine organism is by the LC50 test. In this test the concentration which kills 50 percent of the test organisms in 48 or 96 hours is determined and is frequently used to set upper limits for concentrations in effluent discharge. The test can be criticized on a number of points, a) the duration of the test is too short, when effluent discharge will be continuous, b) should the organism survive the test, it may not grow and reproduce at the tested concentration and in nature the organism may avoid that concentration of chemical (important to migratory fish and shellfish), c) on the assumption that toxicity increases with temperature, summer temperatures are used in the test, whereas stress conditions may be greater at lower temperatures, d) the organisms used are frequently at high trophic levels and are adults, whereas lower trophic levels and larvae are known to be more susceptible, e) chemicals are tested singly, whereas in nature mixtures of chemicals occur. In an attempt to allay such criticisms we have used an organism of low trophic level, a bacterivorous ciliate, and have measured changes in growth rate rather than mortality as criteria of pollution. Using factorial designs and response surface analysis, experimetnal conditions were optimized with respect to salinity-temperatre cominations. With near optimum conditions the effects of mercuric ions ($HgCl_2$), lead ions ($Pb(NO_3)_2$) and zinc ions ($ZnSO_4$) were tested each at three concentrations in a 3(3) factorial design. $HgCl_2$ at an added concentration of 0.0025 ppm reduced growth rate by 9.7 percent. On mixing the chemicals, significant supplemental synergistic effects were found at all two factor and three factor combinations. Models of the effects and graphical response surface contours are given. Since many chemicals are likely to interact (supplementally or antagonistically), the method used seems of widespread relevance to toxicity testing.

198
Insecticides, Polychlorinated Biphenyls, and Mercury in Wild Cormorants, Pelicans, their Eggs, Food, and Environment

Greichus, Yvonne A.; Greichus, A.; Emerick, R.J.; Exp. Stn., South Dakota State Univ., Brookings, South Dakota

Bull. Environ. Contam. Toxicol., 9(6), 321-8; 1973

The concentration of organochlorine insecticide residues in and around Lake Poinsett, South Dakota, decreased in the order fish is greater than bottom sediments is greater than water. The levels of polychlorinated biphenyls (PCB) were greater in fish than in bottom sediments and the PCB levels in both bottom sediments and fish were higher than those of insecticides. Mercury residues were not detected in water, bottom sediments, or fish except carp which also had the highest levels of insecticides and PCB residues. The bodies of adult cormorants and pelicans had 250 and 280 times greater insecticide levels, respectively, than fish and 60 and 30 times, respectively, more PCB. Levels of PCB and insecticides in nestling cormorants apparently reflected the levels in local fish as both the fish and young birds had more PCB residues than insecticides whereas the opposite was true with the adults. The insecticide and PCB levels in cormorant eggs reflected body levels but in pelican eggs they did not.

199
Concentration of Trace Elements (Iodine, Fluorine, Cobalt, Copper, Zinc, Manganese, and Molybdenum) in The External Environment and Food in an Endemic Goiterogenic Region of the Kuba-Khachmas Zone of Azerbaidzhan

Grekalova, T.V.; Nauchno-Issled. Inst. Virusol. Mikrobiol. Gig. Im. Musabekova, Baku, USSR

Azerb. Med. Zh. (AZMZA6), 50(5), 25-9; 1973

TRACE ELEMENTS; FLUORINE; MANGANESE; ZINC; COPPER; MOLYBDENUM; IODINE; COBALT; HUMANS; HEALTH; GOITER

GEOGRAPHICAL DESCRIPTION: Azerbaidzhan, Kuba-Khachmas Zone

The content of all the trace elements examined in water resources of the zone was rather low, with fluorine greater than manganese greater than zinc greater than copper greater than molybdenum greater than iodine greater than cobalt. The intake of fluorine by humans was 1/3 - 1/4 of the optimum concentration, that of iodine approximately 1/2, and cobalt less than 1% of the daily requirement. The trace elements were present in soil in the following decreasing order: manganese greater than copper greater than cobalt greater than zinc greater than molybdenum greater than iodine. The content of the trace elements was also low in food products, especially of animal origin. Relatively high was , however, the content of iodine in potatoes and wheat, and that of manganese and zinc in all the examined products (except milk and cheese); rather low were the contents of cobalt, molybdenum, and copper. Children's iodine demand is satisfied only to 78.1%. Iodine, copper, molybdenum, and cobalt were considered highly deficient in this region. Prophylactics in combination with the other trace elements are proposed.

200
Concentration of Some Metals in Algae from the Sea of Japan

Gryzhankova, L.N.; Saenko, G.N.; Karyakin, A.V.; Laktionova, N.V.; Inst. Geokhim. Anal. Khim. Im. Vernadskogo, Moscow, USSR

Okeanologiya (OKNOAP) 13(2), 259-63; 1973

ALGAE; METALS; MANGANESE; COPPER; IRON; SALTWATER; MARINE ALGAE; NICKEL; TITANIUM

TAXONOMY: AGARUM CRIBROSUM; ENTEROMORPHA SP; SARGASSUM PALLIDUM

GEOGRAPHICAL DESCRIPTION: Sea of Japan

The concentration of the polyvalent metals Fe, Mn, Cu, Ni, Co, Ti, V, and Cr in 12 algae species from the Sea of Japan was studied. The studies were carried out with the aid of a 36-channel quantometer, on red, brown, and green algae. Iron concentrations in brown and green algae was n 10-2%, that of Mn, Ni, and Ti n 10-3%, and Cu, Co, and Cr n 10-4% on a dry wt. basis. The AGARUM CRIBROSUM of the brown algae and ENTEROMORPHA species of the green algae were the strongest concentrators of polyvalent metals. Float bladders of SARGASSUM PALLIDUM were the richest in metals as compared to other parts of the algae.

201
Environmental Lead in the Netherlands. A Status Report on the Overall Situation

Guicherit, R.; Res. Inst. Public Health Eng., TNO, Delft, Netherlands

Part of Proceedings of International Symposium on Environmental Health Aspects of Lead, Amsterdam, Netherlands, October 2-6, 1972, Organized jointly by Commission of the European Communities, Directorate General of Social Affairs-Health Protection Directorate and Environmetnal Protection Agency, EUR 5000 d-e-f. Luxemburg: Commission of the European Communities, Directorate General for Dissemination of Knowlege, Centre for Information and Documentation (26YVAJ), 807-17; 1973

LEAD; POLLUTION; AUTOMOBILE EXHAUST; ATP; WATER

202
On Some Trace Metals in the Baltic

Gupta, R.S.; Institute of Oceanography, University of Gothenburg, Sweden

Ambio, 1(6), 226-230; 1972, December

TRACE METALS; SALT WATER; MARINE LIFE; WATER QUALITY; ZINC; COPPER; NICKEL; COBALT; IRON; LEAD

This report on the background values of trace metals in the Baltic presents the most comprehensive information available in this particular area of ecology. Prior to the investigations described here, very little data had been recorded. This project was started in January 1970 to investigate the state of some trace metals in the Baltic, their variation in space and time, and their effect on the area's marine life and water quality. The project is still in progress. Samples are obtained from an extensive network of stations in the Baltic and are analyzed by atomic absorption spectrophotometry for zinc, copper, nickel, cobalt, iron and lead. Besides presenting the data in this preliminary report, the author examines the relationship between the concentrations of some of the metals and primary production. He suggests that iron and copper concentrations seem to give a fair indication of water quality in anoxic zones. And he postulates a possible explanation for the chemistry of nickel in sea water.

203
Supposed Toxicities of Marine Sediments, Beneficial Effects of

Gustafson, J.P.

World Dredging & Marine Construction p. 44-49; 1972, December

TURBIDITY; WATER; CLAYS; ADSORPTION; ION EXCHANGE; OXYGEN DEFICIENCY; CADMIUM; CHROMIUM; LEAD; NICKEL; MERCURY; ZINC; CLAMS; CONCENTRATION; DREDGING

This author maintains turbidity is beneficial in terms of water pollution. The suspension of clay particles promotes the absorption on the clay particles of heavy metal ions, pesticides, polychlorinated biphenyls, etc. Turbid waters offer some shelter to larval and immature marine life that use bay areas as nursery grounds. By preventing the penetration of light turbidity reduces algal growth. In any event the turbidity produced by dredging is small compared to that produced by nature. Preliminary studies showed some erratic changes but no large increase in the concentration of heavy metals in clams subjected to excessive turbidity. The author urges further studies.

204
Polluted Snow in Southern Norway and the Effect of the Melt Water on Fresh Water and Aquatic Organisms

Hagen, A.; Langeland, A.; Zool. Lab., Univ. Oslo, Blindern/Oslo, Norway

Environ. Pollut. (EN VPAF), 5(1), 45-57; 1973

SNOW; SULFATES; NITRATES; ZINC; LEAD; MELT; FISH; PHYSIC-CHEMISTRY; INVERTEBRATES; WATER

GEOGRAPHICAL DESCRIPTION: Norway (S)

In winter, surface water in some oligo-dystrophic lakes in southern Norway differed physico-chemically from what might be expected. Analyses of snow and of ice-trapped and surface water showed that polluted snow had a considerable influence on the quality of water in lakes and brooks in the winter and spring. Great quantities of, for example, SO(4) --, NO(3) --, zinc and lead were found together with high acidity. The zinc concentration and acidity found are known to be dangerous to fish. The contaminants in general have probably had a negative effect on fish and invertebrates. It is probable that oligotrophic lakes are more susceptible to contamination than dystrophic lakes.

205
Significance of pH and Chloride Concentration on Behavior of Heavy Metal Pollutants: Mercury (II), Cadmium (II), Zinc (II), and Lead (II)

Hahne, H.C.H.; Kroontje, W.

J. Environ. Quality, 2(4), 444-50; 1973

HYDROLYSIS; SALT ACCUMULATION; WATER QUALITY; PH; CHLORIDE; MERCURY; LEAD; CADMIUM; ZINC; COMPLEXES

Calculations were performed (1) to assess the degree to which Hg(II), Cd(II), Zn(II), and Pb(II) complex with hydroxyl and chloride ions and (2) to evaluate the significance of such complexation in natural systems. Results indicate that both the hydroxy and chloride complexes may contribute to the mobilization of these heavy metal ions in the environment. Hydrolysis of Hg(II) becomes important at pH values above 1 where Pb(II), Zn(II), and Cd(II) hydrolyze above pH 5, 7, and 8, respectively. Chlorides complex with Hg(II) at chloride concentrations above 10(-9)M (35 X 10(-6)ppm). HgCl2 forms above 10(-7.5)M Cl- (1.1 X 10(-3)ppm), and HgCl3- and HgCl4(2-) formation occurs above 10(-2)M Cl- (350 ppm). The MCl+ species of Zn(II), Cd(II), and Pb(II) appear at chloride concentrations above 10(-3)M (35 ppm), and MCl2 complexes occur above 10(-2)M (350 ppm Cl-). The respective MCl3- and MCl4(2-) species become important above 10(-1)M Cl-(3,500 ppm). Hydrolysis and chloride complexation of these heavy metal ions are important factors affecting the solubility of the sparingly soluble salts of these metal ions. This is most pronounced for mercuric salts. Intrinsic solubilities of the metal-ion hydroxides allow for 160 ppm Zn(II) and 107 ppm Hg(II) to be soluble as complexed Zn(OH)2 and Hg(OH)2, respectively. These values are higher than calculated solubilities based on solubility products. An example of the competition between hydroxy and chloride complexes shows that at pH 8.5 and a chloride concentration range of 350-60,000 ppm, Hg(II) and Cd(II) are mainly complexed by chlorides. Zn(II) and Pb(II), under these conditions, are predominantly in the form of hydroxy complexes.

206
Mercury in some Swedish Lake Sediments

Hakanson, L.; National Swedish Environment Protection Board, Limnological Survey, Box 550, S-751 22 Uppsala, Sweden

Ambio, 3(1), 37-43; 1974

MERCURY; LAKES; SEDIMENTS; RELEASE; DISTRIBUTION; SORPTION; PH

GEOGRAPHICAL DESCRIPTION: Sweden, Lake Ekoln, Lake Bjorken, Southern Lake Vattern

The significance of mercury as a biologically active pollutant has been recognized for more than 15 years. Increased mercury content of bottom sediments and fish characterizes many water systems as a result of industrial and other types of pollution. Due to the release from contaminated sediments, mercury may continue to contaminate the water environment, even if the discharge of the pollutant is halted. Some of the factors that influence the distribution of mercury in lake sediments are discussed and some quantitative data is given about the situation in three different Swedish lakes; Lake Ekoln, Lake Bjorken, and Southern Lake Vattern. Factors that affect the distribution are: the amount and type of mercury discharged; the size, topography, and water turnover of the lake; and the water quality of the lake (pH, nutrition, suspended and dissolved matter). Laboratory tests have indicated that the affinity and distribution of mercury (Hg^{2+}) for inorganic and organic particles show a significant pH dependency. Practically all the mercury in the sediments is adsorbed by organic particles and very little mercury is found in the interstitial water or adsorbed by inorganic materials.

207
Metabolism and Metabolic Action of Lead and Other Heavy Metals

Hammond, P.B.; Coll. Vet. Med., Univ. Minnesota, St. Paul, Minn.

Clin. Toxicol. (CTOXAO), 6(3) 353-65; 1973

REVIEW; HEAVY METALS; METABOLISM; DISTRIBUTION; TRANSLOCATION; ANIMALS

A review with 78 references the metabolism of metal compounds their distribution and translocation in animals, and dose-response relationships of the heavy metals are covered.

208
Water Quality Studied on Texas Gulf Coast

Hann, R.W., Jr.; Slowey, J.F.

World Dredging & Marine Construction, p. 30-38; 1972, December

WATER QUALITY; DREDGING; TURBIDITY; SEDIMENTS; DREDGING SPOILS; SEASONAL VARIATIONS; SPOIL DISPOSAL; RUNOFF; MERCURY; LEAD; ZINC; COPPER; CHROMIUM; CADMIUM

GEOGRAPHICAL DESCRIPTION: U.S. (SW), Texas, Texas Gulf Coast, Houston Ship Channel, Neches River, Sabine River

Water quality problems are presented from the point of view of dredgers. Information on the heavy metal contamination of sediments in the Houston Ship Channel, Neches River and Sabine River is given. Measurements of the biochemical oxygen demand, chemical oxygen demand, oil and grease profiles and sedimentation rates are included. Problems of minimizing pollution, spoil disposal, spoil area runoff are mentioned Professional study, evaluation and planning should precede actual dredging.

209
Accumulation, Retention and Elimination of Zn 65 in Fresh Water Organisms Studied in Pond Experiments

Hannerz, L.

National Water Protection Service, Drottningholm, Sweden

A pond 62 x 33 x 4 ft was lined with polyethylene sheets welded together. Water, plants and gravel were introduced and a continuous flow of untreated water from Lake Malar was arranged. One hundered small pikes and about 5000 fry of roach and perch were introduced. In all 3.27 mCi Zn 65 was gradually dosed into the water to a mean concentration of about $3 \times 10^{(-6)}$ uCi/ml. The activity concentrations were continuously recorded in pond water, sediments, plants, invertebrates and fish. Considerable concentrations of Zn 65 were found in the bottom sediments (concentration factor: about 20,000). Zn 65 was taken up in the emergent parts of the water plants to low concentrations. The submersed parts of the plants had much higher concentrations indicating a considerable surface adsorption. Several explanations for this surface absorption are conceivable. The attached microflora and microfauna are believed to play important roles in this connection. Also in invertebrates high concentrations of Zn 65 were found. The concentration factor for chironomid larvae was 1700, for snails 590 and for leaches 400. The mean concentration factor for pike was about 1250. The variation in concentration between individual fishes was, however, considerable. It was found that the Zn 65 concentration of the fish was inversely related to its length.

210
The Effect of Some Sulfur and Mercury Containing Fungicides on Bacteria

Hansen, J.C.; Institute of Hygiene, University of Aarhus, Denmark

Chemosphere No. 4, 159-162; 1972

FUNGICIDES; TOXICITY; BACTERIA; INHIBITORY EFFECTS; SOILS; MICROORGANISMS; MERCURY; MERCURIALS

TAXONOMY: PSEUDOMONAS

As a result of their use in agriculture and horticulture fungicides are introduced into both terrestrial and aquatic environments. In these ecosystems the biomass will react with the foreign compounds. To determine whether fungicides may be able to change the composition of bacterial population 11 fungicides were tested for toxicity to 211 bacterial strains. There is a marked inhibitory effect of the fungicides to bacteria. From the results it was concluded that Captan will be of no risk to a bacterial population, while the dithiocarbamates possess more pronounced antibacterial activity, especially to gram-positive organisms. Environmental pollution may thus favor higher gram-negative ratio. The same effect was seen with mercurial fungicides; some pseudomonads, especially, show remarkable resistance to mercurials and are often seen as the dominant organisms in heavily polluted sediments.

211
Accumulation and Loss of Cobalt and Cesium by the Marine Clam, MYA ARENARIA, under Laboratory and Field Conditions

Harrison, F.L.

Part of Radioactive Contamination of the Marine Environment, Proceedings of Symposium held by the International Atomic Energy Agency, Seattle, WA, July 10-18, 1972 (453-470), 786 p.; 1973

BIOACCUMULATION; CLAMS; COBALT; CESIUM; SALTWATER; LABORATORY STUDIES; FIELD STUDIES; MARINE BIOLOGY; COBALT 60; CESIUM 137; KINETICS; TRACERS

TAXONOMY: MYA ARENARIA

The accumulation of Co 60 and Cs 137 by clams was followed in the laboratory in aquarium systems in which the levels of radioactive and stable caesium and cobalt were held constant. At 3- to 21-day intervals during the 6-month accumulation period, groups of 8 animals were removed from the water and their soft tissues were dissected into 7 different organs and tissues. The concentrations of both Co 60 and Cs 137 in the edible tissues increased rapidly and then levelled off at concentrations of Co 60 that were about 200 times that of the water and of Cs 137 that were about 5 times that of the water. Variations in concentration among the body parts were larger for Co 60 than for Cs 137. The effect of stable element concentration in water on the accumulation rates were assessed in groups of animals maintained in seawater containing 0.5, 2.5 and 12.5 mg/litre each of stable cobalt and caesium. Little regulation of caesium accumulation was observed at these concentrations; the rates of accumulation increased with the concentration in water. Some regulation of cobalt occurred at the higher concentrations. The accumulation of Co 60 and Cs 137 was followed also in clams introduced into a discharge canal receiving radioactive waste from a boiling-water reactor. Groups of 6 animals were sampled at 3-week intervals and concentrations were measured in the pooled, total soft tissues. Results obtained in the field will be compared to those obtained in the laboratory. Loss of Co 60 and Cs 137 was followed in animals that had accumulated a radioactive burden in the laboratory and then were transferred to unfiltered oceanic water at a marine station. Loss of Co 60 by the whole clam was monophasic, that of Cs 137 was biphasic. The kinetics of accumulation and loss were described by exponential equations. The rate constants of accumulation and loss and the steady-state concentration factors are being used in models to predict the dose to man from the consumption of animals exposed to radioactive releases.

212
Content of Lead and Some Other Heavy Elements in Different Fish Species From a Fjord in Western Norway

Havre, G.N.; Underdal, B.; Christiansen, C.; Vet. Coll., Oslo, Norway

Proc., Int. Symp., Environ. Health Aspects Lead (26YVAJ) 1973, 99-111; 1972

ZINC; FISH; LEAD; CADMIUM; SALTWATER

The cadmium content of fish from a Norwegian fjord near a zinc factory was greater than that of fish from the open sea. The Cd and lead content of the fish livers was approximately the same, but the Pb content of muscles from the same samples was approximately 10 times higher than the Cd content. The mean ratio of liver Pb to muscle Pb was about 6, whereas the mean liver Cd/muscle Cd ratio was about 42. A highly significant correlation was found between the Zn content and the Cd content of the liver. The Zn uptake in fish from a polluted area like this was not seriously affected, but the Pb uptake was increased greater than 10 times when the Zn and Pb outlets into the sea were nearly the same. When the outlet of Pb into the sea was greater than 100 times the outlet of Cd, the content of the 2 elements in fish liver was nearly equal, in fact slightly higher for Cd, but the content in fish muscles was about 10 times higher for Pb than for Cd.

213
Cadmium Concentration in Some Fish Species from a Coastal Area in Southern Norway

Havre, G.N.; Underdal, B.; Christiansen, C.

Oikos 24(1), 155-157; 1973

COASTAL WATERS; FRESHWATER; WATER; HERRING; PIKE; PERCH; COD; COALFISH; WHITING; CADMIUM; FISH

GEOGRAPHICAL DESCRIPTION: Norway (S. Coast)

214
The Use of Experimental Streams to Determine Environmental Factors Responsible for the Productivity of Aquatic Communities

Haydu, E.P.; Weyerhaeuser Company, Longview, WA

Weyerhaeuser Company, Longview, WA, report

EXPERIMENTAL STREAMS; PRODUCTIVITY; AQUATIC COMMUNITIES; ANNUAL VARIATIONS; TROPHIC LEVELS; SEASONAL VARIATIONS; ENERGY FLOW; WATER

GEOGRAPHICAL DESCRIPTION: U.S. (NW), Washington, Longview

Comprehensive biological studies utilizing outdoor experimental streams have been under way at Weyerhaeuser Company's St. Helens Tree Farm near Longview, Washington, since 1965. The water for these streams is furnished by a nearby spring which maintains a fairly uniform flow as well as uniform physical and chemical characteristics. The study was designed to proceed in two distinct phases: (1) develop detailed background information on the seasonal and annual variations in the physical, chemical, and biological characteristics of the streams; determine the flow of energy through the major trophic levels of the aquatic community; (2) manipulate physical, chemical and biological features of the streams to determine their effects on the composition and production of the aquatic community. Phase I is near completion and Phase 2 is expected to get under way by the spring of 1971. The overall purpose of the study is to develop a better understanding of the factors responsible for the production of aquatic organisms in fresh water streams in order to better protect and manage this resource. Such an understanding may make it possible to utilize man's waste discharges to surface waters advantageously by minimizing the creation of nuisance conditions while, at the same time, producing maximum beneficial levels of productivity of desirable species.

215
Characteristics of the Nitrogenase System of the Blue-Green Alga ANABAENA CYLINDRICA

Haystead, A.; Stewart, W.D.P.

Arch Mikrobiol 82(4), 325-336; 1972

BACTERIA; LEGUMES-D; METALLO-PROTEIN; IRON; THIOLS; ATP; MAGNESIUM; COBALT; MANGANESE; COPPER; ZINC; IONS; FERREDOXIN; HYDROGENASE; NITROGEN FIXATION; PHOTOSYNTHESIS; ELECTRON TRANSPORT; BLUE GREEN ALGAE; ALGAE

TAXONOMY: ANABAENA CYLINDRICA

The requirements for activity of blue-green algal nitrogenase have been studied. The optimal concentration ranges for ATP and Na2S2O4 are 2-3 mM and 8-10 mM respectively. A magnesium requirement has been confirmed but the enzyme is not specific for Mg2+, Co2+ and Mn2+ will also support activity but Ca2+, Cu2+ and Zn2+ will not. The partially purified enzyme is soluble and specific activities of 50-100 nmoles C2H4/mg protein/min have been obtained. The biochemical characteristics of the enzyme, as determined in studies using enzyme inhibitors, are similar to those of bacterial and legume nitrogenases in that the enzyme is a metallo-protein containing iron and reduced thiol groups and the redox capacity of the enzyme involves a possible valency change in the iron. The transfer of electrons from H2 via a bacterial hydrogenase has been shown to be mediated, at least in part, by ferredoxin. The role of ferredoxin and the interrelationships between photosynthesis, reductant pool and hydrogen metabolism are discussed in the light of recent results obtained by ourselves and other workers.

216
Radionuclide Transport Studies in the Humboldt Bay Marine Environment

Heft, R.E.; Phillips, W.A.; Ralston, H.R.; Steele, W.A.

Part of Radioactive Contamination of the Marine Environment, Proceedings of Symposium held by the International Atomic Energy Agency, Seattle, WA, July 10-14, 1972 (595-613), 786 p.; 1973

RADIONUCLIDES; TRANSPORT; MARINE BIOLOGY; NUCLEAR POWER PLANTS; LIQUID WASTE; EFFLUENTS; SEDIMENTS; ANALYSIS

GEOGRAPHICAL DESCRIPTION: U.S. (W), California, Eureka, Humboldt Bay

Operation of the Pacific Gas and Electric Company nuclear power reactor (65 MW(e) boiling water) at Humboldt Bay, Eureka, California, produces as a by-product in low concentration in aqueous solution a number of radionuclides (fission products, Zn 65, Co 60, Mn 54, H3, etc.). At irregular intervals the accumulated radioactive liquid waste is released into the Bay in accordance with limits prescribed by the Atomic Energy Commission and the State of California North Coastal Regional Water Control Board. The Lawrence Livermore Laboratory, in co-operation with the Pacific Gas and Electric Company, has undertaken a program to study the transport of the released radionuclides through the Humboldt Bay marine environment. The Bay is considered to be divided into five aqueous pools. Within each pool, the radionuclides are partitioned among some or all of the following compartments - aqueous solution, bottom sediment, suspended sediment, benthic algae, eelgrass, phytoplankton. The experimental program consists of three main parts - assay of each release for gamma-emitting radionuclides; monthly analyses for radionuclide and stable element concentration in each of the listed compartments; and intercompartment exchange rate studies. Radionuclied release data accumulated since April 1971 is compared with monthly measurements of radionuclide concentration in the Bay. It is found that the amounts released have little effect on field concentrations. Exchange study programs now being carried out in the discharge canal and laboratory are discussed. The nature and status of a proposed transport model for the Bay is described.

217
Chemistry and Occurrence of Cadmium and Zinc in Surface Water and Groundwater

Hem, J.D.; U.S. Geological Survey, Menlo Park, CA 94025

Water Resources Research, 8(3), 661-669; 1972, June

CADMIUM; ZINC; SURFACE WATER; WATER; CARBONATES; HYDROXIDES; ACCUMULATION; CHROMIUM; COBALT; LEAD; MERCURY; SULFATES; SPHALERITE; PLATING; WASTE WATER; GROUND WATER; REMOVAL; SORPTION; SILICATES; ATOMIC ABSORPTION SPECTROPHOTOMETRY

GEOGRAPHICAL DESCRIPTION: U.S.

The median concentration of zinc in 726 filtered samples of water taken from rivers and lakes of the United States in November 1971 was close to 20 microgram/l and the median concentration of cadmium was a little below 1 microgram/l. The concentrations of both elements tended to be consistently higher in water from northeastern and southeastern states. Chemical thermodynamic calculations summarized by solubility graphs suggest that the carbonate and hydroxide solubilities of these elements are higher than the concentrations commonly found, but for 24 of 80 analyses for which chemical equilibrium computations could be made, saturation with respect to one or both of the metals was closely approached. Zinc solubility may also be controlled by silicate in some waters. Biological factors and sorption by stream sediments may also be significant controls. Concentrations of cadmium above 10 microgram/l may be stable in water having low total solute concentrations and pH and can be difficult to remove by conventional water treatment processes.

218
Availability of Trace Elements to Plants with Respect to Soil-Palnt Interaction

Hemphill, D.D.

Part of Hopps, H.C. (Ed.), Cannon, H.L. (Ed.), Annals of the New York Academy of Sciences, Volume 199, Geochemical Environment in Relation to Health and disease (p. 46-61); 1972, June 28

SOILS; PLANTS; TRACE ELEMENTS; AVAILABILITY; MICROORGANISMS; PH; TEMPERATURE EFFECTS; MOISTURE EFFECTS; SPECIES VARIATIONS; ORGANIC MATTER; NITROGEN; OXYGEN; ACCUMULATORS; PROSPECTING; BIOLOGICAL INDICATORS; SILICON; ALUMINUM; IRON; CALCIUM; SODIUM; POTASSIUM; MAGNESIUM; PHOSPHORUS; MANGANESE; SULFUR; CHLORINE; TIN; VANADIUM; ZINC; COPPER; COBALT; MOLYBDENUM; IODINE; DEFICIENCY; LEAVES; FERTILIZERS; TOXICITY; BANANA; CITRUS; SWEET CHERRY; RASBERRY; CHLORINE; BORON; UPTAKE; ADSORPTION; INTERACTIONS; COMPETITION; CATION EXCHANGE CAPCITY; ROOTS; ROOT MORPHOLOGY; GENETIC CONSTITUTION; CHROMIUM; STEMS; PLANT DISEASES; CATTLE; SHEEP; ANIMALS; FORAGE; CITRUS; APPLES; APRICOT; FLUORINE; TEA ; GRAPES; PONDEROSA PINE; GLADIOLI; GOITER; SALTWATER; AQUATIC PLANTS; CORN; LETTUCE; LEAD; HIGHWAYS; SHELTERS; OATS; SUGAR BEETS; ALFALFA; CABBAGE; CEREALS; PINEAPPLE; TOMATOES; SPINACH; MOLYBDENOSIS; SULFATES; SELENIUM; FRUIT TREES; PEACHES; BARLEY; RYE; WHEAT; RAGWEED; HORSETAIL; CADMIUM; RICE; VEGETABLES; RIVERS; IRRIGATION; ITAI ITAI DISEASE; MERCURY

TAXONOMY: ASPERGILLUS NIGER

The main source of major and trace elements for man and animals is plant materials. The adequacy or deficiency of plant materials in supplying the dietary needs of animal life depends upon several factors. The concentration of all minerals in plants depends upon the interaction of the plant species with the soil and environmental conditions during growth. The total amount of an element in the soil is not necessarily a reliable guide to the amount that is available. Various extractants are used to determine available levels of elements; these tests may be well correlated with the uptake by certain species but are not valid for other species. Chemical extractants may not indicate the interactions of elements that influence availability and cannot indicate the influence of environmental factors of soil moisture and temperature. However, the genetic constitution of the plant plays a major role in mineral element uptake, and the selenium accumulator species provide an outstanding example of this genetic effect. The ability of a plant to accumulate minerals from a specific soil can be determined only by analysis of the plant parts. A detailed paper with 55 references. See keywords for items not covered in abstract.

219
Contamination with Lead of Water in Eastern Belgium

Heusghem, C.; De Graeve, J.; Lab. Chim. Med. Toxicol. Hyg., Univ. Liege, Liege, Belg.

Trib. Cebedeau (Cent. Belge Etude Doc. Eaux Air) 26(354), 204-15; 1973

LEAD; WATER; CONTAMINATION; UPTAKE

220
Lead Content of Water Supply in East Belgium

Heusghem, C.; De Graeve, J.; Lab. Toxicol., Univ. Liege, Liege, Belgium

Part of Proceedings of International Symposium on Environmental Health Aspects of Lead, Amsterdam, Netherlands, October 2-6, 1972, organized jointly by Commission of the European Communities, Directorate General of Social Affairs-Health Protection Directorate and Environmental Protection Agency, UR 500A d-e-f. Luxemburg: Commission of the European Communities, Directorate General for Dissemination of Knowledge, Centre for Information and Documentation (26YWAJ), 85-92; 1973

LEAD; DRINKING WATER; WATER PIPES

GEOGRAPHICAL DESCRIPTION: Belgium, Verviers

The lead content of the drinking water of the town of Verviers (Belgium) was 1-1.5 mg/l. Lead plumbing was the main contributing factor.

221
Drinking Water Contamination by Lead in Eastern Belgium

Heusghem, C.; De Graeve, J.; Lab. Chim. Med. Toxicol. Hyg., Univ. Liege, Liege, Belg.

Trib. Cebedeau (Cent. Belge Etude Doc. Eaux Air) (TCEBAA), 26(354) 204-15; 1973

LEAD; CONTAMINATION; DRINKING WATER; WATER

GEOGRAPHICAL DESCRIPTION: Belgium

227
Copper and Zinc in Estuarine Waters Near a Coal-Fired Electric Power Plant. Correlation with Oyster Greening

Hill, J.M.; Helz, G.R.; Dep. Chem., Univ. Maryland, College Park, MD

Environ. Lett. (ENLTAX) 5(3), 165-78; 1973

COPPER; ZINC; ESTUARIES; COAL; POWER PLANTS; OYSTERS; BIOACCUMULATION; WATER

GEOGRAPHICAL DESCRIPTION: U.S. (NE), Maryland, Chalk Point Power Plant

Oysters in waters around the Chalk Point Power Plant, Maryland, accumulate copper, especially in the summer; however it appears that the power plant itself is not the primary copper source. A series of water samples collected in the summer of 1972 and analysed for both Cu and Zn reveal first, that the concentration of both metals increased during the summer, second, that this increase was greatest in bottom waters, and third, that waters near the power plant contained more copper than those elsewhere. Horizontal distribution of copper in the water agrees with the previously observed horizontal distribution of copper accumulation in oysters. The maximum Cu concentration observed in the water was 31.5 ug/l; maximum Zn was 50.4 ug/l. It is suggested that the power plant's cooling water, which contains dissolved oxygen and is chlorinated during the summer, is oxidizing metal-rich organic matter and sulfides in the sediments near the plant, releasing Cu and Zn to the water.

223
The Physico-Chemical Behavior of Radioactive Cerium in Seawater

Hirano, S.; Koyanagi, T.; Saiki, M.

Part of Radioactive Contamination of the Marine Environment, Proceedings of Symposium held by the International Atomic Energy Agency, Seattle, WA, July 10-14, 1972 (47-58), 786 p.; 1973

PHYSICO-CHEMISTRY; RADIOACTIVITY; CERIUM; CERIUM 144; TRACERS; SALTWATER; PH

An investigation has been carried out since 1969 on the nature of chemical species and existing states of radioactive cerium in seawater by means of filtration, ion-exchange and solvent extraction with carrier-free Ce 144 as a tracer in pursuit of the physico-chemical behaviour and its effect on biological concentration. From the results of the experiments it was concluded that: radioactive cerium added into seawater exists mainly in dissolved forms and 20 - 25% of cerium becomes particulate forms having a diameter more than 0.01 um after the aging for 40 days; almost all of the radioactive cerium exists as ionic species in seawater or easily dissociates into ionic forms even after being associated with other anions present in seawater; although the ionic forms or easily dissociable species are the dominant existing states in the seawater with lowered pH below 6, radioactive cerium is hydrolysed slowly when the pH is greater than 6 and forms complexes by hydroxide or chloride ions in seawater or changes to polymerized forms; and it was reported that the residence time of natural cerium in the sea is about 80 years and the forms of precipitation for natural cerium is CeO2. Threfore, it is inferred that the equilibrium between natural cerium and radioactive cerium added in seawater is achieved after a considerable time.

228
Retention of Fall-Out Constituents in Upper Layers of the Pacific Ocean as Estimated from Studies of a Tuna Population

Hodge, V.F.; Folsom, T.R.; Young, D.R.

Part of Radioactive Contamination of the Marine Environment, Proceedings of Symposium held by the International Atomic Energy Agency, Seattle, WA, July 10-14, 1972 (263-275), 786 p.; 1973

RETENTION; SALTWATER; PLUTONIUM; PLUTONIUM 239; ZINC; ZINC 65; COBALT 60; COBALT; MANGANESE 54; MANGANESE; CESIUM 137; CESIUM; ATTENUATION; FISH; TUNA; PERSISTENCE; SILVER; SILVER 108M; SILVER 110M; ALBACORE

Repeated measurements of cobalt-60, zinc-65, manganese-54, caesium-137, silver-110m, silver-108m, and plutonium-239 in several organs of albacore tuna suggest that the upper layers of the north Pacific Ocean can retain large fractions of several species of trace elements for periods of a decade or more. For example, caesium-137 concentrations in the livers and muscle tissues of North Pacific albacore caught from 1965-1971 decreased to half in about 10 years. In comparison, the reported rate of input from fall-out during this period decreased more rapidly, closer to half in one year. This suggests a strong retention of caesium-137 in the upper water masses which are accessible to the fish. It is of interest to note that long environmental persistences in the upper oceanic layers are also indicated for some other nuclides that are much more highly accumulated by organisms than is caesium. For example, cobalt-60 and silver-108m concentrations in albacore liver tissues fell to half during this period in 2.6 and 7.1 years respectively. Plutonium-239 concentrations in the livers decreased to half in about 3.5 years. The attenuation rate of zinc-65 was discontinuous between 1965 and 1968. This fact, along with observation of comparatively high ratios of zinc-65 to cobalt-60 in tunas of the southern hemisphere following 1968, suggests that new large weapons were tested that gave off relatively large amounts of zinc-65.

225
Chemistry of Trace Elements in Soils with Reference to Trace Element Concentration in Plants

Hodgson, J.F.

Part of Hemphill, Delbert D. (Ed.), Proceedings of University of Missouri 3rd Annual Conference on Trace Substances in Environmental Health, XIII 191 p. University of Missouri: Columbia, MO, 45-58; 1970

ROCK; CHEMISTRY; ANIMALS; LEACHING; ORGANIC MATTER; ADSORPTION; ABSORPTION; PARTICLE SIZE SORTING; PH; OXIDATION; BORON; IRON; MANGANESE; COPPER; ZINC; COBALT; MOLYBDENUM; NICKEL; CHROMIUM; SELENIUM; ARSENIC; LEAD; VANADIUM; TRACE ELEMENTS; SOILS; PLANTS; CYCLE; ENVIRONMENTAL FACTORS; BARYLLION; BROMINE; CADMIUM; IODINE; STRONTIUM; AVAILABILITY; COMPLEX FORMATION

The interrelationship in the content of trace elements among rocks, soils, plants and animals in any particular geographical location are complex. The factors influencing plant elemental composition are: 1. elemental content of rocks that give rise to soil; 2. soil forming factors; 3. availability of elements in soil; 4. plant interaction with its environment; and 5. the hostility of the environment. None of these factors can be excluded when considering the trace element content of plants.

226
Natural Dispersion of Mercury from Puhipuhi, Northland, New Zealand

Hoggins, F.F.; Brooks, R.R.; Dep. Chem., Biochem., Biophys., Massey Univ., Palmerston North, N.Z.

New Zealand Journal of Marine and Freshwater Res. (NZJMFR), 7(1-2) 125-32; 1973

MERCURY; RIVERS; WATER; MOLLUSCS; DISPERSION

GEOGRAPHICAL DESCRIPTION: New Zealand, Northland, Puhipuhi

227
Mercury in Fish and Shellfish. Review

Holden, A.V.; Freshwater Fish. Lab., Pitlochry, Scotland

J. Food Technol. 8(1), 1-25; 1973

FISH; REVIEW; MERCURY; SHELLFISH

228
Present Levels of Mercury in Man and His Environment

Holden, A.V.

Part of Technical Report No. 137, Mercury Contamination in Man and his Environment, International Atomic Energy Agency, Vienna, Austria (p. 143-58), 181 p.; 1972, July

MERCURY; CONTAMINATION; HUMANS; BIRDS; FISH; FUNGICIDES; CHLOR-ALKALI PLANTS; ELECTRICAL APPARATUS; FOSSIL FUELS; SMELTERS; PAINTS; CATALYSTS; PULP; PAPER MILLS; ATMOSPHERE; MAXIMUM ACCEPTABLE CONCENTRATION; RAIN; SNOW; RIVERS; NEUTRON ACTIVATION ANALYSIS; COLORIMETRY; GAS CHROMATOGRAPHY; CHROMATOGRAPHY; SUSPENDED MATTER; SALTWATER; COMPLEXES; SOILS; SEDIMENTS; METHYLMERCURY; PLANTS; TREES; VEGETABLES; CABBAGE; CARROTS; UPTAKE; BIOACCUMULATION; SEEDS; GRASSES; FLOUR; RICE; TOBACCO; RESIDUES; AQUATIC PLANTS; CONCENTRATION FACTOR; ADSORPTION; ALGAE; INVERTEBRATES; FRUIT FLIES; EGGS; FISH; PIKE; SHELLFISH; OYSTERS; LOBSTERS; CRAB; MUSSELS; EUTROPHICATION; OLIGOTROPHIC; FOODS; TOXICITY; SEED DRESSINGS; PERTHERS; LIVER; KIDNEYS; PHEASANTS; HATCHABILITY; DDT; BRAIN; DEER; ANIMALS; RABBITS; MARTINS; SKUNKS; FOXES; MUSKRATS; SEALS; RATS; URINE; BLOOD; HAIR; MERCURY 203; FECES; BIOLOGICAL HALF-LIFE

Unlike many toxic substances produced synthetically by man, mercury occurs naturally in organic combination in living organisms. With the addition of mercury in wastes discharged to the environment from mining operations, by industrial uses, through the disposal of medical preparations, or by its incorporation in agricultural chemicals, populations of many species of wildlife now have elevated levels of mercury. In some areas, the original natural levels of mercury in the flora and fauna may not be difficult to determine. In living tissues mercury appears to exist almost entirely as methylmercury, probably bound to proteins. Bacterial or enzymatic processes can convert other inorganic or organic forms to methylmercury. The natural mercury levels in both fresh water and marine fish are generally less than 0.2 mg/kg in muscle tissue, and the natural level in birds is probably of the same order. Most analyses of birds have, however, been made on liver and kidney, rather than on muscle tissue as used for field investigations on fish. Relatively fewer uncontaminated samples of birds have been examined. The distribution of mercury between tissues, in fish, birds and mammals, is such that kidneys and liver contain the highest concentrations, those in muscle, brain and blood being significantly lower, although this is only a generalization. Many populations of fish and birds examined in Scandinavia and North America, in areas where mercury is used by industry or in agriculture, have been found to contain concentrations at least one order higher than the upper limit of the estimated natural range. Individual birds found dead, or dying in experimental work on mercury poisoning, have contained 30 mg/kg or more in liver. Concentrations of a similar order have been found in humans dying of organomercury poisoning, and there is some evidence that marine fish found dead off Japan contained about 20 mg/kg in muscle tissue. The concentrations of mercury present in some populations of birds and fish have been found to be abnormally high as the result of pollution but, with the exception of some species of birds in Sweden, there is little evidence that these elevated concentrations have as yet had any direct toxic effect whereby the species have been placed at risk. However, the levels sometimes found in fish and birds may render them unacceptable as human food. The maximum permissible levels of mercury established in some countries are 0.5 or 1.0 mg/kg, values only 2.5 or 5 times the approximate upper limit estimated for many natural populations. Thus, such populations can tolerate only small increases in mercury concentrations if they are to remain acceptable for human consumption.

229
Migration and Redistribution of Zinc and Cadmium in Marine Estuarine System

Holmes, C.W.; Slad, E.A.; McLerran, C.J.; U.S. Geological Survey, Corpus Christi, Texas 78411

Env. Sci. Technol. 8(3), 255-259; 1974

MIGRATION; REDISTRIBUTION; ZINC; CADMIUM; SEDIMENTS; SALTWATER; ESTUARIES

GEOGRAPHICAL DESCRIPTION: U.S. (W), Texas, Corpus Christi Bay

A survey of trace-element levels in the estuarine sediments of Texas shows that Corpus Christi Bay has anomalously high concentrations of zinc and cadmium. Maps of elemental abundance within the bay indicate large concentration gradients, the highest values being near the harbor entrance. Seasonal determinations of metal levels in the harbor and bay waters also revealed variations with time. During summer, stagnation of the harbor water increases the concentration of metals so that significant quantities precipitate in the reducing environment of the bottom water. In winter, the exchange of water between the bay and the harbor increases, and metals are redissolved from harbor deposits, washed into the bay, and adsorbed by particles settling to the bottom.

230
Geochemistry and Transport of Manganese, Iron, Cobalt, Copper, Zinc, Cadmium, and Lead in the Fresh-Water and Estuarine Environments of the Big Cypress-Everglades Region of Florida

Horvath, G.J.; Florida State Univ., Tallahassee, Fla.

Univ. Microfilms, Ann Arbor, Mich., Order No. 73-25, 116, Diss. Abstr. Int. B 1973, 34(4), 1574-5

WATER; SWAMPS; ESTUARIES; GEOCHEMISTRY; MANGANESE; IRON; COBALT; COPPER; ZINC; CADMIUM; LEAD

231
Accumulation of Soluble and Particulate Radionuclides by Estuarine Fish

Hoss, D.; Baptist, J.

National Marine Fisheries Service, Beaufort, NC). 1971. From 3rd national symposium on radioecology; Oak Ridge, Tennessee, USA (10 May 1971); 1971

CERIUM 144; CHROMIUM 51; ESTUARIES; FISH; RADIOECOLOGY; FOOD CHAINS; GASTROINTESTINAL TRACT; MUSCLES; RADIONUCLIDES; KINETICS; SEDIMENTS; UPTAKE; WATER; ZINC 65

A series of experiments was conducted to measure the accumulation of Zn 65 (soluble in seawater) and Ce 144 and Cr 51 (particulate in seawater) by estuarine fish, mummichog (Fundulus heteroclitus), flounder (Paralichthys sp.), Atlantic croaker (Micropogon undulatus), and menhaden (Brevoortia tyrannus). Comparisons were made between (1) accumulation of Zn 65 and Ce 144 from food and from water, and (2) accumulation of Zn 65 and Cr 51 in the presence and absence of sediment substrate. Under experimental conditions the presence of a sediment substrate reduced the accumulation of both Zn 65 and Cr 51 by Atlantic croaker. Of the tissues analyzed, croaker muscle accumulated the least amount of both isotopes. Higher levels of Zn 65 were accumulated by mummichog from food than from water. In contrast neither mummichog nor flounder accumulated appreciable amounts of Ce 144 from food. Accumulation of Ce 144 in the gastrointestinal tract of menhaden was attributed mainly to swallowed seawater.

232
Mercury Concentrations in Fish of the Great Smoky Mountains National Park

Huckabee, J.W.; Oak Ridge National Lab., Tenn.

ORNL-TM-3908, 17 p.; 1972, November

FLY ASHES; COAL; MERCURY; FISH; MERCURY POLLUTION; ATOMIC ABSORPTION SPECTROPHOTOMETRY; RAINBOW TROUT; BROOK TROUT; STONEROLLER; TROPHIC LEVELS; BIOCONCENTRATION; CHRONIC EXPOSURES

TAXONOMY: SALMO GAIRDNERI; SALVELINUS FONTINALIS; CAMPOSTOMA ANOMALUM

Excessive mercury concentrations ostensibly due to pollution have been reported in fish tissue from Asia, North America, and Europe. However, the concentrations of mercury occurring naturally in fish tissue have not been well defined; published values range from 0.02 ppm to 0.2 ppm mercury. Organisms free from mercury pollution are difficult to find due to the wide distribution of mercury-containing fly ash deriving from the burning of coal. In order to obtain data on mercury concentrations in fish at or near natural background levels, 121 fish of three species were collected from high altitude streams 15-20 miles from the nearest fly ash or other pollution source. Mercury analysis was by flameless absorption spectrophotometry. There was no significant difference in mercury concentrations among fish analyzed whole, with gastrointestinal tract removed, or a strip of axial musculature. There was no significant difference in mercury concentration in all samples of one species and each separate sampling of one species. There was no systematic change in mercury concentration in the fish along an elevational gradient. The mercury concentration (mean values in ppm) were: rainbow trout (SALMO GAIRDNERI), 0.036; brook trout (SALVELINUS FONTINALIS), 0.018; stoneroller (CAMPOSTOMA ANOMALUM), 0.039. There was no evidence of trophic level concentration of mercury, since the primary consumer stonerollers had a higher mean mercury concentration than the secondary consumer Rainbow trout collected at the same sampling station. These results indicate that all fish acquire about the same tissue concentrations of mercury at chronic exposure to very low levels.

233
Neutron Activation Analysis for Studying the Role of Humic Acids During Transport of Trace Elements in the Marine Biocycle

Huliev, D.; Strohal, P.

Part of Nuclear Activation Techniques in the Life Sciences, Vienna International Atomic Energy Agency, 1972, 385-390. From Symposium on Nuclear Activation Techniques in Life Sciences, Bled, Yugoslavia, CONF-720025; 1972, April 10

ACTIVATION ANALYSIS; ANTIMONY; CESIUM; COBALT; EUROPIUM; HUMIC ACIDS; IRON; MULTI-ELEMENT ANALYSIS; NEUTRONS; QUANTITATIVE CHEMICAL ANALYSIS; SCANDIUM; SELENIUM; SILVER; STRONTIUM; TRACE AMOUNTS; TRANSPORT; BIOCYCLE

The role of humic acids in the transport of trace elements in marine biocycle has been investigated by means of neutron activation analysis. It is a well-known fact that humic acids can accumulate certain trace elements, but little is known about their selectivity under certain physico-chemical conditions. Humic acids isolated from the Worth Adriatic sediments were hydrolysed to their main components, namely to amino acids, phenols, sugars and condensed benzene core. Each of the mentioned components can also fix some trace elements. Degradation of humic acids in the environment occurs by the action of microorganisms and during this step certain trace metals become available to marine animals through standard physiological processes. In this work neutron activation analysis was applied to the qualitative and quantitative determination of trace elements in humic acids of marine origin, and in their hydrolysis products. The trace elements measured were Fe, Co, Sc, Sb, Eu, Cs, Se, Ag and Sr. The concentrations obtained ranged from 10(-2) to 10(-8)g of a certain microconstituent per gram of sample. The results concerning the role of humic acids in the cycle of trace elements in marine biocycle are discussed. The experimental data are compared with the laboratory experiments dealing with the determination of stability constants for metal complexes of humic acids and their hydrolysis products. From these data it is possible to suggest the ecological importance of trace elements bonded to humic acids in a certain region.

234
Cadmium and Zinc Toxicity and Synergism to Floating Aquatic Plants

Hutchinson, T.C.; Czyrska, H.; Department of Botany and Institute of Environmental Sciences and Engineering University of Toronto, Toronto, Ontario

Water Pollution Research in Canada 1972, 59-65, Institute of Environmental Sciences and Engineering Publ. No. EI-3; 1972

CADMIUM; ZINC; TOXICITY; SYNERGISM; AQUATIC PLANTS; UPTAKE; GROWTH

Floating aquatic plants have been used in a study of the uptake, toxicity and synergism of cadmium and zinc. Both of the species used were found to accumulate the metals, from even very low levels in solution. Cadmium at 0.01 ppm had an inhibitory effect on growth; and 0.1 ppm was enough to cause death. A concentration factor of up to 9500 times occurred; with clear implications of potential food chain effects. Interspecific competition was found to be a further factor influencing metal toxicity. Interspecific competition was found to be a further factor influencing metal toxicity. In natural "field" situations, biological competition is the norm. Cadmium and zinc acted synergistically together. Zinc markedly increased the inhibitory effect of cadmium, even though it was itself stimulatory. The presence of one metal also increased the uptake of the other. The ecological implications are discussed.

235
Removal of Metal Ions and Oil from Waste Water

Ichiki, M.; Nakade, K.; Mitsui Mining and Smelting Co., Ltd.

Ger. Offen. (GWXXBX) 2313640 (C 02C), 11 p.; 1972, March

WASTE WATER; METALS; REMOVAL; CADMIUM; LEAD; OIL; ELECTROLYSIS; ALUMINUM; ZINC; ALLOY; ANODE; COAGULATION; POLYACRYLAMIDE; FLOTATION

236
Determination of the Diffusion Coefficient of Radioelements in the Rhone Sediments

Ijuin, M.; Picat, P.; Saas, A.; Grauby, A.; Department of Environmental Contamination, Natl. Inst. Radiol. Sci., Chiba, Japan

Health Physics (HLTPAO), 24(6), 665-672; 1973

RADIONUCLIDES; SEDIMENTS; RHONE SEDIMENTS; CERIUM 141; CESIUM 137; MANGANESE 54; STRONTIUM 85; ZINC 65; ANALYSIS; DIFFUSION; CERIUM; COBALT; CESIUM; MANGANESE; STRONTIUM; ZINC

The transfer phenomena of cerium-141, cobalt-60, cesium-137, manganese-54, strontium-85 and zinc-65 in the Rhone sediments were studied in the laboratory. The transfer of the various radioelements in the environment concerned obeys Fick's second law of diffusion. The diffusion coefficients (D) of strontium-85 and manganese-54 were determined. They are respectively 2.1 x 10(-2) cm(2)/day and 1.1 x 10(-2) cm(2)/day. The values of the diffusion coefficients of the other elements were not determined accurately enough due to their fixation very near the sediment bed surface. However, they are expected to follow the same diffusion law according to the experimental protocol used. The stable elements in the Rhone sediments were analysed by various spectro-photometric methods and by neutron activation.

237
Radioactive Contamination of the Marine Environment

International Atomic Energy Agency

Proceedings of a Symposium, Seattle 10-14, July 1972, 786 pp., Vienna; Symposium on the Interactions of Radioactive Contaminants with the Constituents of the Marine Environment; 1973

RADIONUCLIDES; RADIOACTIVITY; MARINE BIOLOGY; CONTAMINATION; SALTWATER

238
Result of Fluvial Zinc Pollution on the Zinc Content of Littoral and Sub-Littoral Organisms in Cardigan Bay, Wales

Ireland, M.P.; Dep. Zool., Univ. Coll. Wales, Aberystwyth/Cardiganshire, Wales

Environ. Pollut. (ENVPAP) 5(1), 27-35; 1973

ZINC; SEAWEEDS; MOLLUSCS; MARINE ORGANISMS; FILTER FEEDERS; DISTRIBUTION; SALTWATER

TAXONOMY: LITTORINA LITTOREA

GEOGRAPHICAL DESCRIPTION: Wales, Cardigan Bay

Following fluvial zinc pollution, the concentration of zinc in seaweed was related to that in the external medium, while the zinc in the mollusk Littorina littorea reflected that found in the food supply. An anomalous distribution of zinc in filter-feeding animals might indicate a species specificity for metal uptake.

239
Distribution of Alkyl Arsenicals in Model Ecosystem

Isensee, A.R.; Kearney, P.C.; Woolson, E.A.; Jones, G.E.; Williams, V.P.; Agricultural Environmental Quality Institute, Agricultural Research Center, ARS, U.S. Department of Agriculture, Beltsville, MD 20705

Env. Sci. Tech., 7(9), 841-845; 1973, September

CARBON 14; BIOMAGNIFICATION; ALKYL ARSENICALS; MODEL ECOSYSTEM; C14-LABELED CACODYLIC ACID; DIMETHYLARSINE; DMA; FOOD CHAINS; ALGAE; SNAILS; FISH; ARSENIC; AQUATIC ECOSYSTEMS

TAXONOMY: DAPHNIA MAGNA

Distribution of carbon-14-labeled cacodylic acid (CA) and dimethylarsine (DMA) among aquatic organisms in a model ecosystem was studied. Fish, DAPHNIA MAGNA, snails, and algae were exposed to CA and DMA for 3, 29, 32, and 32 days, respectively. Lower food chain organisms (algae and DAPHNIA) bioaccumulated more CA and DMA than did higher food chain organisms (snails and fish). Amounts accumulated indicate that CA and DMA do not show a high potential to biomagnify in the environment. An increase in biomass (primarily algae) over 32 days largely accounted for a gradual loss of CA and DMA from solution.

240
Chemical Behavior of Ruthenium-106 in Seawater and Uptake by Marine Organisms

Ishikawa, M.; Sumiya, M.; Saiki, M.

Part of Radioactive Contamination of the Marine Environment, Proceedings of Symposium held by the International Atomic Energy Agency, Seattle, WA, July 10-14, 1972, (359-366), 786 p.; 1973

RUTHENIUM; CHEMISTRY; SALTWATER; MARINE BIOLOGY; PHYSICO-CHEMISTRY

TAXONOMY: MERETRIX LAMARKI

The physico-chemical behavior of prepared ruthenium-106 chloro- and nitrosyl chloro-complex species were investigated by filter paper electrophoresis using 0.1N HaC10(4) as a supporting electrolyte. Ruthenium-106 chloro-complexes (III,IV) in a seawater system were fractionated physico-chemically into at least four "anionic", one "neutral" and one "cationic" species. The electrophoretic mobilities of fractionated ruthenium-106 species in seawater were found to be constant for the nitrosyl chloro-complexes (III) during the aging period from 2 to 240 h, but remarkable changes were observed on the electrophoretic patterns of ruthenium-106 chloro-complexes throughout the experimental periods. It appears, in both cases, that significant physicochemical changes take place within the initial stage after addition of ruthenium-106 complexes. Biological uptake experiments in clams, MERETRIX LAMARCKI, were carried out with electrochromatographically fractionated ionic species of ruthenium-106 nitrosyl chloro-complexes. The gill and mid-gut gland (liver) showed high concentrations for all the fractionated species. Considerable differences of concentration factors (concentration ratio) of ruthenium by clams were observed in the anionic, cationic and neutral species, i.e. the concentration factor of the cationic fraction was 10 times higher than that of the other fractions. The order of the concentration factor was as follows: "cationic" is greater greater than "neutral" is greater than "anionic" species.

241
Cadmium Content and Distribution in the Mud, Blood Clams, Fish Flesh, and the Alga, PORPHYRA TENERA, in the Ariake Bay

Ishio, S.; Ohba, H.; Tanaka, Y.; Tadokoro, S.; Fac. Agric., Kyushu Univ., Fukuoka, Japan

Nippon Suisan Gakkaishi (NSUGAF), 39(6), 705-712; 1973

CADMIUM; CLAMS; ALGAE; TOXICITY; FISH; HUMANS

TAXONOMY: PORPHYRA TENERA

The cadmium content in the mud obtained from the Ariake Bay, Japan, was in a range from 0.4 to 15 ppm. On the basis of the maximum permissible amount of Cd intake by man, 0.3 mg/day, the intake of clams should be restricted to 90-300 g/day. No significant amount of Cd was detected in fishes. The conten in dried algae (PORPHYRA TENERA) was in a range of 0.3-4.0 ppm, indicating that the human consumption of algae as food is not hazardous.

242
Concentration of Heavy Metals in Sediment Cores from Selected Wisconsin Lakes

Inkandar, Y.K.; Kaeney, D.R.; Department of Soil Science, University of Wisconsin, Madison, WI

Env. Sci. Technol., 8(2), 165-170; 1974

COPPER; ZINC; CADMIUM; LEAD; CHROMIUM; NICKEL; SEDIMENT CORES; ENRICHMENT; RUNOFF; SEWAGE; ATMOSPHERIC LOADING; LAKES; FRESHWATER

GEOGRAPHICAL DESCRIPTION: U.S. Wisconsin

The concentrations of Cu, Zn, Cd, Pb, Cr, and Ni in sediment cores from five hard-water and five soft-water lakes in Wisconsin were determined. Based on estimates of sedimentation rates, the sediment samples used for estimation of the early cultural or precultural concentrations were deposited 180 to 800 years ago. The precultural concentrations of Cu, Zn, Cd, and Pb were, in nearly all cases, less than those of postcultural and especially of modern (0-10 cm) sediments. In general, there was no significant trend in the vertical distribution of Ni, but four of the 10 lakes had accumulated Cr in recent times. The accumulation of Cu in three of the hard-water lakes investigated was related to copper sulfate (used as an algalcide) input from 1918 to 1968. Surface enrichment may have been due to runoff from urban and agricultural lands and from sewage inputs. The noticeable buildup in Pb was attributed mainly to atmospheric loading.

243
Removal of Heavy Metals from Aqueous Solutions

Tverson, M.L.; Rockwell International Corp.

Ger. Offen. (GWXXBX) 2316238 (C 22B), 31 Mar 1972 17 pp.; 1972, March 31

CADMIUM; REMOVAL; WATER; COPPER; MERCURY; HEAVY METALS; WASTE WATER;

244
Interaction of Heavy Metallic Ions with Microorganisms

Izaki, K.; Fac. Agric., Tohoku Univ., Sendai, Japan

Seikagaku(SEIKAQ)45(5), 219-33; 1973

REVIEW; METALS; MICROORGANISMS; INHIBITORY EFFECTS

A review with 68 references is given on the mechanism of the inhibitory effect of heavy metal ions on microorganisms, and on the resistance of the organisms to heavy metals.

245
Cadmium Content in Sea Water, Bottom Sediment, Fish, Lichen, and Elk in Finland

Jaakkola, T.; Takahashi, H.; Miettinen, J.K.

Part of Coulston, F. and Korte, F. (Eds.), Environmental Quality and Safety, Vol. 2. Global Aspects of Chemistry, Toxicology and Technology as Applied to the Environment. 18, 333 p. Georg Thieme Publishers, Stuttgart, W. Germany. Academic Press, Inc., New York, NY, p. 230-237; 1973

CADMIUM; SEDIMENTS; FISH; LICHENS; ELK; SALTWATER

GEOGRAPHICAL DESCRIPTION: Finland

246
Cadmium Content of Sea Water, Bottom Sediment, and Fish, and its Elimination Rate in Fish

Jaakkola, T.; Takahashi, H.; Soininen, R.; Rissanen, K.; Miettinen, J.

Part of Radiotracer Studies of Chemical Residues in Food and Agriculture. Vienna-International Atomic Energy Agency, from Radiotracer Studies of Chemical Residues in Food and Agriculture Meeting, Vienna, Austria, October 25-29, 1971 (69-75); 1972

CADMIUM; FISH; QUANTITY RATIO; SALTWATER; SEDIMENTS; CADMIUM 115; METABOLISM; TRACER; ELIMINATION

247
Influence of Lead and Other Metals on Fish Delta - Aminolevulinate Dehydrase Activity

Jackim, E.; Natl. Mar. Water Qual. Lab., U.S. Environ. Prot. Agency, West Kingston, R.I.

J. Fish Res. Board Can.(JFRBAK)30(4), 560-2; 1973

LEAD; FISH; AMINOLEVULINATE DEHYDRASE; MERCURY; FLOUNDER; SILVER; SILVER NITRATE; ENZYME ACTIVITY; CADMIUM; METALS; KUMMICHOG

TAXONOMY: FUNDULUS HETEROCLITUS; PSEUDOPLEURONECTES AMERICANUS

The prolonged exposure of summichog (FUNDULUS HETEROCLITUS) and winter flounder (PSEUDOPLEURONECTES AMERICANUS) to a 50 ppm initial concentration of lead nitrate resulted in reduction of liver and kidney delta-aminolevulinic acid dehydrase activity. The 50 ppm Pb(NO3)2 concentration decreased to 0.7 ppm total Pb in 24 hr and remained at this level indefinitely. Cadmium chloride, zinc chloride, and silver nitrate all increased the enzyme activity. Prolonged exposure to 0.02 ppm mercury chloride (initial concentration) produced a marked inhibition of the enzyme activity in the early stages followed by a partial recovery. The concentration also dropped from an initial concentration of 0.02 ppm to 0.001 ppm and remained at that concentration for up to 1 week.

248
A Review of Outboard Motor Effects on the Aquatic Environment

Jackivicz, T.P.; Kuzminski, L.N.

Jour. Water Poll. Control Fed., 45, 1759; 1973

BOATS; REVIEW; MOTORS; OIL; ORGANIC COMPOUNDS; AQUATIC BIOLOGY; WATERCRAFT

Various aspects of outboard motor operation, including the magnitude of watercraft usage, operation and efficiency of a two-cycle engine, composition of outboard motor fuels, and compounds emitted during operation are reviewed. Compounds emitted to receiving waters originate from drainage of crankcase liquids and from unburned fuel passing through the combustion chamber. Over half the original fuel mixture for outboard motors may be emitted unburned into receiving waters. Factors affecting the quantity of compounds exhausted from outboard motors include horsepower rating, crankcase size, composition of fuel mixture, tuning of the engine, and speed of operation. Some of the compounds measured in water contaminated by motor exhaust include volatile and nonvolatile oil, lead, and phenols.

249
Aqua Regia for Quantiative Recovery of Mercuric Sulfide from Sediments

Jacobs, L.W.; Keeney, D.R.; Department of Soil Science, University of Wisconsin, Madison, WI 53706

Environmental Science and Technology 8(3), 267-268; 1974

DIGESTION PROCEDURE; SEDIMENTS; MERCURIC SULFIDE; MERCURY; RECOVERY

A digestion procedure consisting of a 2:1 concentration of H(2)SO(4):HNO(3) plus KMnO(4)-K(2)S(2)O(8) oxidation to be inadequate for quantitative recovery of HgS, a Hg compound that may be present in reduced materials such as river and lake sediments and waste sludges. Since HgS or Hg(II) associated with metal sulfide phases may be a significant fraction of the total Hg in these substances, incomplete dissolution of these Hg(II) sulfide phases during sample digestion will cause total Hg concentrations to be underestimated. An aqua regia digestion procedure which quantitatively recovers HgS from sediments is described, and is recommended for total Hg analyses of sediments. The authors found that KMnO(4) and K(2)S(2)O(8) must be included with aqua regia to obtain complete recovery of five other Hg compounds implicated in Hg transformations and pollution in the environment. Nonaqua regia procedures being used to analyze sediments or sludges for total Hg should be tested for quantitative recovery of HgS.

250
Literature of Mercury: Availability of English Translations

Jenne, E.A.; Sanders, W.

Jour. Water Poll. Control Fed., 45, 1952; 1973

BIBLIOGRAPHY; MERCURY; TRANSLATIONS

All references to published non-English language articles contained in five recent major reviews of mercury in the environment have been compiled. The availability, as of July 1, 1971, and the source of English translations is indicated in this compilation of 280 papers. Only 109 are available in English translation. A number of the references compiled are not listed in standard abstract journals and hence could not be verified. These references are primarily from the Japanese and Swedish literature.

251
Problems in Lead Mining Waste Control

Jennett, J.C.; Wixson, B.C.

Water Poll. Control Assoc. J., 44(11), 2103-2110; 1972, November

LEAD; MINING; MINING WASTEWATER; WASTE CONTROL; CALCIUM; MAGNESIUM; HARDNESS; PH; AQUATIC BIOLOGY; STREAMS; PRECIPITATION; ABSORPTION; TOXICITY; LEAD; ZINC; COPPER; DIATOMS; ALGAE

TAXONOMY: SYNEDRA; NAVICULA; CYMBELLA

GEOGRAPHICAL DESCRIPTION: USA, Missouri

Environmental problems have occurred in streams below the mines and mills of the New Lead Belt or Viburnum Trend of southeast Missouri, principally because of liquid wastes produced by the operations. Selected chemical and physical parameters were measured and evaluated: calcium, magnesium, total water hardness, pH, because these factors may affect aquatic life by the precipitation or absorption of heavy metals. No significant changes in stream water quality was observed for alkalinity, hardness, pH or DO. Previous studies of heavy metals in control steams indicated that the normal unpolluted background values for lead, zinc, and copper were in the range of 6 to 12 ug/l. Under existing conditions, any heavy metals remaining in solution from the milling process are precipitated rapidly in the settling and treatment lagoons by the slightly basic (ph 7.5 to 8.2) mine wastewater and do not pose a toxicity problem in the lagoon effluent at the present. Biological examination of water samples indicated that the three diatom genera SYNEDRA, NAVICULA, and CYMBELLA were useful as biological indicators. SYNEDRA and NAVICULA were tolerant of mining effluent and CYMBELLA intolerant. SYNEDRA became the dominant population close to treatment discharges while CYMBELLA, abundant in control steams, almost disappeared in polluted streams. The visible prolific growth of gray-colored slime mats in the area streams was the first obvious sign of mining pollution.

252
Studies on the Concentration of Iron 55 in South Pacific Ocean Water and Marine Organisms and in the Columbia River

Jennings, C.; Oregon Coll. of Education, Monmouth, Oregon

Progress Report, March 1, 1972 - November 30, 1972, Report RLO-2231-1, Contract AT (45-1)-2231, Oregon College of Education, Monmouth, Oregon; 1972

AQUATIC ECOSYSTEMS; RIVERS; DISTRIBUTION; FISH; FOOD CHAINS; IRON 55; QUANTITY RATIO; RADIONUCLIDES; KINETICS; SQUAW FISH; CARP; RADIONUCLIDE MIGRATION; ZINC 65; IRON; ZINC

TAXONOMY: CYPRINUS CARPIO; PTYCHOCHULAS OREGONENSE

GEOGRAPHICAL DESCRIPTION: U.S. (NW), Washington, Oregon, Columbia River, McNary Dam, Pacific Ocean

One study traced the decline of iron 55 and zinc 65 activity in Columbia River fish with time and detected the variations in the length of time for a given tissue to cycle the radionuclide out of it. The common squaw fish, PTYCHOCHULAS OREGONENSE, and the common carp, CYPRINUS CARPIO, from the collections made near the McNary Dam on the Columbia River were used. The second study dealt with the concentration of iron in Pacific Ocean organisms--pink shrimp, euphausid, Pacific herring, anchovy. Preliminary findings indicated that iron concentrations were low in organisms in equatorial regions and higher in the temperate zones.

253
Behavior of Mercury in the Environment

Jensen, S.; Jernelov, A.

Part of Technical Report No. 137, Mercury Contamination in Man and his Environment, International Atomic Energy Agency, Vienna, Austria (p. 43-7), 181 p.; 1972, July

MERCURY; SEED DRESSINGS; BIRDS; INDUSTRIAL WASTES; NATURAL SOURCES; SLIMICIDES; COMPLEXES; MERCURY SULFIDE; ALKYLMERCURY; PHENYLMERCURY; ALKOXYALKYLMERCURY; METHOXYETHYLMERCURY; SOLUBILITY PRODUCT; AEROBIC; ANAEROBIC; METHYLATION; CHEMISTRY; SEDIMENTS; SUSPENDED MATTER; WATER

A discussion of the chemistry of inorganic and organic mercury compounds, and their interconversions in water sediments, etc. under aerobic and anaerobic conditions, including methylation and degradation. The mercury problem is mainly based on the occurrence of mercury in fish in the form of methylmercury, usually resulting from methylation outside the fish. Since dimethylmercury is quite volatile, it is important to know what the main result of methylation is, in monomethylmercury or dimethylmercury. The dimethylmercury may be broken down in the air and deposited with precipitation. Thus, both mercury and dimethylmercury are cycled in the atmosphere, with the latter cycle being the more important for the local contamination of organic mercurials.

254
The Anifauna of Sweden as Indicators of Environmental Contamination with Mercury and Chlorinated Hydrocarbons

Jensen, S.; Johnels, A.G.; Olson, M.; Westermark, T.

Part of Proceedings of the 15th International Ornithological Congress, 455-465; 1972

BIRDS; BIRD POPULATIONS; PESTICIDES; MERCURY; CHLORINATED HYDROCARBONS; SEED EATING BIRDS; PHEASANTS; PARTRIDGES; PIGEONS; OWLS; SEASONAL VARIATIONS; SEED DRESSINGS; NEUTRON ACTIVATION ANALYSIS; FEATHERS; PREDATORY BIRDS; HISTORICAL TRENDS; ALKOXYALKYLMERCURY; PHENYLMERCURY; ALKYLMERCURY; GOSHAWK; LIVER; STARLINGS; FISH; CHLOR-ALKALI PLANTS; PULP; PAPER MILLS; OSPREY; METHYLMERCURY; GREBE; METHYLATION; PH; SOLUBILITY; GEOGRAPHIC VARIATIONS; BIOLOGICAL HALF-LIFE; DDT; POLYCHLORINATED BIPHENYLS; GUILLEMOTS; FAT; EGGS; CORMORANTS; EAGLES; MERGANSERS; DUCKS

GEOGRAPHICAL DESCRIPTION: Sweden

The concentration of mercury and chlorinated hydrocarbons in several varieties of Swedish birds is discussed, including historical trends during this century, mostly based on feather analyses. Seasonal variations related to the use of alkylmercury seed dressings are given for some seed eating birds. The levels of mercury in fish eating birds show a more gradual rise, while that in the seed eating birds showed a very rapid rise with the use of alkylmercury seed dressings and a reduction following the ban of such dressings. Some work was done with migratory birds and inferred an environment less polluted with mercury in Africa. Some work was done on the contamination of fats and eggs by chlorinated hydrocarbons (DDT & PCBs).

255
Mercury Food Chains

Jernelov, A.

Part of Hartung R. (ed.) Environmental Mercury Contamination. International Conference, 1970, Ann Arbor Science Publishing, Inc. Ann Arbor, Michigan) p. 174-177; 1972

BIOACCUMULATION; MERCURY; FISH; MICROORGANISMS; PIKE; WHITEFISH; FOOD CHAINS; METHYLATION; METHYLMERCURY; BOTTOM FAUNA; ANIMALS

In order to study the accumulation of mercury in fish, 1500 Kg of Northern pike were caught in heavily contaminated waters in Sweden. Fish inside the stomachs of the pike, mostly whitefish, were analyzed for mercury. Bottom fauna, on which the whitefish feed, were also analyzed for mercury. Accumulation up the food chain was observed to be 10-15% of intake at each step level. Investigation of the capacity of microorganisms in fish to methylate mercury yielded anomalous data. Subsequent findings showed that certain microorganisms which are predominant in fish slime during the late winter and early spring in Sweden have a high capacity to methylate mercury, while those present the rest of the year do not have the same capacity. Those microorganisms which methylated mercury, or which did so at a very high rate, only methylated mercury when kept on a fish extract substrate, but not when kept on a meat extract.

256
Factors in the Transformation of Mercury to Methylmercury

Jernelov, A.; Inst. Water Air Pollut. Res., Stockholm, Swed.

Part of Hartung, R. (ed.) Environmental Mercury Contamination. International Conference, 1970, Ann Arbor Science Publishing, Inc. Ann Arbor, Michigan (p. 167-172), 000 1970; 1972

METHYLATION; LAKES; WATER; PHENYLMERCURY; INDUSTRIAL WATER; MUSSEL; TUBIFICID SEDIMENT; SEDIMENTS; TRANSFORMATION; MERCURY; METHYLMERCURY

257
Studies in Sweden on Feasibility of Some Methods for Restoration of Mercury-Contaminated Bodies of Water

Jernelov, A.; Lann, H.; Swed. Water Air Pollut. Res. Lab., Stockholm, Swed.

Environ. Sci. Technol. (ESTHAG) 7(8), 712-18; 1973

MERCURY; WATER; METHYLMERCURY; RIVERS; LAKES; SEDIMENTS; METHYLATION; FISH; METHYLATION RATE; DREDGING; MERCURY SULFIDE; PH; ADSORPTION

Laboratory experiments and small-scale field tests have been performed to investigate some theoretically possible methods to restore mercury-contaminated lakes and rivers. Properties of the different methods with respect to practical use are discussed. The following methods have been suggested: removing of mercury deposits by dredging; converting mercury to mercuric sulfide with a low biological methylation; binding of mercury to inorganic material-such as silica minerals--to achieve l[illegible] methylation; the introduction of ferric ions and manganese ions which adsorb heavy metals in the form of oxides which subsequently crystallize; covering of mercury deposits with mercury-binding or inert material, retarding the release of methylated mercury into water; increasing of pH so that the biological methylation process will produce volatile dimethyl mercury rather than monomethyl mercury.

258
Mercury Accumulation in Food Chains

Jernelov, A.; Lann, H.

Oikos 22(3), 403-406; 1971

FISH; ANIMALS; MERCURY; ACCUMULATION; FOOD CHAINS

The relation between methyl mercury concentrations in the liver and in muscle of fish indicates the relation between accumulation and excretion rates of methylmercury. The total mercury content of benthic animals is of little interest when one calculates the rate of mercury transport from benthic animals to fish that feed on them. This is because the percentage of methyl mercury in the total mercury content of the benthos is generally low (much lower than the percentage in fish) and the total mercury content is quite variable. The methyl mercury transportation from benthic fauna to bottom feeding fish is evidently small. By comparing the total mercury content of the three ecological subgroups of benthic animals, it seems possible to separate situations where release of mercury prevails from situations where it has ceased.

259
Biological Effects and Physical Properties in the Marine Environment of Aliphatic Chlorinated By-Products From Vinyl Chloride Production

Jernelov, A.; Rosenberg, R.; Jensen, S.; Swed. Water Air Pollut. Res. Lab., Goteborg, Swed.

Water Res. (WATRAG) 6(10), 1181-91; 1972

VINYL BYPRODUCTS; ANIMALS; EDC; TAR; SALTWATER; BIOLOGICAL EFFECTS

TAXONOMY: OPHRYOTROCHA LABRONICA; BALANUS BALANOIDES; ALLIUM CEPA

A mixture of short-chained aliphatic hydrocarbons, the so called EDC-tar, is formed as a byproduct from vinyl chloride production in quantities of approximately 75,000 tons per annum in Northern Europe. Most of this is dumped into the sea. In 1970, concentrations of EDC-tar from the North Sea were reported to be as high as 10 per cent of that causing acute toxic effects on marine organisms. This work was undertaken to find out the behavior of some components of the EDC-tar in the marine environment. Dumped into the sea, EDC-tar has a tendency to disperse and to adhere to particles. Acute toxicity of these Cl-C components, evaluated by LC50 48 h tests, was found to be approximately 2.5-9 ppm for some marine animals. Accumulation factors of between 10 and 3 x 10(3) were estimated for animals presented to EDC-contaminated sea water. Accumulation in cod fed with EDC-contaminated shrimp was higher in liver than in muscle. Excretion was rapid when feeding was discontinued, and the biological half-lives of the Cl-C compounds were found to be a few weeks. Sublethal EDC concentrations were found to bring about disorders in growth in the Polychaete OPHRYOTROCHA LABRONICA and to reduce swimming ability in the barnacle BALANUS BALANOIDES. In ALLIUM CEPA, c-mitotic effects of EDC-tar were observed.

260
Lead Availability Related to Soil Properties and Extractable Lead

John, M.K.

J Environ. Qual. 1(3), 295-298; 1972

NICKEL; ALUMINUM; PH; SOILS; AVAILABILITY; LEAD; EXTRACTION; PLANTS; HEAVY METALS; UPTAKE; CONTAMINATION; ORGANIC MATTER; LETTUCE; OATS

TAXONOMY: LACTUCA SATIVA; AVENA SATIVA

Lead content of lettuce (LACTUCA SATIVA L.) and oats (AVENA SATIVA L.) was related to lead extracted from 29 contaminated soils by several different extraction procedures. Correlation studies showed that 1N nitric acid extractable lead was significantly related to lead in lettuce; however, milder extraction with 0.01N nitric acid and 1N ammonium acetate provided a better correlation with lead content of oat shoots and roots. Soil properties, particularly soil pH, were also important when attempting to predict plant lead. Lead availability was related to soil pH, extractable aluminum, and total nickel. No relationship with organic matter was observed.

261
Cadmium Contamination of Soil and Its Uptake by Oats

John, M.K.; Chuah, H.H.; VanLaerhoven, C.J.; Research Station, Canada Department of Agriculture, Agassiz, BC, Canada

Environmental Science and Technology, 6(6), 555-557; 1972, June

SOIL; PLANTS; ROOTS; HYPERTENSION; FOODS; FUNGICIDES; TRANSLOCATION; ABSORPTION; DISTRIBUTION; SMELTERS; BATTERIES; CADMIUM; CONTAMINATION; UPTAKE; OATS; ACCUMULATION; HUMANS; SMELTERS; EMPHYSEMA; CHRONIC BRONCHITIS; ANIMALS; PLANTS; ZINC; OIL; TIRES

The extent of cadmium contamination of soils in the Lower Fraser Valley (SW, British Columbia, Canada) was evaluated. Nitric acid-soluble cadmium in the surface samples among 33 agricultural soils averaged 0.88 ppm. However, nitric acid-soluble cadmium reached as high as 9[illegible] ppm in a surface sample taken near a battery smelter, but this level decreased considerably with distance and depth. The effect of soil application of carbonate, nitrate, chloride, sulfate, and phosphate salts of calcium on cadmium uptake by oats was determined in a growth chamber study involving soils taken near a battery smelter and from farmland. Oats grown on the contaminated soils contained very high amounts of cadmium in the roots, with smaller amounts in the above-ground portions. Soil treatments affected the cadmium content of roots significantly but did not affect the cadmium content of tops.

262
Lead Uptake by Lettuce and Oats as Affected by Lime, Nitrogen and Sources of Lead

John, M.K.; Van Laerhoven, C.

J. Environ. Qual. 1(2), 169-171; 1972

LETTUCE; OATS; UPTAKE; LEAD; LIMING; NITROGEN; SOILS; SULFUR; PHOSPHORUS

TAXONOMY: LACTUCA SATIVA; AVENA

Uptake of lead by lettuce (LACTUCA SATIVA L.) and oats (AVENA SATIVA L.) as a result of application of lime, nitrogen, and various sources of lead to the soil was studied in a growth chamber experiment. Soil application of lea increased the uptake of lead by lettuce to a greater degree than by oats. Application of lime repressed the uptake of added lead by both plants, while application of low levels of nitrogen reduced the uptake of lead by lettuce and oat roots only. Application of lead chloride lowered the amount of sulfur and phosphorus in plants, but levels of other elements studied were not affected by any lead treatment.

263
Factors Affecting Plant Uptake and Phytotoxicity of Cadmium Added to Soils

John, M.K.; VanLaerhoven, C.J.; Chuah, H.H.; Research Branch, Canada Department of Agriculture, Agassiz, B.C., Canada

Environ. Science and Technology, 6(12), 1005-1009; 1972, November

CADMIUM; CADMIUM CHLORIDE; SOILS; RADISHES; LETTUCE; AVAILABILITY; EXTRACTANTS; CONCENTRATION; NICKEL; IRON; ZINC; COPPER; ACCUMULATION; UPTAKE; GROWTH RETARDATION; CHLOROSIS; ATOMIC ABSORPTION SPECTROPHOTOMETRY; COLORIMETRY

For a set of 30 surfac bsoils, addition of 50 mg of cadmium, from CdC12, to 500 grams of soil reduced yields and sharply increased cadmium level in analyzed portions of radish and lettuce plants when compared with those plants grown on control soils. For the treated soils, plant cadmium was significantly related to cadmium extracted from soil by neutral N ammonium acetate. The N HC1 and N HN03 extractions did not indicate plant availability but removed most of the soil cadmium. From among 18 potential independent variables, stepwise linear regressions to predict cadmium found in plant parts harvested from treated soils included a measure of the relative ability of soild to adsorb cadmium, acetate-soluble cadmium in the soil, soil reaction, and organic matter as significantly contributing independent variables. Plant cadmium levels were significantly correlated with amounts of nickel, iron, zinc and copper in the same plant portion. Results of this study indicated that the cadmium pollutant may readily be taken up from the soil and may result in potentially hazardous accumulation of cadmium in plants. Besides its effect on the cadmium levels, the treatment produced toxicity symptoms and reduced yields.

264
Early Actions of Cadmium in the Rat and Domestic Fowl - VI. Testicular and Muscle Blood Flow Changes

Johnson, A.D.; Turner, F.C.

Comp. Biochem. Physiol., 41(3A), 451-6; 1972, March 1

RATS; ANIMALS; MALES; POULTRY; TESTES; BLOOD FLOW; CADMIUM; CADMIUM CHLORIDE; ZINC; ZINC ACETATE; HEMORRHAGE; EDEMA; SUBCUTANEOUS; PRETREATMENT

Male rats and domestic fowl were injected subcutaneously with 0.03 m-moles cadmium chloride (Cd)/kg body weight with some rats previously pre-treated with zinc acetate (Zn). Early rolative blood flow changes were studied. In the fowl no blood flow changes were detected due to cadmium. In the rat cadmium resulted in a sharp increase in blood flow to the testis at 2.5 and 10 min after cadmium followed by a return toward normal. Zinc pre-treatment resulted in blood flow which was higher than in untreated rats. However, when this pre-treatment was followed by cadmium the sharp changes in blood flow, found in rats treated with cadmium but without zinc pretreatment, were not manifest. This also resulted in a more rapid return to control levels. Cadmium acts on the vasculature of the testis of the rat but not that of the domestic fowl and zinc pre-treatment in the rat moderates the action of cadmium on the vasculature.

265
Arsenate in the Western North Atlantic and Adjacent Regions

Johnson, D.L.; Pilson, M.E.Q.

Journal of Marine Research, 30(1), 40; 1972, January

ARSENATES; ARSENIC; FOOD CHAINS; SALTWATER

Arsenate concentration at 2% stations in the North Atlantic, Caribbean, and Gulf of Mexico averaged 0.028 gram atom per liter at the surface and 0.048 in deep water. Being chemically similar to phosphate, it may enter the marine food chain.

266
Mercury in Marine Organisms of the Tay Region

Jones, A.M.; Jones, V.; Stewart, W.D.P.

Nature, 238, 164-165; 1972, July 21

MERCURY; METALS; ALGAE; MOLLUSCS; ATOMIC ABSORPTION SPECTROPHOTOMETRY; PLANTS; ANIMALS; ADSORPTION; STIPE; HOLDFAST; UPTAKE; CTENIDIA; ACCUMULATION; SALTWATER; GREY SEAL; EIDER DUCK; BIRDS; LIVER; KIDNEYS; PHEASANTS; CORVIDS

Mercury concentrations in marine organisms (algae, molluscs) and in the grey seal and eider duck were determined by atomic absorption spectrophotometry. A few measurements on the distribution of mercury in these organisms were 0.3 and 20.0 parts per million in dry tissue. Plants and organisms collected at Broughty Ferry in the Tay estuary were high in mercury but those collected from the sea north of Arbroath contained negligible amounts.

267
Concentration of Copper, Lead, Zinc, and Cadmium in Shallow Marine Sediments, Cardigan Bay (Wales)

Jones, A.S.; Marine Sci. Lab., Univ. Coll. North Wales, Menai Bridge, Wales

Mar. Geol 14(2), M1-M9; 1973

SEDIMENTS; METALS; COPPER; LEAD; ZINC; CADMIUM; SALTWATER

268
Lead Uptake from Solution by Perennial Ryegrass and Its Transport from Roots to Shoots

Jones, L.H.; Clement, C.R.; Hopper, M.J.; Grassland Res. Inst., Hurley/Berkshire, Engl.

Plant Soil, 38(2), 403-414; 1973

LEAD; ENGLISH RYEGRASS; TRANSLOCATION; PLANTS; TRANSPORT; UPTAKE; ROOTS; SHOOTS

The uptake of lead by roots and its transport to the shoots was examined with perennial ryegrass in solution cultures. Root uptake as measured by the decrease in concentration of lead in an aqueous solution containing 1 mg Pb/l as lead (NO(3))-2 was rapid, almost complete, and unaffected by removing the shoots or killing the roots. Lead bound in the roots was not released by exchange with Ca or Ba ions. The distribution of lead within the plant was examined at intervals after a single, 3-day exposure to various levels of lead added to a nutrient solution. The total uptake, or lead burden, increased with increasing rates of addition and ranged from 281 to 9969 mg/Pb per 3 plants. The proportion of the lead reaching the shoots at the first harvest (7 days after adding lead) was 3.5 to 22.7 per cent of total uptake, the lower value being for plants with the greatest burden. Transport to the shoots continued throughout the experimental periods of 21 and 28 days but did not exceed 28.9 per cent of total uptake. The concentration of lead in shoots at the first harvest ranged from 0.2 to 58.4 ppm and that in the corresponding roots from 5.5 to 5310 ppm. At later harvests, and after cutting, the concentration in the shoots decreased; an exception was in plants with the greatest lead burden. It is concluded that roots of actively growing ryegrass provide a barrier which restricts the movement of lead to the above-ground parts of plants, and so to animals or man.

269
Molybdenum Transport in Dillon Reservoir

Jorden, R.M.

Part of Transport and the Biological Effects of Molybdenum in the Environment, Progress Report, January 1, 1973 (p. 64-93), 375 p.; 1973, January

MOLYBDENUM; WATER; RESERVOIRS; MASS BALANCE; TAILING PONDS; MIXING; INTERNAL CYCLING; STRATIFICATION; SEDIMENTS; ALGAE; CONCENTRATION FACTOR

In April 1972, Dillon Reservoir contained some 180,000 pounds molybdenum in solution. During May and June 1972 some 240,000 pounds molybdenum entered the Reservoir from Ten-Mile Creek and an additional 100 pounds each from the Snake and Blue Rivers. This massive slug input during the spring runoff resulted from an apparent need to discharge waters from the tailings ponds of Climax Molybdenum Company in order to prevent washout, an event worthy of avoiding. By November some 39,000 pounds molybdenum was diverted toward Denver (in the South Platte River drainage) and 187,000 pounds was discharged to the Colorado River drainage. This event resulted in an observed increase to 220,000 pounds molybdenum in Dillon Reservoir and an indicated 12 percent bookkeeping error when comparing deposits-withdrawals to the balance, the latter being larger. The flow through of some 240,000 pounds into the existing 187,000 pounds of this strategic element masked the apparent biologically-induced-internal cycling which was indicated the previous year.

270
Aqueous Release of Molybdenum from Non-Point and Point Sources

Jorden, R.M.; Meglen, R.R.

Part of Hemphill, D.D. (Ed.), Seventh Annual Conference on Trace Substances in Environmental Health, Held at Memorial Union, University of Missouri-Columbia, Columbia, MO, June 12-14, 1973; 1973

MOLYBDENUM; RELEASE RATES; DRAINAGE; MINING; TRANSPORT; STREAMS; WATER

GEOGRAPHICAL DESCRIPTION: U.S. (SW)

The aqueous mass release rate of molybdenum per unit of drainage area (gram year-1 mile-2) has been determined for a number of locations in Colorado and New Mexico and it has been estimated for the world. Release rates for unmined molybdenum-rich deposits in a acidic alpine environment and for non-rich alkaline environments are very similar to one another and to the world rate. However, release rates for streams draining areas of active molybdenum mining-milling exceeds the rates in unmined areas by a factor as high as 10E4 times. A log-log fit of release rate versus drainage area vividly depicts the existence of point and non-point sources. This relationship also indicates that 10E5 square miles of drainage area is required to "dilute out" the elevated levels emanating from point sources in Colorado.

271
Lead Inclusion Bodies in Osteoclasts

Jsu, P.S.; Krook, L.; Shively, J.N.; Duncan, J.R.; Pond, W.G.

Science 181 (498) 447-448; 1973

LEAD; OSTEOCLASTS; PIGS; NUCLEUS; INCLUSION BODIES; TOXICITY; CHRONICITY; RESORPTION; BONES; OSTEOCYTES; OSTEOLYSIS

Inclusion bodies occur frequently in the nuclei and rarely in the cytoplasm of osteoclasts in pigs with experimental lead poisoning. The light and electron microscope picture of unmineralized sections are similar to those described for liver cord cells and renal tubular cells. Intranuclear inclusion bodies occurred in abundance in liver cord cells and in renal tubular epithelium in pigs with lead in their diets; none were found in controls. Lead inclusion bodies were not observed in osteoblasts or osteocytes. Osteocytic osteolysis is the primary mechanism in bone resorption in both physiological and pathological situations. During osteolysis, the osteocyte is metabolically very active and responds quickly to lead intoxication, and with greater chronicity it dies and the dead bone tissue us resorbed by osteoclasts.

272
Distribution of Chemical Elements in White Sea Deposits

Kalinenko, V.V.; Inst. Okeanol. Im. Shirshova, Moscow, USSR

Dokl. Akad. Nauk SSSR (DANKAS), 208(4), 948-950; 1973

SEDIMENTS; TRACE ELEMENTS; ORGANIC MATTER; DISTRIBUTION

273
Thiamine Pyrophosphate-Metal Ion Complexation. Equilibrium and Kinetics

Katz, H.B.; Kustin, K.; Dep. Chem., Brandeis Univ., Waltham, Mass.

Biochim. Biophys. ACTA (BBACAQ), 313(2), 236-248; 1973

THIAMINE; PYROPHOSPHATE; METALS; COMPLEXES; MAGNESIUM; MANGANESE; COBALT; COPPER; ZINC

Acid dissociation constants of thiamine pyrophosphate were from pH titration data at 25 in 0.1M KNO3. Stability constants of the metal ionthiamine pyrophosphate complexes MTPP and MHTPP+, where M is Mg(2+), Mn(2+), Co(2+) were determined from pH titration data at 25 in 0.1 M Me4NBr utilizing a Newton-Raphson algorithm to solve simultaneous mass balance equations and a reiterative nonlinear least-squares approach to compute the constants. The stabilities of these complexes did not follow the Irving-Williams order, but instead were typical of the order generally found with phosphate ligands. The kinetics of complexation of Ni(2+) and Mg(2+) with thiamine pyrophosphate were studied by the temperature-jump method. The concentration dependence of the relaxation times observed was not consistent with the common assumption that the concentration of the intermediate ion pair fulfills the steady-state conditions, but was consistent with the more general expression of the 2-step mechanism of complex formation. The results are in agreement with the rate determining loss of a water molecule from the inner coordination sphere of the metal ion. Nevertheless, for those cases in which the rate of water dissociation from the intermediate ion-pair is known experimentally, this rate invariably was slightly less than the rate of solvent exchange. This effect is examined and its implications discussed. For systems where calculation of the fraction ion-pair using experimentally determined values is possible, it can be concluded that the greater the charge at the binding site, the more predominant the inner sphere complexes.

274

274
Absorption of Lead in Drinking Water

Kempf, T.; Inst. Wasser, Boden Lufthyg., BGA, Berlin, Ger.

Part of Proceedings of International Symposium on Environmental Health Aspects of Lead, Amsterdam, Netherlands, October 2-6, 1972. Organized jointly by Commission of the European Communities, Directorate General Social Affairs-Health Protection Directorate and Environmental Protection Agency, EUR 5008 d-e-f. Luxembourg: Commission of the European Communities, Directorate General for Dissemination of Knowledge, Centre for Information and Documentation (26TVAJ), 785-58; 1973

LEAD; ABSORPTION; DRINKING WATER

275
Cadmium Accrual in a Flowing Marine Microcosm

Kerfoot, W.B.

Part of Ryther, J.H., WHOI-73-2, The Use of Flowing Biological System in Aquaculture, Sewage Treatment, Pollution Assay, and Food-Chain Studies, Woods Hole Oceanographic Institution, January 1, 1972 - December 31, 1972, Unpublished Manuscript, 11 p.; 1972

MICROCOSMS; MARINE ORGANISMS; ACCUMULATION; CADMIUM; TRACE ELEMENTS; SEDIMENTS; OYSTERS; CLAMS; WORMS; SHRIMP; ALGAE; PHYTOPLANKTON; SHELLFISH; MATERIAL BALANCE; ECOSYSTEM ANALYSIS; CADMIUM IODIDE; PERSISTENCE; CONCENTRATION; UPTAKE; SAND; QUAHOGS; AQUATIC ECOSYSTEMS

An experimental flowing marine microcosm has been prepared to be used for the evaluation of chronic accumulation of trace materials released into coastal waters. To test the performance of the microcosm, trace quantities of cadmium were added to the seawater flowing through compartments filled with representative samples of sediment and marine life. A material balance of the cadmium introduced into the microcosm reflects the removal of 15% of the cadmium by sediment and biota. The bulk of the retained cadmium was incorporated in the sediment (62%) and the oysters (39%). However, the greatest enrichment occurred in algae, shrimp, and sand worms. These results suggest that oysters, temporarily, and sediments, ultimately, serve as reservoirs for cadmium in the marine environment.

276
The Accumulation of Metal by Organisms Cultured in a Combined Tertiary Treatment-Aquaculture System

Kerfoot, W.B.; Jacobs, S.A.

Part of Ryther, J.H., WHOI-73-2, The Use of Flowing Biological Systems in Aquaculture, Sewage Treatment, Pollution Assay, and Food-Chain Studies, Woods Hole Oceanographic Institution, January 1, 1972 - December 31, 1972, Unpublished Manuscript, 10 pp.; 1972

ACCUMULATION; METALS; AQUACULTURE; SEWAGE; PHYTOPLANKTON; OYSTERS; ZINC; CHROMIUM; CADMIUM; LEAD

Two studies of long-term exposure to a single effluent to assess the possibility of metal accumulation by organisms cultured in a combined tertiary treatment-aquaculture system have been conducted. The first study used a marine microcosm wherein sewage-cultured phytoplankton were fed to oysters. In the second study shellfish cultured in large outdoor tanks were assayed for metal content. No significant increase in metal content occurred in organisms feeding on algae cultured in secondary effluent. In fact the concentration of several metals (zinc, chromium, cadmium and lead) actually decreased.

277
Predmeditated Cadmium Contamination of a Combined Waste Water Treatment - Aquaculture System

Kerfoot, W.B.; Jacobs, S.A.

Part of Ryther, J.H., WHOI-73-2, The Use of Flowing Biological Systems in Aquaculture, Sewage Treatment, Pollution Assay, and Food Chain Studies, Woods Hole Oceanographic Institution, January 1, 1972- December 31, 1972, (Unpublished Manuscript); 1972

CADMIUM; AQUACULTURE; SEWAGE; EFFLUENTS; SHELLFISH; ALGAE; FOOD CHAINS; BIOACCUMULATION; PLANKTON; INGESTION; ABSORPTION; TRACE METALS

The use of sewage effluent as a nutrient source in aquaculture of foodstuffs for human consumption may introduce contaminants of three types into the food chain: (1) microbial; (2) organic; and (3) inorganic including trace metals. The accumulations of cadmium in shellfish in an experimental tertiary treatment-aquaculture systems was investigated. Cadmium was introduced into the food chain (1) in plankton cultures, and (2) directly into the seawater system in which the shellfish are cultured. Cadmium may be obtained by shellfish by either absorption or ingestion. Even considering the algae in which cadmium is absorbed at the highest rate, and using the highest measured percentage retention, the rate of cadmium increase due to ingestion of algae is only about 1/10 of that absorbed directly from the seawater solution at the same level of contamination.

278
Mercury Content of Modern and Old Striped Bass (MORONE SAXATILIS)

Kerfoot, W.B.; White, G.G.

Part of Ryther, J.H., WHOI-73-2, The Use of Flowing Biological Systems in Aquaculture, Sewage Treatment Pollution Assay, and Food-Chain Studies, Woods Hole Oceanographic Institution, January 1, 1972 - December 31, 1972, Unpublished Manuscript, 13 p.; 1972

FISH; MERCURY; BASS; AGE; BIOACCUMULATION

TAXONOMY: MORONE SAXATILIS

A common marine sportfish, MORONE SAXATILIS, shows a progressive increase in mercury content with natural age. In a study of fish ranging up to 12 years of age, the mercury content of axial muscle exhibited an annual increase of .059 micrograms of mercury per gram of wet weight of tissue. The rate of accumulation was significantly higher than that observed previously in fresh water lake trout of similar sizes and ages. However, no difference in metal content was detected between present-day marine bass specimens and similar individuals from museum collections.

279
Absorption of Copper Ions by CANDIDA UTILIS Cells

Khovrychev, M.P.; Inst. Mikrobiol., Moscow, USSR

Mikrobiologiya (MYKBAS), 42(5), 839-844; 1973

COPPER; ABSORPTION; YEAST; CUPRIC SULFATE; IODACETATE

TAXONOMY: CANDIDA UTILIS

The saturation level of copper in the C. UTILIS cells was reached 2 hr after they were placed in a medium containing cupric sulfate (1mM). A pH range of 3-7 and a temperature of 30 degrees were optimal for Cu absorption. The relation between the rate of Cu absorption and its concentration in the medium was described by the Michaelis-Menten Equation. Hg or Ph ions, iodoacetate, KCN, or 2,4-dinitrophenol at 0.1-1.0 mM inhibited the absorption of Cu. The absorbed Cu ions could be washed out of the cells by 0.1n HCL, but not by H20 or NACL (80MM) solution.

280
Studies on the Contents of Mercury, Cadmium, Lead and Copper in Edible Seaweeds in Korea

Kim, C.Y.

Bull. Korean Fish Soc 5(3), 88-96; 1972

MERCURY; CADMIUM; LEAD; COPPER; SEAWEEDS; FOODSTUFFS

TAXONOMY: ENTEROMORPHA SP; UNDARIA SP; PORPHYRA; LAMINARIA SP; HIZIKIA SP

281
Seasonal Fluctuations of Ionic Copper in Knights Pond, Massachusetts

Kimball, K.D.; Dep. Zool., Univ. Massachusetts, Amherst, Mass.

Limnol. Oceanogr. (LIOCAH) 18(1), 169-72; 1973

COPPER IONS; PONDS; ZINC; SEASONAL VARIATIONS; MUMMICHOG; CADMIUM; FRESHWATER; COPPER

TAXONOMY: FUNDULUS HETEROCLITUS

GEOGRAPHICAL DESCRIPTION: U.S. (NE), Massachusetts, Knights Pond

Effects of mixtures of chloride salts of cadmium, copper and zinc on survival, whole body residues, and histopathology of mummichog, FUNDULUS HETEROCLITUS (L.), were investigated in synthetic seawater at 20% salinity and 20 degrees C. Mixtues of Cu 2+ and Zn 2+ as indicated by 96 h bioassay studies produced more deaths than expected on the basis of toxicities of individual components. Concentrations of Cd 2+ not ordinarily lethal exerted a negative effect on survival of fish intoxicated by salts of copper, zinc, or both. Atomic absorption determinations of Cd, Cu, and Zn residues in mummichog which survived 96 h exposures to each of these toxicants provided useful indices of total body burdens for these metals. Residues from survivors held in mixtures, especially Cd 2+ and Zn 2+ mixtures, did not conform to patterns observed for single elements. Whole body aggregates of Cd, Cu, and Zn from dead mummichogs were of limited worth owing to possible accumulation of these metals from the medium after death. Renal and lateral line canal lesions were noted in all fish subjected to copper concentrations of 1 mg/l and higher. Renal lesions observed in fish immersed in mixtures of Cu 2+ and Cd 2+ assumed a damage pattern characteristic of Cd 2+; with mixtures of Cu 2+ and Zn 2+, lesion were typical of Cu 2+-induced damage. Lesions induced in lateral line epithelium by Cu 2+ were not affected by either Cd 2+ or Zn 2+. Epithelia lining the oral cavity were necrotized by the caustic action of high levels of Zn 2+ (60 mg/l) and of Cu 2+ (8 mg/l).

282
Selenium Compounds in Nature and Medicine. V. Metabolism of Selenium by Plants and Microorganisms

Klayman, D.L.; Shrift, A.; Dep. Biol. Sci., State Univ. New York, Binghamton, NY

Part of Org. Selenium Compounds: Their Chem. Biol. 1973, 760-814 Klayman, D.L. (Ed.). Wiley: New York, NY; 1971, November

REVIEW; SELENIUM; METABOLISM; MEDICINE; BIOLOGY; PLANTS; MICROORGANISMS

A review with 306 references.

283
The Influence of an Industrial Plant on the Chemistry of Quaternary Waters in its Vicinity, Upper Odra River Valley

Kleczkowski, A.S.; Kowalski, J.; Inst. Hydrogeol. Eng. Geol., Acad. Min. Metall., Mickewicza 30, Cracow, Poland

Bull Acad Pol Sci Ser Sci Terre 20(1), 65-70; 1972

INDUSTRY; EFFLUENTS; CHEMISTRY; WATER; RIVERS; SULFATES; CHLORIDE; SODIUM; POTASSIUM; NITRATES; MINERALIZATION; HYDROCHEMISTRY

GEOGRAPHICAL DESCRIPTION: Poland, Upper Odra River Valley

From an area of 100 square km surrounding a chemical plant, more than 400 samples of water were taken in monthly series (1969-1970). In the non-isolated water-bearing horizon, marked changes in the chemical composition of water down to 15 m depth were established (SO_4, Cl, Na + K, NO_3 mineralization). This is connected with hydrochemical characteristic zonality and extension of pollution by chimney exhalations into the atmosphere and their infiltrations (S and N).

285
Interaction of Temperature and Copper Ions as Orienting Stimuli on the Locomotor Behavior of the Goldfish (CARASSIUS AURATUS)

Kleerekoper, H.; Waxman, J.B.; Matis, J.; Dep. Biol., Texas A and M Univ., College Station, Tex.

J. Fish Res. Board Can. (JFRBAK) 30(6), 725-8; 1973

GOLDFISH; BEHAVIOR; COPPER; FISH; TEMPERATURE; AVOIDANCE

TAXONOMY: CARASSIUS AURATUS

Movements of single goldfish (CARASSIUS AURATUS) were monitored in a free choice situation comprising zones of laboratory water or copper-containing water (0.010 ppm as CuCl2) each at two temperatures, 21.1 +- .1 and 21.5 +-.1 C. Fish entered the copper zone at 21.1 C significantly less frequently and spent less time there per entry as compared to the noncopper zone ("avoidance" behavior). The copper zone at 21.5 C became significantly "attractive" to the fish in terms of both frequency of entry and time spent. In the same terms, laboratory water at 21.5 C was "attractive" to the fish but became significantly more so in the presence of copper ions at the concentration of 0.010 ppm.

287
Seasonal Variations of Cadmium, Copper, Manganese, Lead, and Zinc in Water and Phytoplankton in Monterey Bay, California

Knauer, G.A.; Martin, J.H.; Hopkins Marine Station, Calif.

Limnology & Oceanography, 18(4), 597; 1973, July

PHYTOPLANKTON; SURFACE WATERS; CADMIUM; COPPER; MANGANESE; ZINC; SEASONAL VARIATIONS; SALTWATER

GEOGRAPHICAL DESCRIPTION: U.S., California, Monterey Bay

Surface water and mixed phytoplankton samples, collected over one year in Monterey Bay, Calif., were analyzed for cadmium, copper, manganese, lead, and zinc. The phytoplankton had little effect on element concentrations in water with the cadmium, however, decreased during peak periods of productivity. Generally, metal levels in nearshore surface waters depended more on hydrographical fluctuations than on biological factors. Surface water collected on a transect between Hawaii and Monterey were also analyzed for these trace metals, for inshore and offshore comparisons. Levels of copper, manganese, and zinc were usually higher inshore than offshore but those of cadmium and lead were almost always higher inshore.

285
Heavy Metals: Fallout Around a Power Plant

Klein, D.H.; Russell, P.; Department of Chemistry, Hope College, Holland, Mich. 49423

Environ. Sci. Tech. 7(4), 357-358; 1973

SOILS; COAL; POWER PLANTS; SILVER; CADMIUM; COBALT; CHROMIUM; COPPER; IRON; MERCURY; NICKEL; TITANIUM; ZINC; METALS; WIND PATTERNS

Soils around a coal-burning plant are enriched in Ag, Cd, Co, Cr, Cu, Fe, Hg, Ni, Ti, and Zn. Plant materials are enriched in Cd, Fe, Ni, and Zn. Soil enrichments correlate with wind patterns and with the metal content of coal except of Hg, which is only slightly enriched.

288
Distributions of Radionuclides in Reef Corals: Opportunity for Data Retrieval and Study of Effects.

Knutson, D.W.; Buddemeier, R.W.

Part of Radioactive Contamination of the Marine Environment, Proceedings of Symposium held by the International Atomic Energy Agency, Seattle, WA, July 10-14, 1972 (735-745), 786 p.; 1973

SEASONAL VARIATIONS; NUCLEAR EXPLOSIONS; AUTORADIOGRAPHY; RADIONUCLIDES; REEFS; CORAL; DISTRIBUTION; CARBON 14; DATA RETRIEVAL; STRONTIUM 90; UPTAKE; RADIOACTIVITY

GEOGRAPHICAL DESCRIPTION: Eniwetok

Autoradiography of sectioned massive corals from Eniwetok has revealed the presence of discrete bands of radioactivity identifiable with specific nuclear test series. X-radiographs of these and other corals show structural density variations which comparison with the autoradiography demonstrates to be seasonal in nature. The coral structure thus contains a reasonably reliable internal calendar. Residual Sr 90 activities have been determined for the Eniwetok corals, and a Fanning Island coral has been used to reconstruct the uptake of excess C14 at that location. In addition to permitting retrieval of past radionuclide concentrations as sampled by the corals, the method permits retrospective study of the organism's structural response to incorporation of the radioactivity.

286
Mercury Levels in Marine Biota

Klemmer, H.; Luoma, S.N.; Lau, L.S.; Univ. Hawaii, Honolulu, Hawaii

Report NOAA-73022303, 3 p.; 1973, Jan.

MERCURY; MARINE BIOTA; ANIMALS; FISH; SEDIMENTS; SALTWATER; BENTHOS; TRANSPORT; FOOD CHAINS; PLANKTON; HERBIVORE; CARNIVORE; BIOACCUMULATION

Studies of Hg levels in a wide range of biota collected from a nearshore area on Kauai indicate that benthic feeders accumulate Hg better than animals feeding above the sediment-water interface. The most effective pathway of Hg transport may not be through a linear food-chain from plankton to herbivore to carnivore. Greater concentrations of Hg may be found in organisms associated with short food chains linked directly to the benthos.

289
Removal of Mercury in Industrial Waste Water with Chelate Resin

Kobayashi, Y.; Tanaka, A.; Sugai, M.; Dep. Saf. Eng., Yokohama Natl. Univ., Yokohama, Japan

Bull. Fac. Eng., Yokohama Nat. Univ. (BFEYA8), 22, 85-63; 1973

MERCURY; REMOVAL; WATER; RESIN; METALS; CHELATES; ADSORPTION; INDUSTRY

290
Mercury-Selenium Correlations in Marine Mammals

Koeman, J.H.; Peters, W.H.M.; Koudstaal-Hol, C.H.M.; Department of Toxicology, Agricultural University, Wageningen, The Netherlands Interuniveristy Reactor Institute, Delft, The Netherlands

Nature 245, 385-386; 1973

MERCURY; SELENIUM; CADMIUM; ZINC; ANTIMONY; MARINE BIOLOGY; ANIMALS; SEALS; DOLPHINS; LIVERS; SYNERGISM

Cadmium, arsenic, selenium, zinc, and antimony were measured in juvenile seals, adult seals, porpoises, bottle-nosed dolphins and dolphins. The concentration of mercury in the livers of these marine mammals seems to be strongly correlated with the concentration of selenium, but not with any of the other elements. This association may point to a protective mechanism in response to mercury incorporation by marine mammals.

291
Ecological Implications of Dimethyl Mercury in an Aquatic Food Chain.; Project Completion Rept. 1

Kolb, L.P.; Porcella, D.B.; Middlebrooks, E.J.; Utah Water Research Lab., Logan. 405 725

Agency Rept No. W73-13657, OWRR-B-070-Utah(3); Proj. OWRR-B-070-Utah, 55 p.; 1973, June

WATER; ANIMALS; DIMETHYL MERCURY; AQUATIC ECOSYSTEMS; MERCURY; FOOD CHAINS; AQUATIC ANIMALS; TOXICITY; ALGAE; FISH; DAPHNIA; MERCURY ORGANIC COMPOUNDS; MICROORGANISMS; METHYLATION

The purpose of these studies was to investigate a variety of ecologically significant interactions between dimethyl mercury and the aquatic environment in which it may be present. Laboratory studies indicate dimethyl mercury may be a major product of microbial methylation in organic mercury. The physical, chemical, and biological factors affecting the transport and food chain distribution of dimethyl mercury have remained unclear. Results are presented of laboratory studies of volatilization rates of dimethyl mercury from water as a function of temperature and mixing conditions. Absorption kinetics and equilibrium concentration of dimethyl mercury in algae, daphnia, and fish are reported. Toxicity to fish, and studies of metabolism of the compounds by microbes are discussed. Mercury-203 labeled dimethyl mercury was used in the study, and in all tests the organisms used were live counted. A unique method was developed for measuring dimethyl mercury uptake in algae. In water, dimethyl mercury was found to behave similarly to nonreactive gases such as oxygen.

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Ecological Implications of Dimethyl Mercury in an Aquatic Food Chain

Kolb, L.P.; Porcella, D.B.; Middlebrooks, E.J.; Utah Water Research Laboratory, College of Engineering, Utah State University, Logan, UT 84322

Report No. PRWG-105-2; Contract DI-14-31-0001-3659; Monitoring; 1973, June

MERCURY; DIMETHYL MERCURY; METHYLATION; ALGAE; FISH; RADIOISOTOPES; VOLATILIZATION; ADSORPTION; DESORPTION; TOXICITY; UPTAKE; KINETICS

TAXONOMY: DAPHNIA

Laboratory studies indicate dimethyl mercury may be a major product of microbial methylation of inorganic mercury. Although another methylation product, monomethyl mercury, has been extensively studied, the physical, chemical, and biological factors affecting the transport and food chain distribution of dimethyl mercury have remained unclear. This report represents results of laboratory studies of volatilization rates from water as a function of temperature and mixing conditions, uptake kinetics and equilibrium concentrations in algae, DAPHNIA, and fish, toxicity to fish, and studies of metabolism of dimethyl mercury by microbes. Mercury-203 labeled dimethyl mercury was used in the study and in all tests the organisms used were live counted. A unique method was developed for measuring dimethyl mercury uptake in algae. In water dimethyl mercury was found to behave similarly to non-reactive gases such as oxygen volatilization occurred rapidly.

293
Levels of Copper and Manganese Trace Elements in River Waters, Soils, and Plants of the Southern Ukraine

Kolesnikova, V.G.; Kasatkina, L.A.; Malakhova, C.P.; Kuzychenko, V.I.; Babov, D.M.; Odess. Med. Inst. Im. Piergova,Odessa, USSR

Gig. Sanit (3), 110-11; 1973

COPPER; MANGANESE; SOILS; PLANTS; RIVERS; TRACE ELEMENTS; FRESHWATER

GEOGRAPHICAL DESCRIPTION: USSR, Ukrane

294
Concentrations of Five Trace Metals in the Waters and Oysters (CRASSOSTREA VIRGINICA) of Mobile Bay, Alabama

Kopfler, F.C.; Mayer, J.; Gulf Coast Water Supply Res. Lab., Environ. Prot. Agency, Dauphin Islands, Ala.

Proc. Nat. Shellfish. Ass. (PSNFAN) 63, 27-34, 1972; 1973

TRACE ELEMENTS; CADMIUM; OYSTERS; CHROMIUM; COPPER; LEAD; ZINC; WATER; SALTWATER; FRESHWATER; RUNOFF; DISCHARGE

TAXONOMY: CRASSOSTREA VIRGINICA

GEOGRAPHICAL DESCRIPTION: U.S. (S), Alabama, Mobile Bay

From January 1968 through June 1969, samples of water and oysters were collected at monthly intervals from eight locations in Mobile Bay, Alabama. These samples were analyzed for cadmium, chromium, copper, lead and zinc by atomic absorption spectrophotometry and the results analyzed statistically. Oysters from Mobile Bay contained less cadmium, copper and zinc than the average concentration reported for Atlantic Coast oysters. The concentration of chromium was approximately the same while the lead concentration was about two times that of the average value for Atlantic Coast oysters. Oysters collected from the western side of the Bay were found to contain a significantly greater concentration of copper and zinc than oysters collected from the eastern side. These differences were attributed to differences in river systems that contribute the fresh water discharge and runoff to opposite sides of the Bay. Although concentrations of the trace metals investigated were 10(E3) - 10(E5) higher in oysters than the concentrations in the environmental water samples, poor correlation was observed between the two sets of data.

295
Arsenic Distribution in Deep Subsurface Waters of the Middle Caspian Artesian Basis

Kortsenshtein, V.N.; Karaseva, A.P.; Aleshina, A.K.; Vses. Nauchno-Issled. Inst. Prir. Gazov, Moscow, USSR

GeoKhimiya, (8), 812-17; 1973

ARSENIC; SUBSURFACE WATERS; ARTESIAN BASIN; WATER

The deep subsurface waters in the Jurassic and Cretaceous formations occur at a depth of 3-5 km in the southern Mangyshlak zone. The highly mineralized (10-150 g/l) subsurface waters in the carbonatic-terrigenous facies are perdominantly of the NaCl type with a high concentration of Br, I, B NH 4, and naphthenic acids. Results of colorimetric estimation of As (10-120 ug/l) in the waters are presented. The concentration of As tends to increase with depth. An inverse correlation exists between the As and the Cl contents.

296
Uptake of Mercury by Plants and Its Distribution in Living Organisms in an Environment with Increased Concentration of this Element

Kosta, L.; Byrne, A.R.; Stegnar, P.; Zelenko, V.; "Jozef Stefan" Institute, University of Ljubljana, Yugoslavia

Part of Radiotracer Studies of Chemical Residues in Food and Agriculture. Proceedings of a Combined Panel and Research Coordination Committee., Vienna, 25-29 October 1971. International Atomic Energy Agency, Vienna; 1972

ANIMALS; DISTRIBUTION; FISH; METHYLMERCURY; UPTAKE; MERCURY; PLANTS; TRANSFORMATION; BIOTA; MINING; DISTILLERY; INDUSTRY; HUMANS

GEOGRAPHICAL DESCRIPTION: Yugoslavia, Idrija

The extent of biological transformation of inorganic mercury was measured on fish at a typical inorganic source (mine and distillation plant in Idrija, Yugoslavia) using a newly developed isolation method for methyl mercury. Results are tabulated on the uptake levels and distribution of mercury in the organs of plants, animals and humans. For the latter, beard has been shown to be an advantageous indicator of the exposure.

297
Mechanisms of Mercury Transformation in Bottom Sediments, Part II. Final Report.

Krenkel, P.A.; Burrows, W.D.; Shin, E.B.; Taimi, K.I.; McMullen, E.D.

Technical Report Number 32, Environmental and Water Resources Engineering, Vanderbilt University, Nashville, TN, 319 p.; 1973, October

MERCURY; METHYLMERCURY; SEDIMENTS; TRANSFORMATION

298
Mechanisms of Mercury Transformation in Bottom Sediments, Part I. Final Report

Krenkel, P.A.; Reimers, R.S.; Burrows, W.D.

Technical Report Number 31, Environmental and Water Resources Engineering, Vanderbilt University, Nashville, TN, 383 p.; 1973, May

MERCURY; METHYLMERCURY; SEDIMENTS; TRANSFORMATION

299
Aquatic Ecology

Krishnamurthy, K.; Rao, S.

BNWL 1650(Pt.2), p. 1.1-1.27; 1972, Dec.

AQUATIC ECOSYSTEMS; BIOLOGICAL STRESS; FISHES; INSECTS; TEMPERATURE; ANIMALS; GROWTH; ANTIBODIES; BACTERIA; RADIATION EFFECTS; DOSE-RESPONSE RELATIONSHIPS; INFECTIOUS DISEASES; RADIOACTIVE WASTES; TRITIUM; TROUT; RIVERS; DIFFUSION; MERCURY; METABOLISM; TOXINS; UPTAKE; BIOLOGICAL EFFECTS; GASES; LIQUID WASTES; SYNERGISM; THERMAL POLLUTION; DISEASE RESISTANCE

GEOGRAPHICAL DESCRIPTION: U.S. (NW), Washington, Columbia River, Priest Rapids Dam, McNary Dam, Bonneville Dam

Mercury levels in all river and waste water samples were less than methodological sensitivity, i.e., 0.1 ug/liter (or 0.1 ppb). Sediments behind Priest Rapids, McNary, and Bonneville Dams on the Columbia River contained 0.115, 0.331 and 0.096 ug mercury/g of sediment on a dry weight basis. Thus, McNary Dam sediments, situated below the confluences of the Yakima, Snake, and Walla Walla Rivers, contained significantly higher mercury levels than sediments behind Priest Rapids Dam, above the confluence of these rivers or Bonneville Dam, below McNary Dam.

300
Mercury Residues in Fishes from Water Bodies in Tirol

Krocza, W.; Pechlaner, H.; Wetscher, M.; Inst. Biochem., Tieraerztl. Hochsch., Vienna, Austria

Wien. Tieraerztl. Monatsschr. (WTMOA3), 60(5), 161-170; 1973

MERCURY; FISH

GEOGRAPHICAL DESCRIPTION: Austria, Innsbruck, Inn River

Mean mercury contents of fish caught in Tirol were 0.3 ppm for cyprinids and 0.8 ppm (90% <0.2 ppm) for salmonids. Fish caught in the Inn River near Innsbruck and in some of its tributaries were heavily contaminated (0.5- greater than 1.0 ppm). High Hg levels were also found in fish from certain lakes, whereas levels in fish from breeding farms averaged 0.06 ppm.

301
Lead, Cd, Zn, Cu, and Co in Streams and Lake Waters of Cayuga Lake Basin, New York

Kubota, J.; Wills, E.L.; Oglesby, R.T.; Agronomy Department, and the SCS, U.S. Plant, Soil, and Nutrition Laboratory, Cornell University, Ithaca, N.Y. 14850; Department of Natural Resources, Cornell University, Ithaca, NY 14850

Env. Sci. Technol. 8(3), 243-248; 1974

LEAD; CADMIUM; ZINC; COPPER; COBALT; LAKES; FRESHWATER

GEOGRAPHICAL DESCRIPTION: U.S. (NE) New York, Cayuga Lake, Ithaca

Waters of 12 tributary streams of Cayuga Lake were studied to determine the levels and seasonal and geographic patterns of trace elements in the Cayuga Lake basin, a primarily rural area. Trace elements in soluble form (filtered water) and in suspended particulates were studied. The trace element concentrations were generally low, but a seasonal pattern reflecting higher concentrations with high stream flow was noted in the case of Pb. Values for streams of rural areas reflect levels associated with normal geochemical processes and soil weathering. An impact of urbanization was reflected in higher levels of the trace elements in suspended particulates carried by these streams that flow through Ithaca, N.Y. A basis has been established to evaluate changes in trace element load with future changes in land use and urbanization.

302
Transport of Cs 137--II Interaction with Bed Sediments

Kudo, A.; Gloyna, E.F.; Civil Engineering Department, The University of Texas at Austin, Texas, U.S.A.

Water Research, 5, 71-79; 1971

TRANSPORT; CESIUM 137; SEDIMENTS; WATER; SORPTION; MODELS; RIVERS; PLUME; UPTAKE

The purpose of this study was to describe the transport of Cs 137 in an aqueous environment. The interaction phenomena, i.e., uptake and release of Cs 137 by sediments, were observed by using a set of flumes each 17 m in length and a model river which was 61 m long. The greatest uptake rate, Kst, by bed sediment was 88.7 x 10E-5 ((cpm cmE-2)/(cpm cmE-3))/sec) with a velocity of 0.504 m/sec (1.65 ft/sec) and a flow rate of 38.2 l/sec m (0.410 cfs/ft). In this case the sediment transport rate was 117.5 g/sec x m (0.0795 lb/sec X ft). The uptake rate increased as the mean velocity in the channel increased. The desorption rate of Cs 137 was low, being less than 1 per cent per month for a mean flow velocity of 3.0 cm/sec. This rate was obtained in a fresh water system where the concentration of total dissolved solids was about 600 mg/l.

303
Level of Metals in Cell Structures of Plants Differing by Radioresistance

Kulikov, B.N.; Cent. Asian Res. Inst. Phytopathol., Tashkent, USSR

Radiobiologiya (RADOA8), 13(5), 792-796; 1973

RADIORESISTANCE; PLANTS; CELLS; METALS; RADIOBIOLOGY

304

304
Lead Contamination of Snow

LaBarre, N.; Milne, J.B.; Oliver, B.G.; Water Management, Ontario Ministry of the Environment, Ottawa, Department of Chemistry, University of Ottawa, Water Quality Research Division, Department of the Environmenta, Ontario, Canada

Water Research, 7, 1215-1218; 1973

SNOW; LEAD; LEADED GASOLINE; GASOLINE; SEWERS; CONTAMINATION

Snow from disposal sites and along roads contained considerable lead due to the combustion of leaded gasolines by automobiles. In spite of lead concentrations up to 8330 ppm in the sample sediment, the highest concentration in the filtrates was 0.21 ppm with the average, 0.04 ppm. Thus, the dumping of snow away from water-course instead of directly into them significantly reduces lead contamination of the waters from this source.

305
Laboratory Studies of the Purification Kinteics of River Water Isere by Sedimentary Suspensions. Case of 51Cr, 59Fe, 60Co, 85Sr, 106Ru, 137Cs, 141Ce, and 203Hg

Lachet, B.Z.

Radioprotection 7(3), 143-157; 1972

LABORATORY STUDIES; KINETICS; CERIUM; CESIUM; CHROMIUM; COBALT; IRON; MERCURY; PURIFICATION; RADIONUCLIDE MIGRATION; RIVERS; RUTHENIUM; SEDIMENTS; STRONTIUM; RADIONUCLIDES; CHROMIUM 51; IRON 59; COBALT 60; STRONTIUM 85; RUTHENIUM 106; EDTA; CHELATION

The kinetics of purification of water containing radionuclides by sedimentary suspension can be interpreted as a function of time by an empirical equation of the form R=R(o) (1 + 1/a)n where "a" and "n" are two parameters fixed by the least squares method and where "Ro" and "R" are respectively the activities of water initially and after time "t". This fit proves both satisfactory and highly significant under all studied cases: sediments: screened (fine sands or silt) or unscreened in 1 g/l or 20 g/l concentrations; Radionuclides: 51Cr, 59Fe, 60Co, 85Sr, 106Ru, 137Cs, 141Ce, 203Hg, with or without a carier; under chloride, nitrate, citrate, acetate, nitrato-nitrosyl or EDTA forms.

306
Uptake of Lead by Alfalfa and Corn from Soil and Air

Lagerwerff, J.V.; Armiger, W.H.; Specht, A.W.; U.S. Soils Lab., Beltsville, MD

Soil Sci. (SOSCAK) 115(6), 455-60; 1973

LEAD; PLANTS; SOILS; CORN; ALFALFA; UPTAKE; ABSORPTION; LIMING

Growth and Pb uptake by corn and alfalfa were measured in potted Chester silt loam at two soil pH levels (5.2 and 7.2) and with HCl-extractable soil Pb levels of 12, 60, 113, and 212 ppm. Most treatments were carried out in a greenhouse. In addition to aerial Pb associated with nearby heavy traffic, fallout of particles of leaded paint constituted a contamination hazard. The control treatmen of corn was carried out also at a nearby outside location, i.e., in the absence of leaded-paint particulates. While the fallout of Pb was almost three times heavier inside than outside, the aerosol Pb concentration outside was almost twice as large as the one inside. The latter was reflected by the tassels only. All other plant parts, especially in the upper plant section, reflected the heavier Pb fallout inside than outside. Generally, this is associated with higher statistical variability. The plant parts in the lower plant section distinctly reflected increases in soil Pb content. Rinsing the tops of alfalfa removed more Pb from plants growing on unlimed soil than from those on limed soil. The amount Pb so removed from the tops increased s more Pb was taken up from the soil, suggesting translocation of Pb from the roots to the tops.

307
Exchange Adsorption or Precipitation of Lead in Soils Treated with Chlorides of Aluminum, Calcium, and Sodium

Lagerwerff, J.V.; Brower, D.L.; Natl. Agric. Res. Cent., Agric Res. Serv., Beltsville, MD

Soil Sci. Soc. Amer., Proc. (SSSAA8), 73(1) 11-13; 1973

ADSORPTION; PRECIPITATION; LEAD; EXCHANGE; SOILS; CHLORIDE; ALUMINUM; CALCIUM; SODIUM; PH; ALKALINITY

The exchange behavior of Pb2+ present in small concentrations in kaolinitic, montmorillonitic, and illitic soils pretreated with Al3+ or Ca2+, and kept at a number of salt (Cl) levels, was in agreement with mass-action law principles. The mean values of the Gapon exchange coefficient describing the distribution of ions between the adsorbed and solution phases in Cecil, Winsum, and Yolo soils were 0.31, 0.11 and 0.24 for Pb-Al systems, and 4.13, 4.97, and 11.1 for Pb-Ca systems. In Na+ treated, alkalized soils, Pb precipitated. The solubility of the precipitate increased with decreasing pH and concentration of salt (NaCl). The solubility in solutions used for suspending the soil was less in the presence than in the absence of soil. This may indicate that the Pb-soil complex is less soluble than the precipitate formed in solution, so that when soil is present the composition of the precipitate shifts toward a less soluble form. This would imply a multi-component nature of the precipitate.

308
Mercury Methylation in an Aquatic Environment

Langley, D.G.; Lab. Div., T.W. Beak Consult. Ltd., Toronto, Ont.

J. Water Pollut. Contr. Fed. (JWPFA5) 45(1), 44-51; 1973

PH; REDOX POTENTIAL; MICROORGANISMS; AQUATIC CHEMISTRY; TRANSFORMATION; MERCURY; METHYLATION; FISH; METHYLMERCURY

The results show that laboratory-controlled methylation studies are an excellent scientific tool that can be utilized successfully to monitor methylmercury accumulation in one important aquatic community. The results also indicate that mercury methylation depends on a number of parameters. These include temperature, pH, redox potential, microbial activity, mercury concentration, and organic concentration. Methylation of existing mercury contamination in aquatic environments is a serious hazard because under certain favorable conditions methylation can occur in sediments with fairly low mercury concentrations. This study indicates that, for practical purposes, environmental mercury methylation is too slow a process to permit a natural rehabilitation through purging of contaminated sediments. It would seem that mercury-contaminated sediments would require many decades to purge themselves to natural levels. Apart from mercury removal by dredging, which has not yet been proven successful, the approach of sealing off mercury-contaminated sediments shows promise as a rehabilitation measure and warrants further investigation.

309
Analysis of Toxic Responses in Marine Poikilotherms

LaRoche, G.; Gardner, G.R.; Eisler, R.; Jackim, E.H.; Yevish, P.P.; Zaroogian, G.E.; National Mar. Water Qual. Lab., West Kingston, R.I.

Bioassay Tech. Environ. Chem. (26VZAG) 199-216; 1973

COPPER; ANALYSES; POIKILOTHERMS; SALTWATER; NITRILOTRIACETATE; NTA

TAXONOMY: FUNDULUS HERCENARIA LOPHOGOBIUS

310
Chemical Treatment of Metal-Bearing Mine Drainage

Larsen, E.P.; Shou, J.K.P.; Ross, L.W.

Jour. Water Poll. Control Fed., 45, 1682; 1973

EFFLUENTS; LIME; MINES; NEUTRALIZATION; PH; SULFUR; COMPUTER SIMULATION; MODELING; REMOVAL

Heavy metals can be removed from mine drainage waters by a two-stage treatment process involving lime and sulfide additions. the process has been demonstrated in the laboratory and the field, using water from drainage-polluted Rocky Mountain streams. Computer simulation of the equilibrium behavior of metal hydroxides and sulfides is adequate as a predictive tool for metal removal.

311
Concentrations of Some Trace Metals in Pelagic Organisms and of Mercury in Northeast Atlantic Ocean Water

Leatherland, T.M.; Burton, J.D.; Culking, F.; McCartney, M.J.; Morris, R.J.

Deep-Sea Res. Oceanogr. Abstr. (DROAA), 20(8), 679-685; 1973, August

ACTIVATION ANALYSIS; ANTIMONY; ARSENIC; CADMIUM; CRUSTACEA; FISHES; MERCURY; NEUTRON BEAMS; NUCLEAR REACTIONS; TRACE AMOUNTS; ZINC; SALTWATER

312
Arsenic in Marine Fish and Invertebrates

LeBlanc, P.J.; Jackson, A.L.; T.W. Beak Consultants Ltd., Toronto, Ont.

Mar. Pollut. Bull. (MPNBAZ), 4(6), 88-90; 1973

ARSENIC; FISH; CRUSTACEA; CRAB; INVERTEBRATES; SALTWATER

313
Absence of Acute Effects on Threespine Sticklebacks (GASTEROSTEUS ACULEATUS) and Coho Salmon (ONCORHYNCHUS KISUTCH) Exposed to Resuspended Harbor Sediment Contaminants

LeGore, R.S.; DesVoigne, D.M.; Coll. Fish., Univ. Washington, Seattle, Wash.

J. Fish. Res. Board Can. (JFRBAK), 30(8), 1240-1242; 1973

DREDGING; SEDIMENTS; FISH; TOXICITY; STICKLEBACK; SALMON

TAXONOMY: GASTEROSTEUS ACULEATUS; ONCORHYNCHUS KISUTCH

314
Effect of Copper Sulfate Algicide Doses on the Energy Metabolism of Common Carp (CYPRINUS CARPIO) and Goldfish (CARASSSIUM AURATUS)

Leonte, E.; Inst. Biol. "Traian Savulescu", Bucharest, Rome

Bul. Cercet. Piscic. (BCPCB7), 31(1-2), 137-144; 1973

COPPER SULFATE; FISH; TOXICITY; ALGICIDE; RESPIRATION; CARP; COPPER

The O consumption of CYPRINUS CARPIO and CARASSIUM AURATUS was depressed by the presence of 0.1-0.7 mg copper sulfate/L. in the waters. Death occurred at 2-20 hr, depending on the dose. The O consumption decreased steeply following the addition of CuSO4, reaching a plateau which lasted less than 8 hr, and decreased again thereafter, leading to the death of the fish. Toxicity to fish might limit the use of CuSO4 as an algicide.

315
Mercury in the Environment. A Global Review Including Recent Studies in the Delaware Bay Region

Lepple, F.K.; Delaware University, Newark, Delaware

WRIS COM-73-10620, NOAA-73040201, 76 p

MERCURY; REVIEW; SALINITY; SALTWATER; SEDIMENTS

GEOGRAPHICAL DESCRIPTION: U.S. (NE), Delaware Bay

Water samples were obtained by boat and at some shore stations. Although upper Bay values are significantly higher than those in the lower portion, no simple correlation exists between total mercury content and salinity. Especially striking is the relative high concentration (0.4 to 0.6 ppb mercury) region near the center of the bay. An expected correlation between transparency (Secchi disc measurements) and sediment load was not borne out if one assumes that total mercury content is directly related to the amount of particulate matter.

316
Removal and Recovery of Heavy Metals from Waste Water

Lewandowski, R.; Etudes et Procedes D'Assainissement Duratrr Epap

Ger. Offen. (GWXXBX) 2316047 (C 02C), 29 pp.; 1972, March

HEAVY METALS; REMOVAL; WASTE WATER; COPPER; CADMIUM; PALLADIUM; TIN; CONSERVATION; LEAD; CYANIDE

317
Reduction of Copper Toxicity in a Marine Copepod by Sediment Extract

Lewis, A.G.; Whitfield, P.; Bannarine, A.; Inst. Oceanogr., Univ. British Columbia, Vancouver, B.C.

Limnol. Oceanogr. (LIOCAH) 18(2), 324-5; 1973

COPPER; TOXICITY; COPEPODS; SEDIMENTS; CHELATION; SALTWATER

TAXONOMY: COPEPODA; CALANOIDA; EUCHAETA JAPONICA

Seawater extracts of marine sediments from two areas were added to copper-enriched seawater in which the prefeeding states (egg, NI, NII) of EUCHAETA JAPONICA (Copepoda: Calanoida) were maintained. Survival with the sediment extracts was greater than without, indicating an ability of some part of the extracted material to reduce the toxicity of the copper. The effect of the extracts was compared with that of a synthetic chelating agent to provide an "equivalent" value.

318
Anaomalous Arsenic Concentrations in Chautauqua Lake

Lis, S.A.; Hopke, P.K.; Dep. Chem., State Univ. Coll., Fredonia, NY

Environ. Lett. (EVLTAX) 5(1), 45-51; 1973

ARSENIC; LAKES; WATER; ANALYSIS

GEOGRAPHICAL DESCRIPTION: U.S. (NE), New York (SW) Chautauqua Lake

During a preliminary survey of Chautauqua Lake, a lake in southwestern New York State, levels of dissolved arsenic between 3.5 and 35.6 ppb were measured. Possible relationships between the arsenic concentrations and other measured parameters are presented.

319
Health Aspects of Arsenicals in the Environment

Lisella, F.S.; Long, K.R.; Scott, H.G.

Journal of Environmental Health, 34(5), 511-518; 1972, March

ARSENIC; CHEMOTHERAPY; POISONING; TOXICITY; WOOD PRESERVATIVES; SHEEP DIPS; INSECTICIDES; RODENTICIDES; HERBICIDES; SOAPS; GERMICIDES; SODIUM ARSENITE; LEAD ARSONATE; OCCUPATIONAL EXPOSURES; SODIUM ARSENATE; DISODIUM METHYL SODIUM ARSONATE; DSMA; DALLIGRASS; CALCIUM ARSONATE; PREEMERGENCE HERBICIDES; CACODYLIC ACID; METHYL ARSENIC ACID; PLANTS; SILVICIDES; DEFOLIANTS; LEAD ARSENATE; BEER; SELENIUM; TOLERANCE LEVELS; PESTICIDES; CHRONIC; CANCER; CARCINOGENS; KERATOSES; TOBACCO; HAIR; LUNGS; WATER; GRASSES; LEAD; CANCER; DERMATOSES; INHALATION; INGESTION; ABSORPTION; SYMPTOMS; SULFHYDRYL GROUPS; GASTROINTESTINAL; NAUSEA; HEADACHE; VERTIGO; IRRITABILITY; ARSENIC TRIOXIDE; THERAPY; BAL; SHELLFISH; DRINKING WATER; APPLES; NAILS; SKIN; INTAKE; EXCRETION; SOILS; TRANSLOCATION; POTATO; ANALYTICAL PROCEDURES; NEUTRON ACTIVATION ANALYSIS; ATOMIC ABSORPTION SPECTROPHOTOMETRY; ARSENIC; WATER; FISH; SHELLFISH

A review of arsenic and its compounds as poisons and medicines. Arsenic compounds are used widely in wood preservatives, sheep dips, insecticides, herbicides, rodenticides, defoliants, etc. so more than 100 different population groups have some possibility of occupational exposure. Arsenicals may be absorbed by inhalation, ingestion or through the skin. Effects may be principally gastrointestinal disturbances or, in others, nervous manifestations (headache, vertigo, swelling in joints, restlessness, irritability, visual disturbances, etc.). Treatment of arsenic poisoning involves inducing vomiting, gastric lavage and then a saline cathartic. Intermuscular injection of dimercaprol (BAL) may be used. There is some question still unresolved, as to whether arsenic or its compounds cause cancer. They do result in dermatoses and keratoses. Arsenic combines with sulfhydryl groups so is found in hair, nails and skin as well as being eliminated in urine and feces. Small quantities of arsenic compounds may enter the diet as residues of insecticides on apples, potatoes, etc. or as residues of arsanilic acid growth additives in cattle and poultry feeds (supposed to be discontinued several days before marketing). Shellfish and fish sometimes contain measureable amounts of arsenic. Water in parts of Argentina contains enough arsenic to cause a chronic poisoning, but U.S. city water is mostly satisfactory in this respect. Methods of analysis for trace amounts of arsenic are discussed briefly.

320
The State of Cobalt in Seawater and Its Uptake by Marine Organisms and Sediments

Lowman, F.G.; Ting, R.Y.

Part of Radioactive Contamination of the Marine Environment, Proceedings of Symposium held by the International Atomic Energy Agency, Seattle, WA, July 10-18, 1972 (369-383), 786 p.; 1973

AQUATIC CHEMISTRY; COBALT; UPTAKE; MARINE ORGANISMS; RADIONUCLIDES; PHYTOPLANKTON; ZOOPLANKTON; CLAMS; CRUSTACEA; TRACERS; LOBSTERS; SPECIFIC ACTIVITY; SHRIMP.

Two methods, the critical pathway and the specific activity approach, have been used to predict hazards to man and other animals from the introduction of radionuclides into the marine environment. Valid application of the specific activity method is dependent upon the similarity of the physical-chemical forms of the introduced radionuclides and the corresponding natural element in the marine environment. The present work is concerned with the development of methods for investigating the chemical-physical forms of naturally occurring cobalt in seawater, the application of the methods to seawater in tropical areas and the uptake of the different forms of the element by marine organisms. Carrier-free inorganic Co 58 and Co 60 and high specific activity cyanocobalamin Co 57 were used as tracers for ionic and complexed cobalt. Stable cobalt in seawater, tagged with the ionic and complexed radionuclides, were preconcentrated by standard methods and analysed for stable and radionuclide content. The chemical yields for each form of radionuclide and the amounts of the different forms which were found in seawater are reported. Uptake of ionic and complexed cobalt by suspended and bottom sediments and by phytoplankton, zooplankton, brine shrimp, marine clams, pelagic crustacea and the spiny lobster were measured. The results show that significant errors may occur if concentration factors for marine organisms, based on comparisons of the stable element in seawater and in the living organisms, are calculated without consideration of the chemical-physical forms of the radionuclide and the natural element.

321
The Toxicity of Mercury in Man and Animals

Lu, P.C.; Berteau, P.E.; Clegg, D.J.

Part of Technical Report No. 137, Mercury Contamination in Man and his Environment, International Atomic Energy Agency, Vienna, Austria (p. 67-86), 181 p.; 1972, July

MERCURY; CONTAMINATION; HUMANS; ANIMALS; FOODS; FISH; ADI; METHYLMERCURY; TOXICITY; POISONING; INHALATION; BRAIN; MYOCARDIUM; LIPID SOLUBILITY; ACUTE; PNEUMONITIS; SYMPTOMS; TREMORS; CENTRAL NERVOUS SYSTEM; PROTEINURIA; GINGIVITIS; STOMATITIS; SALIVATION; MERCURIALENTIS; HYPERSENSITIVITY; URINE; BLOOD; ABSORPTION; MERCURIC CHLORIDE; KIDNEYS; MICE; MERCURY 203; LIVER; BRAIN; PHENYLMERCURY; POULTRY; RABBITS; GUINEA PIGS; DOGS; EXCRETION; BIOLOGICAL HALF-LIFE; TOXICITY; PHEASANTS; BIRDS; CATS; REPRODUCTIVE FAILURES; TERATOGENS; MINAMATA DISEASE; ATAXIA; PLACENTA; PLACENTAL TRANSFER; SEED DRESSINGS; ELECTROCARDIOGRAPHY; MERKURAN; HAIR; BLOOD; DEGRADATION

Exposure to mercury or its compounds may result in serious intoxication. It may occur among workers engaged in certain occupations or among individuals accidentally consuming grossly contaminated food. This type of health problem is more readily identifiable and usually involves relatively small numbers of individuals. On the other hand, the potential health hazards of low levels of mercury in food is of greater concern, because the symptoms and signs of poisoning might not be readily diagnosed and because a very large number of people may be affected. It is well documented that mercury is present in different foodstuffs, although its levels vary according to the type of food, background level of mercury in the environment, etc. The health hazards involved in the consumption of such foods depend not only on the levels of mercury but also on the chemical nature of the mercury compounds because they possess different toxicities. Since it is impossible to completely eliminate mercury from our food, and because its levels vary greatly, it is imperative that appropriate tolerance levels of mercury compounds in foods be established for use by regulatory agencies in order to protect the health of the consumer. Such tolerances must be based on proper evaluation of relevant toxicological and related data. Although a considerable literature exists on mercury to date, there do not appear to be sufficient studies which permit the assessment of an acceptable daily intake (ADI) for man. This conclusion has been reached in the toxicological evaluations of organomercury compounds as assessed by the FAO/WHO Joint Meetings on Pesticide Residues in 1965, 1966 and 1967 (FAO/WHO, 1965, 1967a, 1968) and by the Joint FAO/WHO Expert Committee on Food Additives in 1966 and 1970 (FAO/WHO, 1967b, 1970). The latter, at its 1970 meeting, noted the various points of toxicological concern (epidemics of poisoning, the higher sensitivity of the foetus, the severity and persistence of central nervous system damage, and the relation between mercury exposure and chromosome breaks in lymphocytes) and urged that further work be initiated before an ADI could be established. Meanwhile, it recommended that mercury contamination from all sources should be reduced to a minimum.

322
Fungicidal Activity of Some Alkyl- and Arylcarboxylatocopper(II) Complexes

Lucanska, B.; Blahova, M.; Hulkova, O.; Kratsmar-Smogrovic, J.; Dep. Inorg. Org. Chem., Pharm. Fac., Bratislava, Czech.

Acta Fac. Pharm., Univ. Comeniana (APFCAG), 24, 29-51; 1973

COPPER; COMPLEXES; FUNGICIDES

TAXONOMY; SCLEROTINIA; PHYTOPHTHORA; MICROSPORUM; TRICHOPHYTON; EPIDERMOPHYTON

323

323
A Study of the Mercury Content of Fish from Various Sources

Luckens, M.M.

Presented at 11th Annual Meeting, Society of Toxicology, Williamsburg, VA, March 5-9, 1972, (p. 43); 1972

SEED DRESSINGS; MERCURIAL FUNGICIDES; MERCURY; FUNGICIDES; OCEANS; RIVERS; FISH; WATER; SEDIMENTS

The mercury content of fish, bottom sediments and receiving waters from various sources was determined. Fish were obtained from: farm ponds receiving drainage from fields in which crops had been grown from seeds treated with mercurial dressings; the Great Lakes; ocean fishing grounds; rivers receiving drainage from farms on which crops had been raised using seeds treated with mercurials; and rivers receiving wastes containing inorganic mercury. Total mercury content of fish tissues ranged from 0-2 ppm, and mercury content was usually related to the fish feeding habits. In addition, mercury content was not uniform throughout the entire filet but was related to the type of musculature from which the sample was taken.

324
Absorption and Metabolism of Arsenic in Fish

Lunde, G.; Cent. Inst. Ind. Res., Blindern/Oslo, Norway

Fiskeridir. (Norway) Skr., Ser. Teknol. Unders. (FSTUAW) 5(1-2), 16 p.; 1972

ARSENIC; METABOLISM; RAINBOW TROUT; EYES; GILLS; ABSORPTION; FISH; MICROORGANISMS

On the basis of the results obtained during these experiments it can be concluded that fish are able to synthesize both fat soluble and water soluble arseno organic compounds from the inorganic arsenic in the feed eaten by the fish. However, this inorganic arsenic plays an insignificant role as source for the organic bound arsenic found in fish. The major part is supplied as already synthesized arseno organic compounds, from lower stages in the marine food chain. An accumulation of arseno organic compounds in specific organs shows that the compounds may possibly have a significance for fish. It is proposed that this may be as a bacteriostatic agent which acts to protect those regions of fish which are especially vulnerable to attack from microorganisms. Inorganic arsenic present in the water will also be absorbed by the fish, but neither water soluble nor lipid soluble arseno organic compounds could be detected by the available methods used in this investigation.

325
The Synthesis of Fat and Water Soluble Arseno Organic Compounds in Marine and Limnetic Algae

Lunde, G.; Central Institute for Industrial Research, Oslo 3, Norway

Acta Chemica Scandinavica 27, 1586-1598,; 1973

BIOSYNTHESIS; FAT; SOLUBILITY; LIPIDS; ARSENIC; ARSENO-ORGANIC COMPOUNDS; MARINE BIOLOGY; LIMNOLOGY; LAKES; SALTWATER; ALGAE

326
Trace Metal Contents of Fish Meal and of the Lipid Phase Extracted from Fish Meal

Lunde, G.; Cent. Inst. Ind. Re ., Blindern/Oslo, Norway

J. Sci. Food Agr. (JSFAAE), 24(8), 913-919; 1973

LIPIDS; FISH; TRACE ELEMENTS; SELENIUM; FISH OILS; FISH MEAL

327
Analysis of Trace Elements, Phosphorus, and Sulfur, in the Lipid and the Non-lipid Phase of Halibut (HIPPOGLOSSUS HIPPOGLOSSUS) and Tunny (THUNNUS THYNNUS)

Lunde, G.; Cent. Inst. Ind. Res., Oslo, Norway

J. Sci. Food Agr. 24(9), 1029-38; 1973

TUNA; HALIBUT; TRACE ELEMENTS; PHOSPHORUS; SULFUR; LIPID; FISH; TUNNY; ANALYSIS

TAXONOMY: HIPPOGLOSSUS HIPPOGLOSSUS; THUNNUS THYNNUS

328
Temperature Effects on Mercury Accumulation, Toxicity, and Metabolic Rate in Rainbow Trout (SALMO GAIRDNERI)

Macleod, J.C.; Pessah, E.; Freshwater Inst., Fish Res. Board Canada, Winnipeg, Manitoba

J. Fish Res. Board Can.(JFRBAK) 30(8), 485-92; 1973

PHENYLMERCURIC ACETATE; MERCURIC CHLORIDE; BIOACCUMULATION; MERCURY; TOXICITY; FISH; METABOLISM; TEMPERATURE; MEDIAN TOLERANCE LIMIT, TLM

TAXONOMY: SALMO GAIRDNERI

The toxicity of Hg in rainbow trout fingerlings was related to temperature and chemical formulation of the Hg at 10 deg. C, the 24-hr TLM concentration (Median tolerance limit) for mercuric chloride was approximately 30 times that for phenylmercuric acetate. The 96 hr TLM values for HgCl2 at 5, 10, and 20 degrees were 0.40, 0.28, and 0.22 mg/kg/l. The velocity of mortality was also linearly related to temperature, and temperature directly affected the accumulation of Hg in the fish muscle. The active metabolic rate, increased by higher temperatures, was depressed by HgCl2, and higher temperatures augmented the depressant effect.

329
Toxicity of Lead Nitrate to Algae

Malanchuk, J.L.; Gremendling, G.K.; Dep. Biol. Sci., State Univ. Coll., Plattsburgh, NY

Water, Air, Soil Pollut. (WAPLAC), 2(2), 181-190; 1973

LEAD; NITRATES; TOXICITY; ALGAE

TAXONOMY: COSMARIUM; ANABAENA; CHLAMYDOMONAS; NAVICULA; OCHROMONAS

Lead nitrate was toxic to 4 species of fresh water algae grown in low salt medium approximating the salt concentration of natural aquatic environments. ED50 (concentration causing a 50% reduction in CO2 fixation compared with controls after 24-hr exposure) values of 5 ppm Pb for COSMARIUM BOTRYTIS and 15-18 ppm Pb for ANABAENA SP., CHLAMYDOMONAS REINHARDTI, and NAVICULA PELLICULOSA were calculated for 1-2 ml samples containing 0.12-0.54 mg dry cell wt./ml. the high surface: vol. ratio for C. COTRYTIS may account for its increased sensitivity. Concentrations of Pb(NO3)2 up to 30 ppm did not inhibit CO2 fixation in OCHROMONAS MALHAMENSIS, but produced a concentration dependent icrease in CO2 fixation.

330
Copper Micronutrient Requirement for Algae

Manahan, S.E.; Smith, M.J.; Dep. Chem., Univ. Missouri, Columbia, MO

Environ. Sci. Technol. (ESTHAG), 7(9), 829-833; 1973

ALGAE; COPPER; NUTRITION

TAXONOMY: CHLORELLA; OOCYSTIS

331
Heavy Metal Ion Interaction and Transport with Synthetic Complexing Agents and Detergent Phosphate Substitutes in Aquatic Systems: Completion Rept 1 Jul 7 1-30

Manahan, S.E.; Smith, M.J.; Missouri Water Resources Research Center, Rolla

Missouri Water Resources Research Center, Rolla; PB 213 252/0; Contract DI-14-01-0001-3525; Monitoring Agency Rept No. W73-02112, OWRR-A-049-MO(1); Proj OWRR-A-049-MO; 198 p.; 1972, August

ION SELECTIVE ELECTRODES; WATER; POLLUTION EFFECTS; PLANTS; ALGAL GROWTH; DETECTION; PCTPLT COMPUTER PROGRAM; FORTRAN 4 PROGRAMMING LANGUAGE; DETERGENTS; ALGAE; NUTRIENTS; COPPER; WATER ANALYSIS; EDTA; CHELATION; TRACE ELEMENTS; CHLORELLA; ELECTRODES; BUFFERS; CHEMISTRY; CALIBRATION; LEAST SQUARES METHOD; COMPUTER PROGRAMS; POTENTIOMETRIC ANALYSIS; FORTRAN

332
Chelation and Olation Reactions of Metal Ions in Aqueous Solution. Final Report.

Martell, A.E.; Texas Agricultural and Mechanical Univ., College Station. Dept. of Chemistry

Texas Agricultural and Mechanical Univ., College Station. Dept. of Chemistry, Contract At (40-1)-3621; ORO--3621-19; 1973, June 15

AQUEOUS SOLUTIONS; CALCIUM; COMPLEXES; CHELATES; CHEMICAL REACTIONS; OALTION; COPPER NICKEL; POLYMERIZATION; THORIUM; URANIUM; URANYL COMPOUNDS

333
Chelation and Olation Reactions of Metal Ions in Aqueous Colugition

Martell, A.E.; Texas Agricultural and Mechanical Univ., College Station. Dept. of Chemistry

ORO-3621-19, Contract AT(40-1)-3621, 7 p.

A summary of work performed during a five-year contract period is presented. Four areas of general study include the chelation and olation of metal ions, new multidenate ligands, mixed ligand chelates, and the structure determination of metal chelates in solution. Papers that have been published are listed.

334
Elemental Composition of Plankton

Martin, J.H.; Knauer, G.A.; Hopkins Mar. Stn., Stanford Univ., Pacific Grove, California

Geochim. Cosmochim. Acta 37(7), 1639-53; 1973

PLANKTON; MINERALS; TRACE ELEMENTS

335
Mercury Uptake by Poly Amine-Carbohydrates

Nasri, M.S.; Friedman, M.

Environ. Sci. Technol., 6(8), 745-746; 1972

UPTAKE; POTATO; CHITOSAN; STARCH; CELLULOSE; DISTRIBUTION; MERCURY; POLYAMINES; NITROGEN; MERCURIC CHLORIDE

Chitosan (deacetylated chitin), other polyamines derived from cellulose, polyamines derived from dialdehyde starch, and poly (aminostyrene) bind mercury in large amounts from water solutions of HgCl2. In contrast, unmodified starch and cellulose adsorb very little mercury, while chitin (with acetylamin groups) binds much less than chitosan. In several instances the adsorbents bound more than one atom of mercury per nitrogen and more than their own weight of mercury. These results show that amino groups in natural and synthetic polymers are effective binding sites for mercuric chloride and point first to the possible utility of such polymers as adsorbents for mercury, and second, to the possible role of naturally occurring polyamine polymers in the distribution of mercury in the environment.

336
Selected Metals in Sediments, Water, and Biota in the Illinois River

Mathis, B.J.; Cummings, T.F.; Dep. Biol., Bradely Univ., Peoria, ILL.

J. Water Pollut. Contr. Fed., 45(7), 1573-83; 1973

SEDIMENTS; CHROMIUM; RIVERS; TUBIFICIDS; CLAMS; FISH; COPPER; NICKEL; LEAD; LITHIUM; ZINC; COBALT; CADMIUM

The Illinois River has been receiving domestic and industrial wastes from Chicago and other cities located along its shores for years, and the drastic decline in biotic diversity has been well documented. In the present study an atomic absorption spectrophotometer was utilized to determine the concentrations of copper, nickel, lead, chromium, lithium, zinc, cobalt, and cadmium in water, bottom sediments, tubificids, clams, and fishes taken from the Illinois River. The bottom-dwelling tubificids and clams closely reflected the concentrations of metals found in bottom sediments. A concentration gradient ranging from highest levels in worms, intermediate levels in clams, and lowest levels in fish fillets was observed for copper, nickel, lead, chromium, lithium cobalt, and cadmium (Figures 2 and 3). Zinc, however, exhibited a partial reversal of this trend. It was present in highest concentrations in clams, at intermediate levels in worms, metals were more highely concentrated in bottom sediments. The water component of the river exhibited the lowest concentration of metals with the exception of lithium.

337
Electrolytic Recovery of Zinc from Zinc-Containing Waste Water Deposits

Matsnev, A.I.; Sinev, O.P.; Rossinskii, N.P.; Ukr. Inst. Inzh. Vodn. Khoz., USSR

Khim. Volokna (KVLKA4), 15(4), 28-29; 1973

ZINC; RECOVERY; WASTE WATER; WATER

338
Mercury Inhibition on Lipid Biosynthesis in Freshwater Algae

Matson, R.S.; Mustoe, G.E.; Chang, S.B.

Environ. Sci. Technol., 6, 158; 1972

MERCURY; METHYLMERCURY; BIOSYNTHESIS; LIPIDS; GALACTOLIPIDS; CHLOROPHYLLS; PHOTOSYNTHESIS; INHIBITION; ALGAE; MICROORGANISMS; CHLOROPLASTS; FRESHWATER

TAXONOMY: ANKISTRODESMUS BRAUNII; EUGLENA GRACILIS

Mercuric chloride and methyl mercuric chloride inhibited the biosynthesis of lipids, especially galactolipids and chlorophylls in photosynthetically grown freshwater algae, ANKISTRODESMUS BRAUNII and EUGLENA GRACILIS. Three and one-half parts per million of mercuric chloride gave 50% inhibition of galactolipid biosynthesis, 98% inhibition, of chlorophyll synthesis in A. BRAUNII, and a slightly smaller degree of inhibition in E. GRACILIS. Also, 2 ppm of methyl mercuric chloride caused 85% inhibition of galactolipid biosynthesis and 98% inhibition of chlorophyll biosynthesis in A. BRAUNII. Both mercuric chloride and methyl mercuric chloride strongly inhibited the galactosyl transferase activity for the galactolipid biosynthesis in the chloroplasts isolated from EUGLENA cells and spinach leaves.

339
Phenylmercuric Acetate: Metabolic Conversion by Microorganisms

Matsumura, F.; Gotoh, Y.; Boush, G.M.

Science 173, 49-51; 1971, July

MICROORGANISMS; PHENYLMERCURIC ACETATE; DIPHENYLMERCURY; ORGANOMERCURIALS; METABOLISM

Phenylmercuric acetate, an organomercurial that has been widely used as a fungicide and slimicide, was found to be metabolized quickly by soils and aquatic microorganisms. One of the major metabolic products was identified to be diphenylmercury. In none of the cases has a methylmercury derivative been found among the microbial metabolic products of phenylmercuric acetate.

340
Factors Influencing Translocation and Transformation of Mercury in River Sediment

Matsumura, F.; Gotoh, Y.; Boush, G.M.; Dep. Entomol., Univ. Wisconsin, Madison, WI

Bull. Environ. Contam. Toxicol. (BECTA6) 8(5), 267-272; 1972

MERCURY; TRANSLOCATION; RIVERS; SEDIMENTS; TRANSFORMATION; MICROORGANISMS; ORGANIC MATTER; PH

Three factors contribute to the release of mercury into water: alkaline pH, the organic content of sediments, and microorganisms. Such processes are not necessarily directly related to methylmercury formation. The most profound effect, in terms of increased mercury level in waters, was observed when the pH of the system was increased above 7. It appears that the release of mercury into water from sediments can be controlled by two factors: the first being its relation to organic matter at high pH, and the second the changes in the state of mercury itself at high pH. The degree of influence of microorganisms on the fate of mercury is not clear. In one experiment considerable microbial growth was associated with high amounts of Hg in water, microorganisms were isolated, incubated with $^{203}HgCl_2$ for 10 days, cells harvested through centrifugation, and in all cases, microorganisms absorbed almost all of the available Hg.

341
Effects of Dissolved Zinc on the Gills of the Stickleback GASTEROSTEUS ACULEATUS

Matthiessen, P.; Brafield, A.E.; Queen Elizabeth Coll., Univ. London, London, England

J. Fish Biol. (JFIBA9), 5(5), 607-613; 1973

ZINC; TOXICITY; FISH; GILLS; CALCIUM; STICKLEBACK

TAXONOMY: GASTEROSTEUS ACULEATUS

342
Cation Exchange Capacity and Exchangeable Metals in a South Florida Watershed

Mattraw, H.C.; Florida State Univ., Tallahassee, FL

Univ. Microfilms, Ann Arbor, Mich., Order No. 73-11, 320, Diss. Abstr. Int. B 33(11), 5420-21; 1973

343
Trace Elements: A Growing Appreciation of Their Effects on Man

Maugh, T.H., II

Science, 181, 253-256; 1973

PHARMACOLOGY; PATHOLOGY; HUMANS; POPULATIONS; TRACE ELEMENTS; HEALTH; METABOLISM; DISEASE; LETHALITY

The pharmacologic and pathologic effects of normal, below normal, and elevated levels trace elements in humans and populations recently has become a great concern in the medical and scientific community. Abnormally high, or low, concentration of certain trace metals in humans may interfere with metabolic processes to the extent that disease, or death, may occur. Further studies will undoubtedly reveal startling facts concerning the essential (beneficial) and harmful interactions between trace elements and human health.

344
Natural Content of Chromium (6+) Ion in the Drinking Waters used by the Inhabitants of a Bulgarian Village

Mautner, G.; Lichev, N.; Kenova, M.; Mancheva, V.; Ivanova, S.; Zakharieva, V.; Zakharieva, Z.; Georgieva, E.; Vasilev, V.; Obedin.
Nauchnoizsled. Inst. Khig. Okhr. Tr., Sofia, Bulgaria

Khig. Zdraveopazvane (KHZDAN), 16(1), 42-47; 1973

CHROMIUM; DRINKING WATER; WATER

GEOGRAPHICAL DESCRIPTION: Bulgaria

345
Toxicity of Methyl Mercury for Steelhead Trout Sperm

McIntyre, J.D.; Oregon Cooperative Fishery Unit, Oregon State University, Corvalis, Oregon 97331

Bulletin of Environmental Contamination and Toxicology 9(2), 98-99; 1973

STEELHEAD TROUT; TROUT; METHYLMERCURY; CHLORIDE; SPERM; FERTILITY; FISH; MERCURY; GENETIC EFFECTS

TAXONOMY: SALMO GAIRDNERI

In a study designed to determine the genetic effects of mercury toxicity for steelhead trout (SALMO GAIRDNERI) it became necessary to determine the concentrations of methylmercuric chloride that would reduce sperm viability. The percentage of eggs that were not fertilized at each concentration of mercury indicated that concentrations of 1.0 ppm and greater reduced sperm viability as compared to the control. The experimental design did not permit studies of the chronic effects on sperm of lower concentrations of methylmercury; however, the extreme sensitivity of steelhead sperm to a level of mercury that often occurs in fish tissue was evident.

346
Investigation of Some Factors in the Biochemical Conversion of Mercury Pollutants to Toxic Methyl-Mercury Effected by Micro-Organisms in a Marine Sediment; Research Rept. Report on a Trident Scholar Project

McKinney, M.; Naval Academy, Annapolis, MD 245600

Report No. USNA-TRPR-32; Monitoring Agency Rept No. 18, 98 p.; 1972, May 19

MERCURY; MARINE BIOLOGY; MICROORGANISMS; REVIEW; SOLUBILITY; TOXICITY; CHEMICAL ANALYSIS; GAS CHROMATOGRAPHY; ATOMIC SPECTROSCOPY; MICROORGANISMS; ANALYSIS; SPECTROCHEMICAL ANALYSIS; TRACE ELEMENTS; ORGANOMERCURIALS; METHILMERCURY; CHELATION

The aim of the investigation was to find some of the factors involved in the conversion of mercury pollutants to toxic methyl-mercury by microorganisms in marine sediments. Research resulted in the definition of the two primary problems: modeling and analysis. A successful modeling technique was then developed, after restrictions in design were found desirable. A successful analytical technique, which had not been applied as such to biological samples, was developed and used with good results. These two solutions were then combined in an investigation of the conversion factors: pollutant type and level; conversion time; movement of water over the sediment (removal of Me-HG produced); chelation; eutrophication; and oxygen content of the water above the sediment.

347
Purification of Industrial Solutions and Waste Waters at the Balkhash Hydrometallurgical Plant

Mekler, L.I.; Gorodetskii, M.I.; Zinkovskii, V.A.; Porubaev, V.P.; Kvyatkovskii, A.N.; USSR

Tsvet. Metal. (TVMTAX), 7, 51-54; 1973

METALLURGY; DETOXIFICATION; INDUSTRY; WASTE WATERS; REMOVAL

348
Effects of Sublethal Amounts of Cadmium and Mercury on the Metabolism of Zinc 65 by Freshwater Fish

Merlini, M.; Argentesi, F.; Brazzelli, A.; Oreqioni, B.; Pozzi, G.

Part of PUR-0800 d.E.i.e., International Symposium, Radioecology Applied to the Protection of Man and his Environment, Rome, 1971. Proceedings. Held Roma 7-10 September, 1971. Luxemburg (Commission of the European Communities) QH 5435 I58 1971, (1327-44).; 1972, May

CADMIUM; FISH; FRESHWATER; MERCURY; METABOLISM; RADIONUCLIDES; KINETICS; RESPONSE; ZINC 65; AQUATIC BIOLOGY; RADIOACTIVITY; RADIATION EFFECTS; RADIATION; NUTRIENTS; ZINC; MICRONUTRIENTS; LAKES

TAXONOMY: LEPOMIS GIBBOSUS

It is known that aquatic environments which receive nuclear reactor effluents contain the neutron-induced radionuclide zinc-65. As a result, aquatic organisms are exposed to a radioactive essential micronutrient known to be physiologically important. Thus, radiozinc enters into the metabolic pools of these organisms just as its stable counterpart. Recent studies utilizing 65Zn have helped delineate the biological pathway of this essential element for a better understanding of mineral metabolism and the fate of this important nuclide in an edible freshwater fish, LEPOMIS GIBBOSUS, L. from Lake Maggiore (northern Italy). In addition, increased industrial and agricultrual pollution makes urgent studies of the effects of heavy metals on vital physiological processes. Cadmium and mercury are two of the heavy metals frequently encountered as pollutants of inland waters and they affect the normal behavior of zinc in freshwater fish. The results of studies conducted on the effects of sublethal quantities of Cd and Hg on the metabolism of Zinc-65 in LEPOMIS GIBBOSUS will be presented and discussed.

349
Lead and Cadmium Distribution in the Particulate Effluent from a Coal-Fired Boiler

Mervin, Fredrick

Dissertation, The Univ. of Iowa, Order No. 73-699, 174 pages.; 1972

LEAD; CADMIUM; DISTRIBUTION; EFFLUENTS; POWER PLANTS; COAL; BERYLLIUM; EMISSIONS; PARTICLE SIZE; ATOMIC ABSORPTION SPECTROPHOTOMETRY; RESPIRABLE FRACTION

This study was designed to evaluate the total emissions and the distribution of concentration with particle size for cadmium and lead in the particulate effluent from a coal-fired boiler. Particular attention was given to the concentration and amounts of these materials in the respirable size range (less than 5 m). Additional information was obtained on the distribution of beryllium and other elements in the particulate effluent. Particulates were collected using a sampling train which consisted of a Los Alamos Scientific Laboratory miniature cyclone followed by a six stage Andersen Sampler followed by an inline membrane filter. After collection, the various size ranges of particulates were analyzed quantitatively for cadmium and lead, using atomic absorption and for beryllium using fluorescence emission spectroscopy. These analyses showed that the largest amounts of cadmium and lead were in the respirable size fractions. An increase in concentration with decreasing particle size was also shown for lead and cadmium. The limited number of samples analyzed for beryllium indicated that there was not an increase in concentration in the smaller particulate size fractions of the samples.

350
Some Remarks on Mercury as an Aquatic Pollutant and Its Implications

Miettinen, J.K.; Department of Radiochemistry, University of Helsinki, Helsinki, Finland

Part of Radiotracer Studies of Chemical Residues in Food and Agriculture. Proceedings of A Combined Panel and Research Coordination Committee, International Atomic Energy Agency, Vienna, 61-68; 1974

MERCURY; WATER; CONTAMINATION; TRANSFORMATION; METHYLMERCURY; FISH; SWORDFISH; TUNA; HUMANS; BLOOD; HAIR; TEMPERATURE; BIOLOGICAL HALF-LIFE; METABOLISM; FRESHWATER

The chemical transformation of mercury in nature and the eventual mechanisms of methylation of mercury are discussed. Mercury levels in marine fish, especially tuna and swordfish from different regions and in fresh-water fish are revieved. The effect of temperature on the biological half-time of methyl mercury in fish is described. Recommended concentration limits of mercury in fish in the USA, Canada, Japan, Sweden and Finland are presented. The correlation between methyl-mercury consumption and Hg-level in blood and hair, as well as the differences of the metabolism of methyl mercury and inorganic mercury in man are discussed.

351
Dynamics of Absorption Rates, Endogeneous Excretion, Tissue Turnover, and Homeostatic Control Mechanisms of Zinc, Cadmium, Manganese, and Nickel in Ruminants

Miller, W.J.; Dep. Dairy Sci., Univ. Georgia, Athens, GA

Fed. Proc., Fed. Amer. Soc. Exp. Biol. (FEPRA7) 32(8), 1915-20; 1973

REVIEW; TRACE ELEMENTS; MANGANESE; ZINC; CADMIUM; NICKEL; TISSUES; RUMINANTS; ABSORPTION; EXCRETION; CONTROL MECHINSISM; ANIMALS; MAMMALS; CATTLE; MILK

After reaching the ruminant duodeum, zinc and manganese are absorbed quite rapidly, with transfer from intestinal mucosa to blood as the rate-limiting step. After absorption, manganese turnover rates in most tissues are much more rapid than those for zinc, but the rate of each decreases with time, both totally and as a percentage of that retained. This inidcates that increasing proportions of zinc and manganese are in tissues and combinations that hold them with high affinity. Although always low, cadmium turnover is extremely slow after the first few days. Absorption change appears to be the major means of zinc homeostasis, with endogenous excretion (and milk in lactating cows) making some contribution. In contrast, variable endogenous excretion is of major and perhaps dominant importance in manganese homeostasis, with differences in absorption probably playing a lesser role. Normally, a cadmium metabolic load does not materially affect total absorption or endogenous excretion of a radioactive cadmium dose. This absence of homeostatic control is in sharp contrast to manganese and zinc. However, little cadmium is absorbed; most of that absorbed is retained for a very long time. Manganese and nickel absorption normally appear to be quite low; however, with the newborn calf, high manganese absorption values have been obtained. Milk zinc content is somewhat related to dietary intake, but the variability in milk is far less, with as much as 18% of dietary zinc going into milk of cows fed a low zinc diet and as little as 0.8% with high zinc intake. Although the data are far less adequate, ruminants appear to have some homeostatic control of nickel. Regardless of the route or mechainsism, homeostasis of zinc, manganese, and nickel probably is a reflection of changes at the tissue level. The patterns of change vary greatly among tissues for each element, suggesting very different homeostatic control mechanisms.

352
Binding of Silver Sulfadiazine to the Cellular Components of PSEUDOMONAS AERUGINOSA

Modak, S.M.; Fox, C.L.; Dep. Surg. Microbiol., Columbia Univ. Coll. Phys. Surg., New York, NY

Biochem. Pharmacol. (BCPCA6), 22(19), 2391-2404; 1973

SILVER; SILVER SULFADIAZINE; PSEUDOMONAS; DNA; BACTERIA; CHEMICAL BONDS

TAXONOMY: PSEUDOMONAS AERUGINOSA

353
Effect of Temperature Variations on Growth, Reproduction, Amino Acid Synthesis, and Fat and Sugar Content in ULVA FASCIATA Plants

Mohsen, A.F.; Nasr, A.H.; Metwalli, A.M.; Alexandria University, Alexandria, United Arab Republic

Hydrobiologia (HYDRB8), 42(4), 451-460; 1973

ULVA; GROWTH; TEMPERATURE EFFECTS; ALGAE; METALS; AMINO ACIDS; LIPIDS; SUGARS; REPRODUCTION; SYNTHESIS

TAXONOMY: ULVA FASCIATA

354
Differentiation of Chemical States of Toxic Species, Especially Cyanide and Copper, in Water

Montgomery, A.C.; Stiff, M.J.

International Symposium on Identification and Measurement of Environmental Pollutants, Ottawa, Ontario, Canada, 375-379; 1971, June 14-17

TOXICITY; CHEMISTRY; CYANIDE; COPPER; CARBON DIOXIDE; AMMONIA; CHROMIUM; HYDROGEN CYANIDE; AMINO ACIDS; POLYPEPTIDES; HUMUS; METHODOLOGY; ANALYSIS

The toxicity of some substances to fish is governed by considerations of chemical equilibirum. Thus it appears that carbon dioxide, ammonia, and hydrogen cyanide are toxic, whereas the ions with which they are in equilibrium are not. A nomogram for the calculation of the proportion of free ammonia is presented. Hydrogen cyanide may be in equilibrium with metallocyanide complexes as well as with cyanide ion. The equilibria involved and the methods of analysis available for free hydrogen cyanide are discussed. Hexavalent chromium is present in water as chromate and hydrogen chromate in equilibrium. Copper forms soluble complexes with carbonate, amino-acids and polypeptides, humic substances, and cyanide. A large fraction of the copper present is often is suspension. Methods of analysis to differentiate the soluble states of copper, and the implications of this analysis, are discussed.

355
Plumbosolvency of Waters

Moore, M.R.

Nature 243, 222-223; 1973

LEAD; PLUMBOSOLVENCY; DRINKING WATER; PH; TEMPERATURE; PIPES; SOLUBILITY

Lead poisonings in the Glasglow area resulting from use of lead water pipes in buildings caused the authors to investigate the effects of various factors on the plumbosolvencies of waters. It was found that plumbosolvency increased considerably outside the pH range 6 to 8. Plumbosolvency increases exponentially with temperature up to a maximum temperature examined (60 degrees C).

356
Gastrointestinal Absorption of Different Compounds of Cadmium-115M and the Effect of Different Concentrations in the Rat

Moore, W.J.; Stara, J.F.; Crocker, W.C.; Natl. Environ. Res. Cent., Environ. Prot. Agency, Cincinnati, Ohio

Environ. Res. (ENVRAL) 6(2), 159-164; 1973

RATS; ABSORPTION; CADMIUM 115M; CHLORIDE; ACETATE; SULFATES; RETENTION; DISTRIBUTION; CADMIUM; GASTROINTESTINAL ABSORPTION; CONTAMINATION

The absorption and retention of three different compounds of (115M)Cadmium and the effects of variations in concentration were studied in female rats. After a single oral dose, the chloride, sulfate, and acetate forms of (115M)Cd did not significantly influece the absorption, retention, or distribution of the (115M)Cd in the tissues. The only organs containing significant amounts of (115M)Cd were the liver, kidney, and gastrointestinal tract. Increases in concentration of cadmium resulted in more cadmium being absorbed from the gastrointestinal tract, although the amount absorbed was not proportional to the increase in concentration.

357
Cadmium Enrichment in Neckar Fish

Mueller, G.; Foerstner, U.; Lab. Sedimentsforsch., Univ. Heilderberg, Heidelberg, Germany

Naturwissenschaften (NATWAY), 60(5), 258-259; 1973

CADMIUM; FISH; LIVER

TAXONOMY: LEUCISCUS RUTILIS

The (006) cadmium content of the liver and flesh of leuciscus rutilis captured in the Neckar River near the mouth of the Enz (Germany) was .LEQ.5690 and .LEQ.260 PPB, Resp., which was 190- and 52-Fold, respectively, higher than in fish captured in the same river near Dilsberg. The former fish were not suitable for human food.

358
Application of Flotation for the Treatment of Waste Water

Mukai, S.; Fac. Eng., Kyoto Univ., Kyoto, Japan

Hyomen (HYMNB7), 11(3), 129-138; 1973

REVIEW; FLOTATION; WASTE WATER; HEAVY METALS; WATER

359
Electron Microscope Autoradiography of Kidney after Administration of (210)Pb in Mice

Murakami, M.; Hirosawa, K.; Department of Public Health; Department of Anatomy, Faculty of Medicine, University of Tokyo, Hongo, Tokyo 113

Nature, 245, 153-154; 1973

ELECTRONMICROSCOPY; AUTORADIOGRAPHY; BIOACCUMULATION; LEAD; LEAD 210; LEAD 218; RADIOACTIVITY; RADIOACTIVE EQUILLIBRIUM; CYTOPLASM; EPITHELIAL CELLS; MICE; ANIMALS; KIDNEY; MITOCHONDRIA

Electron microscopic autoradiography was used to demonstrate the precise localization of (210)Pb in some organelles in the tubular epithelial cells of the mouse kidney. Male mice were injected intraperitoneally with a solution containing (210)Pb, (210)Bi, and (218)Po in radioactive equilibrium. In the epithelial cells, more than half of the grains were found on mitochondria and about third in the cytoplasm, half of which were associated with cytoplasmic membranes. Few grains were located in the nuclei of epithelial cells. Accumulation in the mitochondria and cytoplasm occurs within thirty min. after its administration. The cytoplasm as well as the membranes, seem to be involved in the incorporation and transport of lead.

360
Adsorption-Desorption Equilibria of Some Radionuclides in Sediment-Fresh-Water and Sediment-Seawater Systems

Murray, C.N.; Murray, L.

Part of Radioactive Contamination of the Marine Environment, Proceedings of Symposium held by the International Atomic Energy Agency, Seattle, WA, July 10-14, 1972 (105-122) 786p.; 1973

ADSORPTION; DESORPTION; SEDIMENTS; FRESHWATER; SEAWATER; SALTWATER; RADIONUCLIDES; COBALT; COBALT 60M; ZINC; ZINC 65; SILVER 110M; PH

Knowledge of the behavior of radionuclides in estuarine environments is required in the understanding of their regulation in coastal areas. The present paper describes experiments that were carried out to investigate the uptake of certain radionuclides on fresh-water sediments in river water (adsorption) and their subsequent release from the sediments to the seawater (desorption). It was found that for the radionuclides studied, (60)Co(II), (65)Zn, (110)Ag(I), their behaviour was very individual. Laboratory results suggest that certain factors strongly affect the adsorption-desorption characteristics of the sediment. The influence of important factors such as the pH of the river, estuary and seawater, the concentration of sediment and trace element in the river water, the speciation of the trace element, the mineralogy of sediment, the formation of particulate material in the river water and floculation of this by sediment in the estuary and sea, and salinity effects on desorption, are discussed. From a knowledge of these factors, it is possible to predict, as a first approximation, for a given sediment the amount of radionuclide that will be taken up by a given weight of fresh-water sediment in a very simple river system under equilibrium conditions. When this sediment reaches the marine environment the amount of desorbed radionuclide can be calculated. An example of a predictive calcuation for adsorption desorption of Var river sediment is given for conditions of pH, sediment load and tracer concentration that are typically found in this system.

361
Arsenic Oxidation State in the Presence of Microorganisms. Examination by Differential Pulse Polarography

Myers, D.J.; Holmbrook, M.E.; Ostheryoung, J.; Morrison, S.M.; Dep. Chem., Colorado State Univ., Fort Collins, Colorado

Environ. Lett. (PVLTAX), 5(1), 53-61; 1973

ARSENIC; MICROORGANISMS; OXIDATION; POLAROGRAPHY; OXYACIDS; SEWAGE; EFFLUENTS

TAXONOMY: PSEUDOMONAS FLUORESCENS

Differential pulse polargraphy was used to monitor changes in the oxidation state of arsenic when arsenic oxyacids were acted upon by microorganisms. Arsenite is chemically altered in raw sewage, activated sludge, and sewage effluent under aerobic conditions; it was shown that in the presence of oxygen, activated sludge oxidizes arsenite to arsenate. Activated sludge under anaerobic conditions first reduces arsenate to arsenite. At longer times the arsenite apparently is further reduced. Aerobic cultures of PSEUDOMONAS FLUORESCENS also reduce arsenate to arsenite.

362
Heavy Metals in Wastewater and Treatment Plant Effluents

Mytelka, A.T.; Czachor, J.S.; Guggino, W.B.; Golub, H.

Jour. Water Poll. Control Fed., 45, 1859; 1973

REMOVAL; WASTEWATER; SEWAGE; EFFLUENTS; ANALYSIS

The findings of the Interstate Sanitary Commission's (New York, New Jersey, and Connecticut) routine heavy metals analyses of municipal wastewater treatment plants is presented. The results show that many plants receive and discharge heavy metals above prudent limits. In order to minimize the harmful effects of these heavy metals, state-of-the-art techniques must be implemented to achieve as close to 100 percent removal as is possible before these metals enter the sewer systems allow wastewater to by-pass treatment plants and discharge, untreated, directly into the receiving waterways.

363
Analysis of Some Inorganic Constituents in Well Waters and Their Sediments

Nanda, R.S.; Kapoor, Krishna; Fluoride Study Unit, Dent. Coll. Hosp., Lucknow-3, Uttar Pradesh, India

Indian J Med Sec 60(6), 949-952; 1972

ANALYSIS; ELEMENTS; NUTRIENTS; FLUORIDES; PHOSPHATE; MAGNESIUM; CALCIUM; CHLORIDE; HARDNESS; SEASONAL VARIATIONS; WELL WATERS; WATER; SEDIMENTS

GEOGRAPHICAL DESCRIPTION: India

Well water samples (100) were analyzed for their contents of fluoride, phosphate, Mg, Ca, chloride and hardness for each of the 3 seasons to discover if there were differences in the concentration of these constituents in the sedimented and respective clear samples. A study of seasonal variation in sediments and clear samples was included. All these constituents were significantly greater in the sediments than in the clear samples in the summer. Fluoride in the monsoon and fluoride, phosphate and Mg in the winter sediment samples were significantly higher. Analysis of variance applied to the data revealed significant seasonal differences for each constituent. The content of these constituents was highest during the summer season in both the sediment and clear water samples than during the winter and the monsoon.

364
Toxicity of Lead Nitrate in the Carp (CYPRINUCARPIO). Data on the Modifications of the Nucleoprotein and Carbohydrate Metabolism

Narbonne, J.F.; Muray, J.C.; Serfaty, A.; Lab. Ecophysiol. Univ. Paul Sabatier, Toulouse, France

C.R. Soc. Biol. (CRSBAW) 167(3-4) 572-5; 1973

CARP; PROTEOLYSIS; GLYCOGEN; LEAD; LEAD NITRATE; METABOLISM; FISH; LIVER; NUCLEOPROTEIN

TAXONOMY: CYPRINUCARPIO

Metabolic modifications induced by exposure of carps to 3.5 ppm lead nitrate consisted primarily of glycogen accumulation, proteolysis, and decrease in hepatic proteosynthesis.

365
Occurrence Forms of Cobalt, Nickel, and Copper in Subsurface Waters of Mugodzhary

Nazarova, L.V.; Dement'Ev, V.S.; Davletgalieva, K.M.; Inst. Gidrogeol. Gidrofiz, Alma-Ata, USSR

Izv. Akad. Nauk Kaz. SSR, Ser. Geol. (IKAGA8), 30(4), 40-45; 1973

COPPER; SUBSURFACE WATERS; NICKEL; COBALT; WATER; FORMULATION

GEOGRAPHICAL DESCRIPTION: USSR, Mugodzhary

366
Biological and Photobiological Action of Pollutants on Aquatic Microorganisms

Neely, W.C.; Smith, R.C.; Cody, R.M.; McDuffie, J.R.; Lansden, J.A.; Water Resour. Res. Inst., Auburn Univ., Auburn, AL

PB Report No. 220167/1, Water Resources Research Institute, Auburn University; 1973

MICROORGANISMS; PHOTOBIOLOGY; METALS; IONS; INSECTICIDES; AMINES; MYCOTOXIN; BACTERIA; PARAMECIUM; WATER

TAXONOMY: PARAMECIUM CAUDATUM; ESCHERICHIA COLI

The various aspects of the biological and photobiological action of pollutants on aquatic microorganisms have been explored in a series of studies covering a wide range of chemical species and two classes of aquatic microorganisms, paramecia and bacteria. Certain metal ions, insecticides, polycyclic amines, and mycotoxins are capable of drastic alteration of the life processes in test strains of either bacteria or paramecia or both. In some cases concurrent exposure to light and the pollutant was necessary; in others the toxic and(or) mutagenic reactions were independent of light exposure. In particular the uranyl ion, beta-naphthylamine, and aflatoxin B1 were phototoxic while the insecticide, phygon, was strongly dark-toxic. All agents affected PARAMECIUM CAUDATUM and all but aflatoxin B1 affected ESCHERICHIA COLI.

367
Biodegradation of Phenylmercuric Acetate by Mercury--Resistant Bacteria

Nelson, J.D.; Blair, W.; Brinckman, F.E.; Colwell, R.R.; Iverson, W.P.; National Bureau of Standards, Washington, DC 20080; Dept. of Microbiology, University of Maryland, College Park, MD; Dept. of Microbiology, University of Maryland, College Park, MD

Applied Microbiol. 26(3), 321-326; 1973

ORGANIC COMPOUNDS; BIODETERIORATION; FUNGICIDES; PHENYLMERCURIC ACETATE; MERCURY; DECOMPOSITION REACTIONS; BENZENE; BACTERIA; VOLATILIZATION; MERCURY/ACETATO-PHENYL

Selected cultures of mercury-resistant bacteria degrade the fungicide-slimicide phenylmercuric acetate. By means of a closed system incorporating a flameless atomic absorption spectrophotometer and a vapor phase chromatograph, it was demonstrated that elemental mercury vapor and benzene were products of phenylmercuric acetate degradation.

368
Behavior and Distribution of Radioactive Substances in Coastal and Estuarine Waters

Nichiwaki, Y.; Honda, T.; Kimura, Y.; Morishima, H.; Koga, T.; Miyaguchi, Y.; Kawai, H.

Part of Radioactive Contamination of the Marine Environment, Proceedings of Symposium held by the International Atomic Energy Agency, Seattle, WA, July 10-14, 1972 (177-193), 786 p.; 1973

DISTRIBUTION; RADIONUCLIDES; COASTAL WATERS; ESTUARIES; RADIOACTIVITY; SALINITY; PH; SEDIMENTS; YTTRIUM 91; CERIUM 144

To understand the problems of environmental radioactive contamination due to continuous discharge of low-level liquid radioactive waste into the seawater, a study must be made of the behaviour and distribution of various nuclides which may occur in both ionic and colloidal or particulate state in the coastal and estuarine waters. However, the behaviour and distribution of the various radionuclides in the estuarine water are much more complicated than those in the open sea, because of the complex topographical and marine meteorological variations and the changes in salinities and pH of the water. Since thorium and rare-earth elements had been continuously discharged through a small river into the estuarine water at Osaka Bay, a study was made of the variation of concentration of these elements under various natural conditions. Experimental studies on adsorption of these elements on some bottom sediments were also carried out in the water were different salinities and pH. One important factor influencing the concentration of the elements in the water is tidal oscillation. The gross beta activities in water at the same location in the estuary widely varied at each time of sampling. The average values from April to December in 1966 were 9.5 plus or minus 4.9 pCi/litre at higher tidal level, 84 plus or minus 68pCi/litre at middle tidal level and 157 plus or minus 106 pCi/litre at lower tidal level respectively. However, the concentrations of thorium and total rare-earth elements in the water were not observed to change regularly with the tidal change. The dispersion of the elements in the estuarine water were not interpreted by simple dilution and diffusion of the element in water mass. The presence of the mud flats, as well as the marine meteorological conditions, seem to affect markedly the distribution of the element in the estuarine water. The adsorption of the element on the bottom sediment was influenced not only by the coarseness of the sediment but also by the salinity and pH of the water. The highest distribution coefficients of Y91 and Ce144 in the clay sediment were obtained at the chlorosity of 14 g/litre and pH 7.3 of the water.

369
Analysing Soil Water and Solute Movement Under Field Conditions: Soil Moisture and Irrigation Studies

Nielsen, D.R.; Biggar, J.W.; University of California, Davis, CA

Proceedings of a Panel Organized by the Joint FAO/IAEA Division of Atomic Energy in Food and Agriculture, International Atomic Energy Agency, Vienna, 1973, p. 111-127; 1973

WATER MOVEMENT; FLUX; SOIL PROFILE; DIFFUSION EQUATIONS; POTENTIAL EQUATIONS; SOIL WATER; SOILS; TRANSPORT

Methods are reviewed for assessing water content distribution and water flux out of a soil profile using potential or diffusion equations and data obtainable by means of a neutron moisture meter or by tensiometers. It is suggested that the neutron gauge be used to assess the hydraulic conductivity versus soil-water content relations of field soils together with the reliability of these measurements taken over land areas of sufficient size to be of use in the management and control of soil-water and solutes for crop production.

370
Concentrations and Distributions of Long-Lived Fallout Radionuclides in Open Ocean Sediments

Noshkin, V.E.; Bowen, V.T.

Part of Radioactive Contamination of the Marine Environment, Proceedings of Symposium held by the International Atomic Energy Agency, Seattle, WA, July 10-18, 1972 (671-686), 786 p.; 1973

FALLOUT; RADIONUCLIDES; PLUTONIUM; SEDIMENTS; STRONTIUM; STRONTIUM 90; CESIUM; CESIUM 137; ACCUMULATION; SALTWATER; MODELS; AQUATIC ECOSYSTEMS

Analyses of deep open-ocean sediment cores from the north and south Atlantic and the Mediterranean Sea show the presence of Sr 90, Cs 137 and Pu 139,138 in measurable amounts distributed to depth within the sediment columns. Comparison of the quantities of these radionuclides accumulated in the sediments with either estimated integrated deliveries to the sea surface or the measured inventories in the overlying water masses has been used to estimate the residence times of the radionuclides in the water column. For Sr 90 and Cs 137 these computed residence times are orders of magnitude shorter than those estimated for the stable elements. Plutonium, we find, is being removed from the water column significantly more rapidly than either Sr 90 or Cs 137. The ratio of Cs 137 to Sr 90 in the sediments is higher than that found in precipitation, suggesting that a larger fraction of ocean water Cs 137 is associated with sedimenting particles than has been previously assumed. A simple model assuming plutonium to associate with a mixed population of particles, sinking at rates of 392 to 70 m/yr, predicts very well both the relation of sediment inventory of plutonium to depth of sediment, and the plutonium distribution vertically in the water column.

371
Precipitation and Hydrolysis of Metallic Ions. V. Nickel(II) in Aqueous Solutions

Novak-Adasic, D.M.; Cosovic, B.; Bilinski, H.; Branica, M.; Inst. Rudjer Boskovic, Zagreb, Yugoslavia

J. Inorg. Nucl. Chem. (JINCAO) 35(7), 2371-82; 1973

NICKEL; HYDROXIDE; HYDROLYSIS; METALS; PRECIPITATION; AQUEOUS CHEMISTRY

The change in solubility of nickel(II) hydroxide as a function of pH in aqueous solutions of 0.55 M sodium chloride and 1 M sodium perchlorate was investigated. The precipitation was studied over a wide concentration range of nickel(II) ion 2 x 10(-1) M less than Ni2+ less than 5 x 10(-6) M and pH 2 greater than pH 8. Several different mixing procedures for the preparation of the solutions were employed, and the results are discussed regarding the differences in the observed precipitation pH region. Tyndallometric and polarographic methods were used to analyse the system (24 hr after the mixing at 25 degrees C). Graphical analysis of the solubility curves indicates the presence of species of charge 2+ as the predominant one in aqueous solutions in equilibrium with the solid phase. The exceptions found for some solutions at concentrations higher than 5 x 10(-2) M of Ni(2plus) are due to high local concentration of OH- ions. Assuming the nonhydrolytic species Ni(2plus) is predominant, the solubility product KSO was evaluated.

372
The Influence of Temperature and Salinity on the Toxicity of Cadmium to the Fiddler Crab (UCA PUGILATOR)

O'Hara, J.

Fishery Bulletin, 71(1), 149-53; 1973

CADMIUM; TOXICITY; SALINITY; TEMPERATURE; ELECTROPLATING DISCHARGES; MINE WASTES; CRAB; ACUTE; GILLS; BIOACCUMULATION; CONCENTRATION FACTOR; GREEN GLAND; HEPATOPANCREAS; MUSCLES

TAXONOMY: UCA PUGILATOR

The concentrations of cadmium lethal to the fiddler crab, UCA PUGILATOR, were determined for various environmental regimes of temperature and salinity. Mortality was greatest in high temperatures and low salinities when tested for 240 hr. Concentrations of cadmium were greatest in green gland followed by gill, hepatopancreas, and muscle.

373
Cadmium Uptake by Fiddler Crabs Exposed to Temperature and Salinity Stress

O'Hara, J.; Belle W. Baruch Coastal Res. Inst., Univ. South Carolina, Columbia, S.C.

J. Fish Res. Board Can.(JFRBAK) 30(6), 846-8; 1973

CRAB; CADMIUM; METABOLISM; SALINITY; TEMPERATURE; UPTAKE; MORTALITY

TAXONOMY: UCA PUGILATOR

Recent experiments by the author have shown that cadmium accumulations in the gills of fiddler crabs exposed to different concentrations of cadmium did not exceed 100ug/g(ppm) Cd(2plus) wet weight, and that crabs died shortly after this level was reached. In the present experiment male crabs were placed in each environmental combination of 33, 25, and 10 C at both 10% and 30% salinity. Temperature was found to have little effect on the accumulation of cadmium in the gills at high salinity while it had a strong effect at low salinity. Crabs exposed to high temperature and low salinity had the greatest amount of cadmium in the heaptopancreas. The body burden increased over time in all temperature-salinity regimes tested reaching 17.84 ug at 33 c, 10%.

374
Mechanisms of Heavy Metal Toxicities

Oehme, Frederick, W.

Clinical Toxicology, 5(2), 151-167; 1972

HEAVY METALS; TOXICITY; MECHANISMS; PHARMACOLOGY

375
Treatment of Water Containing Concentrated Ferrocyanides

Ogura, H.; Sanei Suiko Co., Ltd.

Japan. Kokai (JKXXAF) 73 42966 (13(7)A2, 13(7)A21, 91 C91), 07, 2 pp.; 1971, October

FERROCYANIDE; CALCIUM; CHLORIDE; ZINC; WATER; PRECIPITATION AGENT

376
Effect of Mercury on Yeast

Ohlmeyer, P.; Dilgeraklis, C.; Muehlen, D.; Forschungsstelle Prof. Ohlmeyer, Univ. Tuebingen, Tuebingen, Germany

Z. Naturforsch., Teil C (ZNFCAP), 28(9-10), 628; 1973

YEAST; MERCURY CHLORIDE; GENETICS; MERCURY

Mercury chloride ($HgCl_2$) increased in $1.5 \times 10E-5$M the generation time of SACCHAROMYCES CEREVISIAE and induced genetic changes. Hg-treated cells produced a lower amount of dry substance as compared with untreated cells. Their N_2-CO_2 ratio in glucose solution was increased. Hg-treated cells were able to sporulate.

377
Application of Isotope Techniques for Studies on Mechanisms of Land Contamination and Water Pollution

Ohnoko, Y.; Suzuki, H.; Saiki, M.

Proc. Jap. Conf. Radioisotop. No. 10, 499-503; 1972, April

ACTIVATION ANALYSIS; BROMINE; DYSPROSIUM; EUROPIUM; FLOW RATE; INLAND WATERWAYS; WATER; CERIUM 144; CESIUM 137; CONTAMINATION; DRINKING WATER; FALLOUT; LAND POLLUTION; RADIOACTIVE WASTE DISPOSAL; RUTHENIUM 106; SEDIMENTS; SOILS; STRONTIUM 90; COWS; FISH; IODINE 131; MILK; PLANTS; RADIONUCLIDE MIGRATION; UPTAKE; MERCURY; MERCURY 203; TRACERS

378
Heavy Metal Levels of Ottawa and Rideau River Sediments

Oliver, B.G.; Inland Waters Dir., Dep. Environ., Ottawa, Ont.

Environmental Science and Technology, 7(2), 135-7; 1973, February

RIVERS; SEDIMENTS; LEAD; MERCURY; ZINC; COPPER; NICKEL; COBALT; IRON; MANGANESE; CHROMIUM; ATOMIC ABSORPTION SPECTROPHOTOMETRY; INDUSTRIAL WASTES; SEWAGE; FISH; TOXICITY; PARTICLE SIZE; SLIMICIDES; METHOXYETHYLMERCURIC ACETATE; AUTOMOBILE EMISSIONS

Sediment samples were collected at two-mile intervals along the Ottawa and Rideau Rivers near Ottawa, Canada, in July, 1971. The sediments were analyzed for lead, mercury, zinc, copper, nickel, cobalt, iron, manganese, and chromium using atomic absorption spectrophotometry. The surface areas of the samples were measured and taken into consideration when deciding whether or not metal levels were unusually high. Some anomalously high heavy metal concentrations found in the sediments in certain locations appeared to be related to pollution of the rivers by municipal and industrial waste water discharges and waste disposal practices.

379
Ecological Dynamics of Watersheds

Olsen, S.

BioScience, 22(3), 158-161; 1972, March

MODELS; ENERGY FLOW; FUNCTIONS; WATERSHEDS; ATMOSPHERE; WATER; SOILS; TEMPERATURE; LIGHT; PH; PLANTS; ANIMALS; AQUATIC BIOTA; TERRESTRIAL ECOSYSTEMS; AQUATIC ECOSYSTEMS; TERRESTRIAL BIOTA

A graphic transfer function model is developed to demonstrate in a simple though comprehensive form the pathways for energy, water and elements within a watershed. A watershed is taken as the best example of a complete ecosystem, containing both terrestrial and aquatic parts with their populations of producers, consumers, and decomposers. This transfer function model represents only a first step toward the development of quantitative, mathematical models that can serve to describe the complicated interactions between the environment and the biota. While the model can be used for different ecosystems containing aquatic and terrestrial parts, it is planned more specifically for treatment of the data accumulated in the studies on the Fern Lake watershed. These data cover both the terrestrial and aquatic environments. Some of the measurements have been made regularly for more than twelve years and include observations on air (temperature, humidity, pressure, precipitation, solar radiation, wind direction and velocity); water (temperature, oxygen, specific conductance, limit of visibility and light penetration, pH, alkalinity, various chemical elements, and data are available on terrestrial producers (general knowledge of the flora, assessment of biomass, mass of N, K, and P); aquatic producers (primary production); terrestrial consumers (general knowledge of the mammals, reptiles, amphibia, and birds); and aquatic consumers (quantitative data on zooplankton, bottom animals, insect emergence, crayfish, and steelhead trout, including modelling of the population dynamics of the fish). Experiments have been performed on the movement of elements (with the use of 32P, 86Rb, and 45Ca) in Douglas fir, by application of radioisotopes to the lake (32P, 45Ca, 99Mo, and 131I), and by full or partial mineral fertilizations of the lake.

380
Uptake Pathways of Methylmercuric Chloride and Mercuric Chloride by Rainbow Trout (SALMO GAIRDNERI) with Special Reference to Ultrastructural Changes of the Gill

Olson, K.R.; Michigan State Univ., East Lansing, MI

Univ. Microfilms, Ann Arbor, MI, Order No. 73-20, 386, Diss. Abstr. Int. B, 33(3), 1238-1249; 1973

MERCURY CHLORIDE; UPTAKE; RAINBOW TROUT; METHYLMERCURY; GILLS; METABOLIC PATHWAYS; FISH; MERCURY

TAXONOMY: SALMO GAIRDNERI

381
Uptake of Methyl Mercuric Chloride and Mercuric Chloride by Trout. Uptake Pathways into the Whole Animal and Uptake by Erythrocytes in Vitro

Olson, K.R.; Bergman, H.L.; Fromm, P.O.; Dep. Physiol., Michigan State Univ., East Lansing, Michigan

J. Fish. Res. Board Can. (JFRBAR) 30(9), 1293-9; 1973

METHYLMERCURY; UPTAKE; TROUT; ERYTHROCYTE BINDING; BIOACCUMULATION; FISH; MERCURY; MERCURY 203

TAXONOMY: SALMO GAIRDNERI

Esophageal ligation did not affect the rate of uptake of either 203Hg-labeled mercuric chloride or methylmercury chloride (275 ng/l., 24 hr exposure) by nonfeeding rainbow trout (SALMO GAIRDNERI). Thus Hg2+ and CH3Hg+ uptake appeared to be by way of the gills. CH3Hg+ entered the fish faster than Hg2+, and was selectively accumulated in the kidney, muscle, gill, heart, and liver. However, Hg2+ appeared to cross the gill membrane and enter the fish without requisite methylation. Up to 90% of the CH3Hg+ bound to red cells during 60 min in vitro incubation with whole blood. Only 9% of the Hg2+ bound to red cells in whole blood; however, up to 65% bound to red cells washed and suspended in Ringer's solution prior to incubation with Hg.

382
Lake Superior Periphyton in Relation to Water Quality

Olson, T.A.; Odlaug, T.O.

Water Pollution Control Research Series, 18050 DBM 02/72; 1972, February

WATER QUALITY; PERIPHYTON; ALGAE; GROWTH; PRODUCTION; TEMPERATURE; LIGHT; NUTRIENTS

TAXONOMY: SYNEDRA; ACHNANTHES; NAVICULA; CYMBELLA; GOMPHONEMA

GEOGRAPHICAL DESCRIPTION: U.S., Great Lakes, Lake Superior

Laboratory and field studies were conducted to evaluate the importance of periphyton in western Lake Superior with special reference to the make-up and distribution of the periphyton growths and to the overall importance of productive capacity of this assemblage of organisms. The taxonomic protion of the investigation indicated that over 90% of the total number of organisms were diatoms and that the phyla to which these diatoms belonged were the Chrysophyta, the Chlorophyta, and the Cyanophyta. Predominant genera were SYNEDRA, ACHNANTHES, NAVICULA, CYMBELLA, and GOMPHONEMA. In many respects, the periphyton of Lake Superior was similar to that found in streams and there was evidence that the interrelated factors that affected periphyton growths were temprature, light intensity, depth of water, water movements, nutrient levels, and the type of substrate. Artificially denuded rocks demonstrated definite re-growth but after 46 days this growth level was only 18% of that occurring naturally. The mean total counts of organisms in the primary sampling area ranged from 497,000 to 1,470,000 per square centimeter of rock surface. Studies of the pigment concentrations showed that the biomass of periphyton along the North Shore of Lake Superior resemble those of other oligotrophic bodies of water and range from 0.338 to 3.59 mg of total pigment per 100 square centimeters of rock surface. Pigment ratios indicated that the Lake Superior periphyton was dominated by the Chrysophyta. Assimilation values for Stony Point Bay averaged 1.98 grams of carbon fixed per gram of chlorophyll in 1967. In Stony Point Bay, the total standing crop in terms of dry weight was 55.5 tons. In re-growth studies, chlorophyll levels were observed to increase by an average of 0.057 grams (57 mgs) per square meter per day. The efficiency of energy utilization in Stony Point Bay was found to be 0.082%, a typical value for algal communities.

383
Removal of Chromate from Cooling Tower Blowdown by Reaction with Electrochemically Generated Ferrous Hydroxide

Onstott, E.I.; Gregory, W.S.; Thode, E.F.; University of California, Los Alamos Scientific Laboratory, Los Alamos, NM 87544; New Mexico State University, Las Cruces, NM 88001

Environ. Sci. Tech. 7(4), 333-337; 1973

COOLING TOWERS; CHROMIUM; IONS; BLOWDOWN; FERROUS HYDROXIDE; PRECIPITATION; REMOVAL

Treatment of cooling tower blowdown with electrochemically generated Fe(OH)2 quantitatively reduced Cr(VI) to Cr(III) and concurrently precipitated it without pH adjustment. Concentrations of Cr(VI) of less than 0.005 mg/l were achieved. Fe(OH)2 treatment also precipitated a large fraction of the phosphate and other ions(anions) to improve product effluent quality significantly with respect to total dissolved solids. Steady-state generation of Fe(OH)2 in blowdown was accomplished with high Faraday efficiency in a flow cell which utilized sacrificial low-carbon steel anodes and stainless steel cathodes. Colloids were formed under most electrolysis conditions, and special procedures were required to obtain filterable precipitates.

384
Sediment Water Interactions

Oshwald, W.R.

J. Environ Qual 1(4), 360-366; 1972

FISH; FOOD CHAINS; TURBIDITY; EUTROPHICATION; SEDIMENTS; WATER

Sediment originating from soil erosion has physical, chemical, and biological effects on water resource use. Sediment particles pollute water to the extent that their presence reduces water quality for a particular use. The physical presence of sediment produces turbidity. Turbid water has impaired water quality for most uses. Reduction in light penetration due to suspended sediment may alter oxygen relationships in surface water. Production of fish and other aquatic life is reduced by excess turbidity. Taste and odor, temperature, and abrasiveness of water may be altered by the physical presence of sediment.

385
Cadmium Residues in the Environment

Page, A.L.; Bingham, F.T.; Dep. Soil Sci. Agric. Eng., Univ. California, Riverside, CA

Residue Rev. (PREVAH), 48, 1-44; 1973

REVIEW; CADMIUM; TOXICITY; FOOD; SOILS; WATER; ATMOSPHERE; PLANTS; HUMANS; BACKGROUND LEVELS; INDUSTRY; PRODUCTS; CONTAMINATION

A review with 79 references dealing with dealing with the natural occurence, production, uses, and residues of cadmium in soil, water, air, vegetation, and foods, and human toxicity.

386
A Survey of the Lead Content of Fish from 49 New York State Waters

Pakkala, I.S.; White, M.W.; Burdick, G.E.; Harris, P.J.; Lisk, D.J.

Pesticides Monitoring Journal, 5(3), 288-295; 1972, March

LEAD; WATER; LAKES; RIVERS; FISH; CONCENTRATION; TOXICITY; TOXIC MECHANISMS; GILLS; SKIN; SEAFOOD; SHELLFISH; ENRICHMENT; ENZYMES; SULPHYDRYL GROUPS; SPECIES; SEX; AGE

GEOGRAPHICAL DESCRIPTION; U.S. (NE), New York, Cayuga Lake, Lake Canadice, Lake Canadiagua, Lake Erie, Lake Hemlock, Lake Pleasant, Lake Raquette, Hudson River, Great Lakes

An analytical survey was made of the total lead content of 419 fish of various species sampled in 1969 from 49 New York State waters and a group of lake trout samples in 1970 from Cayuga Lake only. Most often, lead concentrations ranged from 0.3 to 1.5 ppm, but a few samples contained levels up to 3 ppm. Fish from certain waters included Lakes Canadice, Canadiagua, Erie, Hemlock, Pleasant, and Raquette and the Hudson River showed higher lead levels more consistently than fish from other waters. No correlation was noted between lead concentration and the size, species, or sex of fish, and lead did not appear to be cumulative in the lake trout of known age up to 12 years from Cayuga Lake.

387
Release, Fixation and Transport of Mercury

Parks, G.A.; Dickson, F.W.; Leckie, J.O.; McCarty, P.L.; Berendsen, P.; Pering, K.L.

Part of Trace Elements in Water: Origin, Fate, and Control: 1. Mercury, Progress Report, Stanford University, March 1, 1972 to February 1, 1973 (p. 65-109) 287 p.; 1973

TRANSFORMATION; MERCURY; OXIDATION; VOLATILIZATION; ALKYLATION; CINNABAR; KINETICS; ANAEROBIC SYSTEMS; SOLUBILITY; VAPOR PRESSURE; SEDIMENTS; METHYLMERCURY; SLUDGE; AEROBIC SYSTEMS; SULFIDES; METHYLATION; LEACHING; ANALYSIS; FIXATION; TRANSPORT;

Studies on transformation of mercury from one form to another have concentrated on microbiologically mediated changes, with emphasis on oxidation of sulfides of mercury, volatilization of Hg(II), and alkylation. Direct evidence for microbial mediation of HgS oxidation has not yet been obtained as the chemistry has proven to be quite complex. Hg(II) released by oxidation of cinnabar (HgS) is tightly adsorbed back onto remaining cinnabar, making analysis difficult. Impure synthetic metacinnabar is oxidized much more rapidly than cinnabar, especially athigh and low pH. Thus, form as well as environmental conditions is highly important in kinetics of oxidation. Tracer studies are continuing in order to separate biological and chemical factors, and leaching studies using mercury ores and mine waste have begun. Hg(II) added to biological systems was volatilized, probably through conversion of HgO, in varying degrees. Greatest volatilization was observed in aerobic systems, and was brought about by the presence of certain biological growth media, and by sterilized effluents from secondary wastewater treatment plants. In other cases it was associated directly with the growth of microorganisms. The extent of volatilization was reduced by suspended solids, perhaps through formation of unreactive complexes of by adsorption of the volatile species. Volatilization was insignificant in anaerobic systems where the potential for complex formation was high. The ease of reduction (Hg(II) to HgO) implied by volatilization losses, the relatively high solubility and vapor pressure of metallic mercury, and the presence of metallic mercury in sediments combine to form a strong case for the significance of metallic mercury as a source material. The same case can be made for HgO (aq) and mercury vapor as highly mobile forms of mercury in the environment. Methylmercury was found in digested sludge from a municipal treatment plant and was increased in concentration through addition of Hg(II). Analysis by extraction techniques also suggest it is formed in aerobic systems using synthetic media, but confirmation is required. The concentration of methylmercury formed is a function of Hg(II) added. Current emphasis is on a survey for evidence of methylmercury formation in benthic sediments from the study area.

388
Methylation of Mercury by Microorganisms.; Technical Research Project Termination Rept., 1 Sep. 71-30 June 72,

Parks, Leo W.; MacDonald, Elizabeth M.S.; Oregon State Univ., Corvallis. Water Resources Research Inst.

Monitoring Agency Rept. No. W72-10921, OWRR-A-015-ORE(1); Proj. OWRR-A-015-Ore; 23p.; 1972, June 30

ANALYSIS; DITHIZONE ANALYSIS; MERCURY; ION EXCHANGE; MERCURY COMPOUNDS; CHEMICAL ANALYSIS; ION EXCHANGE RESINS; ERRORS; PURIFICATION; IMPURITIES; COLORIMETRIC ANALYSIS; ORGANOMERCURIALS; CHELATION

Both organic and inorganic forms of mercury are analyzed by a modification of the classical dithizone method in the range 0-50 microgram. The separation of mercury from the bulk of interfering ions such as Cu(+2), Fe(+3), Bi(+3), Mg(+2), Ca(+2), and Na(+) can be accomplished simply by use of chelating resins. No satisfactory method of separating inorganic mercury compounds from organomercurial compounds by differential elution was found. Mercury is not appreciably volatile in hot oxidizing acidic solution and the elaborate refluxing systems of the standard dithizone method are unnecessary.

389
Theory of Water Movement in Soils. Part 9: The Dynamics of Capillary Rise

Parlange, J.Y.; Aylor, D.

Soil Sci. 114(2), 79-81; 1972

WATER MOVEMENT; SOILS; NUMERICAL SOLUTION; CAPILLARY ACTION; MATHEMATICAL METHODS; MODELS

A simple analytical representation fro the one-dimensional capillary rise of water in porous media is derived in this work, which is valid for all times. The present solution reduces to the proper limits both for t 0 and for t 8. For the case of Yolo clay, the analytical solution and Philip's numerical solution are in complete agreement for times up to 10(6) sec., which is the limit of validity for Philip's time series expansion. However, Philip's time series expansion. However, Philip's solution describes only the early stages of the capillary rise, typically less than 10 per cent of the complete rise, while the present technique describes the whole phenomenon.

390
Preliminary Survey of Mercury and Other Metals Contained in Animals From the Fraser River Mudflats

Parsons, T.R.; Bawden, C.A.; Heath, W.A.; Inst. Oceanogr., Univ. of British Columbia, Vancouver, B.C.

J. Fish. Res. Board Can. (JFRBAK), 30(7), 1014-16; 1973

METALS; CRAB; MOLLUSCS; MERCURY; SILVER; CADMIUM; COPPER; SEWAGE OUTFALLS; SEWAGE

TAXONOMY: CRASSOSTREA GIGAS; MYA ARENARIA; MYTILUS EDULUS

Crabs taken from the Sturgeon Bank of the Fraser River mudflats contained 7-fold the amount of mercury of crabs of comparable size taken from the Roberts bank, the Cowichan River estuary, or Kitimat Arm. The mean Hg content of molluscs from Sturgeon Bank was 0.33 ppm, compared with 0.12 ppm in those from other areas. Silver, cadmium, and copper levels were also higher in animals from Sturgeon Bank, while cobalt, manganese, nickel, lead, and zinc levels showed no geographic pattern. The Vancouver city sewer outfall, rather than the Fraser River itself, is probably the source of high heavy metal concentrations.

391
Spreading of Heavy Metals in Flowing Water in the Region of Occurrence of Natural Deposits and of the Zinc and Lead Industry

Pasternak, K.; Zak. Biol. Wod., Pol. Akad. Nauk, Cracow, Poland

Acta Hydrobiol., 15(2), 145-66; 1973

HEAVY METALS; STREAMS; WATER; LEAD; ZINC; MINING; INDUSTRY

392
Occurrence and Cumulation of Microcomponents in Bottom Sediments of Dam Reservoirs of Southern Poland

Pasternak, K.; Glinski, J.

Acta Hydrobiol., 14(3), 225-255; 1972

ACCUMULATION; SEDIMENTS; LEAD; ZINC; DAMS; RESERVOIRS; WATER

The total amount of microcomponents in sediments depends above all on their grain composition. An exception here are sediments of reservoirs supplied with strongly polluted water. The quantitative differentiation of microcomponents within each granulometric group of sediments, as well as between single samples from various zones of the reservoirs, shows a tendency to a relationship with the quantity and quality of clayey and organic matter in the sediment. The presence in the substratum of the catchment basin of the reservoirs of rock layers containing Zn and Pb minerals, or dust coming from the Zn and Pb industries, have some influence on the increase in the amount of these components in the sediments. The main source of microcomponents in the sediments of pure reservoirs are suspensions brought in by the water of the river, and remains of organisms developing in the reservoirs. The degree of cumulation of microcomponents in the sediments of dam reservoirs is much higher than in land soils and the soils of fish-ponds. The degree of concentration of some microcomponents in the sediments of polluted reservoirs corresponds in general to the quantity and quality of pollution.

393
Radioecology of Certain Molluscs in Indian Coastal Waters

Patel, B.; Valanju, P.; Mulay, C.; Balani, M.; Patel, S.

Part of Radioactive Contamination of the Marine Environment. Vienna-International Atomic Energy Agency (pp. 307-330). From Symposium on the Interaction of Radioactive Contaminants with the Constituents of the Marine Environment, Seattle, Washington, USA, 10 Jul 1972, 14 Jul 1972, See STI/PUB--313-CONF-720708; 1973

AQUATIC ECOSYSTEMS; CALCIUM; CESIUM 137; COASTAL WATERS; CESIUM; COBALT; COBALT 58; COBALT 60; COPPER; DIFFUSION; EXOSKELETON; FOOD CHAINS; GASTROINTESTINAL TRACT; SALTWATER; IODINE 131; IRON; LIVER; MAGNESIUM; MANGANESE; IODINE; MARINE DISPOSAL; METABOLISM; MOLLUSCS; NICKEL; PHOSPHORUS; POTASSIUM; RADIOACTIVE WASTE DISPOSAL; RADIONUCLIDES; KINETICS; RADIONUCLIDE MIGRATION; MIGRATION; RETENTION; STRONTIUM; TISSUES; UPTAKE; ZINC; TISSUE DISTRIBUTION

TAXONOMY: APLYSIA BENEDICTI

Knowledge of the distribution patterns of stable elements in the marine biosphere is an essential prerequisite for understanding the problems of radioactive contamination of marine biota, especially as regards indicator species. This paper discusses the distribution of a few major and trace elements of metabolic significance in the sea-hare APLYSIA BENEDICTI Eliot, which moves shorewards in coastal waters during colder months. The population was found to accumulate trace elements belonging to iron family atomic nos. 23-28). Of the various tissues analysed, the hepatopancreas and intestine including the gut-content showed higher concentrations of Co, Fe and Ni, whereas Fe was deposited in buccal mass. The bio-accumulation of Zn, Cu, Sr and Ca in whole animal and various tissues is also discussed in relation to environment. The APLYSIA BENEDICTI population from Tarapur waters which receive radioactive wastes (I-131, Cs-137, Cr-51, Co-60, Mn-54, etc.) from a boiling-water reactor, was found to accumulate Co-58 and Co-60 in the soft-tissues. Hepatopancreas and gut-content contained the highest concentration of radiocobalt. Iodine-131, on the other hand, was concentrated in horny internal shell, possibly as a means for disposal. The spawn chords of this species were also found to accumulate I-131 from the environment. This species could therefore be used as an indicator of radionuclides of cobalt, although its occurence in nearshore waters is strictly seasonl.

394
Radioecology of Benthic Fishes off Oregon

Pearcy, W.G.; Vanderploeg, H.

Part of Radioactive Contamination of the Marine Environment, Proceedings of Symposium held by the International Atomic Energy Agency, Seattle, WA, July 10-14, 245-259, 786p.; 1973

RADIOECOLOGY; BENTHOS; FISH; ZINC; ZINC 65; COBALT; COBALT 60; MANGANESE; MANGANESE 54; CERIUM 144; CERIUM; CESIUM 137; CESIUM; POTASSIUM; POTASSIUM 40; COASTAL WATERS; SPECIFIC ACTIVITY; RADIONUCLIDES; TRANSPORT; WATER

TAXONOMY: LYOPSETTA EXILIS; SEBASTOLOBUS

GEOGRAPHICAL DESCRIPTION: U.S. (NW), Oregon, Coast

Gamma-emitting radionuclides were found in benthic fishes from depths of 50-2000 m off the Oregon coast from 1964-1971; Zn-65, Co-60, Mn-54, Ce-144, Cs-137 and K-40 were present. Zinc-65, originating mainly from the nuclear reactors on the Columbia River, was the predominant artifically induced radionuclide. Levels of Zn-65 per gram and specific activities of Zn-65 decreased markedly in several species of fishes between 1965 and 1971 because of the shutdown of reactors. This decrease was greater for small than for large LYOPSETTA EXILIS during 1970-1971. Specific activities decreased with increasing depth, both for individual species inhabiting broad depth ranges and for different species inhabiting different depths. Specific activities of Zn-65 were inversely related to body size for L. EXILIS and SEBASTOLOBUS. Other variations of Zn-65 were related to trophic position. Fishes that preyed on low trophic level pelagic animals had higher specific activities than fishes that preyed on benthic invertebrates. Such pelagic feeders may play an important role in accelerating the transport of some radionuclides or elements to the sea floor.

395
Heavy Metals in Somerset Marine Organisms

Peden, J.D.; Crothers, J.H.; Waterfall, C.E.; Beasley, J.; Cty. Anal. Lab., Cty. Hall, Taunton/Somerset, England

Mar. Pollut. Bull. (MPNBAZ) 4(1), 7-9; 1973

CADMIUM; MARINE ORGANISMS; HUMANS; HEAVY METALS; SALTWATER; KIDNEYS; LIMPETS; ANALYSES; MOLLUSCS

TAXONOMY: PATELLA VULATE

GEOGRAPHICAL DESCRIPTION: England, Somerset, Devon, Taunton

Limpets PATELLA VULGATE from 11 cities along the Somerset coast and 4 from Devon had concentrations rising to very high levels toward Monmouth. Limpets collected from near low tide mark contain more Cd than individuals living in a higher situation. Analyses of a number of apparently normal human organs from accident victims showed very high levels of Cd in 87 kidneys. These levels are approximately equivalent to 5.80 ppm of the net wt. There is virtually no Cd present in the kidneys of the new-born child.

396
The Roles of Food and Water in the Accumulation of Radionuclides by Marine Teleost and Elasmobranch Fish

Pentreath, R.J.

Part of Radioactive Contamination of the Marine Environment, Proceedings of Symposium held by the International Atomic Energy Agency, Seattle, WA, July 10-14, 1972 (421-435) 786 p.; 1973

FOOD CHAINS; BIOACCUMULATION; MARINE TELEOST; ELASMOBRANCH FISH; FISH; CESIUM; CESIUM 137; TOXICITY; BIOLOGICAL HALF-TIMES; GASTROINTESTINAL ABSORPTION

A theoretical estimation of the input of many radionuclides into fish, and the relevant roles of food and water, is formulated on the basis of known concentration factors. The importance and methods of estimation of biological half-times in such calculations is also discussed. The accumulation of many fission product nuclides is low due to poor absorption across the gut wall, with the exception of soluble elements such as caesium-137 where both food and water play an equal part. For many neutron activation products, however, the contribution from water alone may be considered to be very small. Experimental evidence is given on the accumulation of certain neutron activation products from water by both teleost and elasmobranch marine fish in relation to their large stable element pools, water fluxes and drinking rates. Calculations on the required dietary input are equated with known feeding rates, and the required retention of such elements is compared with results obtained both from labelled pellets introduced into the gut and from labelled food species. The results imply that, unlike caesium-137, which is increased along the food chain, many neutron activation products (heavy metals) are decreased in concentration at such higher trophic levels. The implication of such work for metal toxicity studies is also discussed.

397
Accumulation from Water of Zinc-65, Manganese-54, Cobalt-58, and Iron-59 by the Mussel, MYTILUS EDULIS

Pentreath, R.J.; Fish. Radiobiol. Lab., Minist. Agric. Fish. Food, Lowestoft/Suffolk, England

J. Mar. Biol. Ass. U.K. (JMBAAK), 53(1), 127-43; 1973

MUSSELS; UPTAKE; RADIONUCLIDES; IRON; ZINC; ZINC 65; IRON 59; SALTWATER; MANGANESE; COBALT; MANGANESE 54; COBALT 58; BIOACCUMULATION MODELS

TAXONOMY: MYTILUS EDULUS

The accumulation from sea water of Zn-65, Mn-54, Fe-59, and Co-58 by the mussel, MYTILUS EDULIS, has been studied in relation to the stable element levels of these isotopes both in the sea water and in individual tissues. For all four radionuclides the greatest accumulation occurred in the stomach and digestive gland samples and further localization of Zn-65 and and Fe-59 was demonstrated by autoradiography. As the animals were starved during the accumulation period the loss of stable elements by individual tissues was also followed. Again the most notable effect occurred in the digestive gland tissues with the exception of a large loss of iron by the foot. Autoradiography showed that after two weeks accumulation Fe-59 occurs in large clusters in the foot, notable in the byssus gland area. These clusters disappear after a further two week period and may thus be secreted into new byssus threads. The accumulation of nuclides was examined using a single exponential model and values obtained for flux rates, biological half times and a symptotic values were compared with the stable element concentration factors. An analysis of parameters of exchange of nuclides in individual tissues with the water was further examined using the Kendall coefficient of concordance which demonstrated that the highest exchange occurs in the order of stomach and digestive gland is greater than gill is greater than foot is greater than mantle is greater than gonad is greater than adductor. The application of Friedman test of two-way analysis of variance indicated that the order obtains for all four nuclides studied, despite the fact that in the aquaria used zinc and cobalt were largely soluble; that manganese was partly in the particulate form with the radionuclide used; and that iron was largely particulate in both stable and active forms. There is an indication that as well as accumulating nuclides via particulate matter in suspension the mucus itself is capable of sequestering them, even though they are in the soluble form, and may even preferentially accumulate soluble forms. The actual role of water in the accumulation of the nuclides studied appears to be relatively minor compared with that of food accumulation as estimated by difference from the calculated stable element values.

398
Physico-Chemical Characteristics of Five Ruthenium Salts During Freshwater to Marine Transition

Peperstraete, H.; Vos, J.; Van Puymbroeck, S.; Vanderborght, O.

Part of Radioactive Contamination of the Marine Environment, Proceedings of Symposium held by the International Atomic Energy Agency, Seattle, WA, July 10-14, 1972 (219-221) 786 p.; 1973

PHYSICOCHEMISTRY; RUTHENIUM; RUTHENIUM SALTS; FRESHWATER; SALTWATER; ELECTROPHORESIS; BIOLOGICAL AVAILABILITY

The changes in physico-chemical characteristics such as mobility in high-voltage electrophoresis, of different Ru-salts in solution are considered during their transition from fresh water to marine conditions. The biological availability for some indicator organisms is also assessed under the same controlled laboratory conditions. The five tested solutions of Ru salts show a different electrophoretic separation pattern. This pattern changes by aging, probably principally by polymer formation. Dilution has no marked influence on this pattern, neither after dilution with fresh water nor with seawater.

399
Distribution of Cadmium, Cobalt, Copper, Iron, Manganese, Nickel, Lead and Zinc in Dissolved and Particulate Solids from 2 Streams in Tennessee

Perhac, R.M.; Dept. of Geology, Univ. of Tennessee, Knoxville, Tenn., U.S.A.

J. Hydrol. (Amst.), 15(3), 177-186; 1972

DISTRIBUTION; CADMIUM; COBALT; COPPER; IRON; MANGANESE; NICKEL; LEAD; ZINC; PARTICULATE SOLIDS; STREAMS

GEOGRAPHICAL DESCRIPTION: U.S. (SE), Tennessee (NE)

In order to study metal distribution in streams, four water samples were taken from two streams in northeast Tennessee. One drains an area of exposed minor zinc mineralization. Three classes of solids were extracted from the water: coarse particulates (greater than 1500 A), colloidal particulates (less than 1500 A, greater than 100 A) and dissolved solids. Each particulate fraction was extracted by continuous flow ultracentrifugation. The dissolved solids in the remaining effluent were recovered by evaporation. Of the total solid, the dissolved fraction accounts for over 95%; colloids make up less than 1%. The three solid fractions were totally dissolved and analyzed for Cd, Co, Cu, Fe, Mn, Ni, Pb and Zn. The dissolved solids always contain the lowest concentrations of metal (ppm metal in solid); the colloids have the highest, typically more than 10 times that of the dissolved material. The coarse particulates occupy an intermediate position. Despite its low concentration, generally over 90% of each metal occurs in the dissolved state. Less than 10% occurs with the coarse particulates, less than 1% as colloids.

400
Trace Metals in Solway Firth Sediments

Perkins, E.J.; Gilchrist, J.P.; Abbott, O.J.; Halcrow, W.; Mar. Lab., Univ. Strathclyde, Garelochhead/Dunbartonshire, Scotland

Mar. Pollut. Bull. (MPNBAZ), 4(4), 59-61; 1973

TRACE METALS; ESTUARIES; SEDIMENTS

GEOGRAPHICAL DESCRIPTION: Scotland, Solway Firth

401
Mercury in Tunas. Review

Peterson, C.L.; Klawe, W.L.; Sharp, G.D.; Scripps Inst. Oceanogr., Inter-Am. Trop. Tuna Comm., La Jolla, CA

NOAA Fish. Bull. (FSYBAY), 71(3), 603-613; 1973

REVIEW; MERCURY; TUNA; FISH

402
Neutron Activation Analysis of Some of the Biologically Active Trace Elements in Fish

Pillay, K.K.S.; Thomas, C.C., Jr.; Hyche, C.M.

Part of Hemphill, D.D. (Ed.), Seventh Annual Conference on Trace Substances in Environmental Health, Held at Memorial Union, University of Missouri-Columbia, Columbia, MO, June 12-14, 1973; 1973

NEUTRON ACTIVATION ANALYSIS; TRACE ELEMENTS; FISH; ANALYSIS; COPPER; MERCURY; ZINC; CADMIUM; ARSENIC; SELENIUM; CHROMIUM; CHEMICAL SEPARATION; SAMPLE PREPARATION; WALLEYE; YELLOW PERCH; WHITE BASS; CHANNEL CATFISH; FRESHWATER DRUM; CARP; COHO SALMON; WHITE SUCKER; GIZZARD SHAD; AGE VARIATIONS; BIOACCUMULATION; BIOCONCENTRATION

High specific neutron activation analysis procedures involving post irradiation chemical separations were developed for the determination of copper, mercury, zinc, cadmium, arsenic, selenium and chromium in fish tissues. The procedures developed were used to determine the levels of these biologically active elements in some of the commercially important fish species of Lake Erie. The nuclear analytical procedures developed generally involved the irradiation of fish tissues followed by wet-ashing in the presence of nonradioactive carriers. From the homogeneous solution of the tissue digest, the elements of interest were chemically isolated and the radioactivities were measured by scintillation gamma ray spectrometry. The results reported included both the determination of the precision and accuracies of each of these elemental analyses and a survey of these seven elements in nine major fish species of Lake Erie.

403
Mercury Pollution of Lake Erie Ecosphere

Pillay, K.K.S.; Thomas, C.C., Jr.; Sondel, J.A.; Hyche, C.M.

Presented at Third Northeast Regional Meeting of the American Chemical Society, October 11-13, 1971, Buffalo, NY, 28 p.; Environmental Research, 5, 172-181; 1972

MERCURY; AIR; PARTICULATES; SEDIMENTS; PLANKTON; ALGAE; WATER; BRAIN; HUMANS; NEUTRON ACTIVATION ANALYSIS; FISH; FISH TISSUES; COAL; WALLEYE; YELLOW PERCH; WHITE BASS; CHANNEL CATFISH; FRESHWATER DRUM; CARP; COHO SALMON; WHITE SUCKER; GIZZARD SHAD; SMALLMOUTH BASS; SMELT

GEOGRAPHICAL DESCRIPTION: U.S., Great Lakes, Lake Erie

The distribution of mercury in the ecosphere of Lake Erie was monitored using a highly sensitive and reliable neutron activation analysis procedure. A variety of samples from the fauna and flora of the lake as well as those from its immediate environment were analyzed for their mercury content. The results of this survey indicate a widespread distribution of mercury in air particulates; coal samples of the region; sediments, plankton/algae and fish samples from the lake; and in the brain tissues of long-term residents of the Lake Erie Basin. Air particulates from 4 stations in Buffalo ranged from 1-30 nanograms per cubic meter, with wide variations due to atmospheric conditions.

404
Incomplete Exchange Reaction Between Radioactive Ionic Zinc and Stable Natural Zinc in Seawater

Piro, A.; Bernhard, M.; Branica, M.; Verzi, M.

Part of Radioactive Contamination of the Marine Environment, Proceedings of Symposium held by the International Atomic Energy Agency, Seattle, WA, July 10-14, 1972 (29-44), 786 p.; 1973

AQUEOUS SOLUTIONS; ISOTOPES; ISOTOPIC EXCHANGE; RADIONUCLIDES; KINETICS; SALTWATER; SODIUM CHLORIDE; ZINC; ZINC 65; COMPLEXES

An apparatus which permits the simultaneous determination of stable and radioactive ionic zinc in aqueous solution is described. With this apparatus it is possible to investigate the exchange reactions between stable ionic and complexed zinc and radioactive ionic zinc in NaCl solution and seawater. In NaCl (34% S), in presence of a complexing agent, after about one hour the Zn 65 is distributed between the non-complexed and complexed fractions in the same way as the stable isotope is not uniformly distributed in all physico-chemical states present in the seawater but it dilutes only in the ionic and particulated fractions. Even one year after the addition of Zn 65 the radioactive zinc has not entered the complexed fraction. The consequences of this fractionation for the interpretation of tracer experiments and hazard evaluation are discussed.

405
Heavy Metals in British Waters

Preston, A.; Fish. Food Fish. Lab., Minist. Agric., Lowestoft, Engl.

Nature (London) (Natuas), 242(5393), 95-7; 1973

METALS; SALTWATER; SEAWEEDS

Seawater sampling revealed that certain areas of British coastal waters have elevated concentrations of some metals by comparison with the general levels prevailing in other areas. Analyses of seaweed samples from these "polluted" areas a decade ago showed overall no significant differences in concentration except for cadmium, which may have fallen, on the average.

406
British Isles Coastal Waters the Concentrations of Selected Heavy Metals in Sea Water Suspended Matter and Biological Indicators a Pilot Survey

Preston, A.; Jefferies, D.F.; Dutton, J.W.R.; Harvey, B.R.; Steele, A.K.

Environmental Pollution, 3, 69-82; 1972

WATER; SALTWATER; METALS; SUSPENDED MATTER; BIOLOGICAL INDICATORS; SEA WEEDS; SEDIMENTS; BIOACCUMULATION; SAMPLING; ZINC; COPPER; IRON; MANGANESE; NICKEL; SILVER; CADMIUM; LEAD; ATOMIC ABSORPTION SPECTROPHOTOMETRY; FUCUS; PORPHYRA; LIMPETS; CONCENTRATION FACTOR; TRACE ELEMENTS; PLANTS; ALGAE

GEOGRAPHICAL DESCRIPTION: Great Britain, Coastal Waters

Data, from British Isles coastal waters, on the concentrations of selected metals in sea water and biological indicators, have been obtained by analytical techniques based on atomic absorption spectrophotometry. The results show that there are some areas where significant contamination exists, and the east Irish Sea appears to have the highest concentrations of most metals. However, data in most regions indicate that the concentrations of the metals examined are not significantly higher than those in the open Atlantic Ocean adjacent to the British Isles. The sampling of seaweeds strongly suggests that concentrations of most metals, including those in polluted areas, have changed little over the ten years up to 1970; the concentrations of cadmium may well, on average, have fallen over this period. In the Irish Sea, where the most detailed examination has been made, there is a rapid decrease in sea water concentrations from the shoreline to offshore, and in general, the proportions of a metal associated with suspended matter remain fairly constant with respect to variations of total concentrations in either time or space.

407
Heavy Metal Content of Surface and Ground Waters of the Springfield-Joplin Areas, Missouri

Proctor, P.D.; Kisvarsanyi, G.; Garrison, E.; Williams, A.

Part of Hemphill, D.D. (Ed.), Seventh Annual Conference on Trace Substances in Environmental Health, Held in Memorial Union, University of Missouri-Columbia, Columbia, MO, June 12-14, 1973; 1974

COPPER; LEAD; ZINC; CADMIUM; MERCURY; IRON; SEASONAL VARIATIONS; WATER; GROUND WATER; SURFACE WATERS; MINING

GEOGRAPHICAL DESCRIPTION: U.S., Missouri, Springfield, Joplin

Some 200 water samples were collected in fall, spring and summer from springs, streams, lakes and selected water wells within a radius of six miles from the populous centers of Springfield and Joplin, Missouri, respectively. Samples were analyzed for copper, lead, zinc, cadmium, mercury and iron. Joplin is within a former very productive zinc mining district. Springfield lies 72 miles to the east. Water well samples represent deep and shallow rock sources. Heavy metal contents in the waters show local concentrations in each area. Heavy metal highs are generally related to known mineralization. Seasonal variations in metal contents are generally restricted to the surface or near surface environment and certain metals. Locally, cadmium, lead, zinc, and iron exceed the acceptable PHS limits for public drinking water. The majority of water samples, however, have heavy metal contents well below the established PHS limits. Maximum ranges of heavy metal values for the two areas are in ppb: Joplin: copper (less than 1-330), lead (less than 1-18), zinc (less than 10-11,500), mercury (less than 0.1), cadmium (less than 1-16), iron (less than 1-119,000); Springfield: copper (less than 1-31), lead (less than 1-70), zinc (less than 1-8,500), mercury (less than 0.1-0.77), cadmium (less than 0.1-11), iron (less than 1-455). High zinc values are related to known lead-zinc mineralization in the Joplin area, and to lead-zinc prospects east of Springfield. Average cadmium values are slightly higher in the Joplin area. Copper and lead average values are quite similar for both areas. Zinc is higher in deep wells in Springfield versus the deep wells of Joplin. Average zinc values for shallow wells are quite similar. Surface waters in the Joplin area have much higher zinc values than those in Springfield. Mercury is higher in the Springfield area but in very low quantity. Iron values are higher and more variable in shallow wells in the Joplin area and lower in the streams there.

408
Absorption of Nickel and Cobalt (Biogenic forms) from Sea Water by Natural Iron and Manganese Hydroxides

Pronina, N.V.; Varentsov, I.M.; Spektorova, L.V.; Spektorov, K.S.; Ovsyannikova, N.; Geol. Inst., Moscow, USSR

Geokhimiya (BEOKAQ), (6), 876-87; 1973

NICKEL; ABSORPTION; COBALT; IRON; MANGANESE; SALTWATER; HYDROXIDE

TAXONOMY: PLATIMONAS SP

The absorption of nickel and cobalt was experimentally studied using deionized sea water and with the addition of biogenic forms of nickel and cobalt from planktonic algae (PLATIMONAS SP.) the nickel and cobalt concentrations were estimated polarographically. The rate of removal of Ni (28.0-47) and Co (28.0-44 microgram/l) was determined and is related to the flow rate of the sea water (in the dynamic variant) and to the time of interaction (in the static variant). The initial stages of absorption have an ion-exchange character. During the later stages, nonexchangeable difficulty-absorbable Co and Ni complexes were formed. The chemosorption is accompanied by the autocatalytic oxidation of these metals. Under both the dynamic and static conditions, the absorption of Co is higher than that of Ni.

409
Uptake of Metal Ions by Lichens. Modified Ion-Exchange Process

Puckett, K.J.; Nieboer, E.; Gorzynski, M.J.; Richardson, D.H.; Dep. Biol., Laurentian Univ., Sudbury, Ont.

New Phytol. (NEPHAV), 72(2), 329-42; 1973

METALS; IONS; UPTAKE; LICHENS; EXCHANGE PROCESSES; ION EXCHANGE; COMPLEXES; IRON; COPPER; NICKEL; ZINC; LEAD

Heavy metal ions were absorbed by lichens to different degrees in laboratory experiments. The relative capacities for uptake from solutions containing a single metal ion were Fe, Cu is greater than Ni is greater than Pb is greater Co is greater than Zn. Competitive uptake studies revealed the selectivity sequence Fe is greater than Pb is greater than Cu is greater than Ni, Zn is greater than Co. The sequences are in accord with a cation uptake mechanism involving exchange modified by metal-complex formation. Correlations between laboratory studies and the metal content of lichens growing in the vicinity of a smelter are discussed.

410
Radionuclide Transport in an Aquatic Model System

Purushothaman, K.

Part of Hemphill, Delbert D. (Ed.), Trace Substances in Environmental Health. IV. Columbia, MO. - University of Missouri, (178-185); 1971

TRANSPORT; AQUATIC ECOSYSTEMS; MODEL ECOSYSTEM; CESIUM 137; CLAYS; CONTAMINATION; MOCKUP; POWER REACTORS; RADIOACTIVE WASTES; MIGRATION; RADIONUCLIDES; RIVERS; STRONTIUM 85; WASTE DISPOSAL; WATER; CESIUM; STRONTIUM

The radioactive wastes at very low concentrations as released by the nuclear power facilities into an aquatic system pose complex problems such as the transport of the radionuclides for further dilution downstream, simple and complex chemical changes of the radionuclide, and the concentration and subsequent release of the radioactive materials in the aquatic biota and sediments depending upon the nature and condition of the environment. The paper deals with the study conducted to evaluate the effects of selected clay suspensions on the transport of Sr-85 and Cs-137 in a model river. An instrumented flume was used to simulate a slow-moving, turbid stream which did not recieve any extraneous biodegrabable organic pollutant. Modified longitudinal dispersion relationships were used to describe the transport of radionuclides in the turbid stream. Data were obtained from instantaneous release of Sr-85 and Cs-137 with suspended Attapulgite and Kaolinite clays. Results showed that suspended clays in the model river system produced a significant reduction in the transport of Cs-137. The transport of Sr-85 is not affected to a considerable degree since most of the Sr-85 remained in solution.

411
Plankton Populations and Some Effects of Mine Drainage on Primary Productivity of the Coeur D'Alene River, Delta and Lake.; Technical Completion Rept.

Rabe, F.W.; Wissmar, R.C.; Winter, R.P.; Idaho Univ., Moscow. Water Resources Research Inst.

Contract DI-14-01-001-3212; Monitoring Agency Rept. No. OWRR-A-030-IDA(2); Proj. OWRR-A-030-IDA 28p.; 1973, January

ANIMALS; PLANTS; EUTROPHICATION; RIVERS; LAKES; PRODUCTIVITY; ZINC; COPPER; CADMIUM; TOXICITY; METALS; TAILINGS; SILVER; LEAD; PH; BIOASSAY; PHYTOPLANKTON; ZOOPLANKTON; INDUSTRIAL WASTES; ALGAE; SUSPENDED SEDIMENTS; ACIDS; MINES; EXCAVATIONS

GEOGRAPHICAL DESCRIPTION: US (NW), Idaho, Coeur D'Alene River

Variations in primary production and physiochemical measurements in the Coeur D'Alene River and Lake in Idaho were examined. These bodies of water have received mine tailings and metallic sulfide minerals for the last 80 years. Metal concentrations Mn, Cd, Mg, Ca, Pb, Cu, Zn, Fe, Na and K; water quality and phytoplankton composition-density were determined. Additional sampling included unpolluted portions of Coeur D'Alene Lake and the unaffected St. Joe river. Nannoplankton from Coeur D'Alene Lake were exposed to known concentrations of Cu(2+), Cd(2+), Zn(2+) and dilutions of Coeur D'Alene river water under controlled light and temperature. Inhibitory effects of separate and interacting metals on carbon-14 uptake by algae were assesed with factoral bioassays and response surfaces.

412
Plant Uptake of Soil and Atmospheric Lead in Southern California

Rabinowitz, M.B.; Inst. Geophys., Univ. California, Los Angeles, Calif.

Chemosphere (CMSHAF) 1(4), 175-80; 1972

UPTAKE; LEAD; ATMOSPHERE; PLANTS; OATS; LETTUCE; SOILS

It was found from growing lettuce and oats in soils with stable isotope tracer, that the concentration of lead in the diffuse roots was about the same as in the soil, while in the leaves, the concentration of lead from the soil was only 0.5 to 3% as much. Atmospheric lead in the water-washed leaves was 50 to 20 ppm in the mountains and 50 to 200 ppm near the freeway. Some of this lead was translocated downward in the plant; 0 to 10 ppm atmospheric lead was found in the tap roots of lettuce grown near the freeway. In commercial lettuce more than 90% of the 3 to 25 ppm lead present was from the atmosphere. Wild oats were found to be a useful indicator of atmospheric lead. A survey in Southern California shows automobile exhaust lead transported 50 to 100 kilometers.

413
Lead Metabolism in the Normal Human: Stable Isotope Studies

Rabinowitz, M.B.; Wetherill, G.W.; Kopple, J.D.

Science, 182, 725-727; 1973

LEAD; METABOLISM; HUMANS; ISOTOPES; DIET; TRACERS; LEAD 204; ATMOSPHERE; INHALATION; KINETICS; BLOOD; SKELETON; SOFT TISSUES; MODELS

Kinetic and metabolic balance studies in a healthy man fed a diet normal in lead content and labeled with lead-204 indicated that approximately two thirds of his assimilated lead was dietary in origin; the remainder was inhaled. Kinetic analysis shows that the isotopic data can be interpreted by a three-compartment model: 1. primary blood (etythrocyte); 2. soft tissue; 3. skeleton. No homeostatic mechanisms for maintaining lead concentration in the blood were seen.

414
Distribution of Metallic Element Complexes Between an Anion Exchange Resin and Water--Methanol--Hydrochloric Acid Mixtures

Rastoix, M.; Commissariat a L'Energie Atomique, Saclay France. Centre D'Etudes Nucleaires

Commissariat A L'Energie Atomique, Saclay France. Centre D'Etudes Nucleaires, CEA-R--4450; 1973, June

ANIONS; CADMIUM; CADMIUM COMPLEXES; CHLORIDE; ETHANOL; HYDROCHLORIC ACID; ION EXCHANGE; METHANOL; SEPARATION PROCESSES; URANIUM; URANYL COMPOUNDS; WATER

415
The Accumulation of Arsenic from Arsenic Rich Natural Waters by Aquatic Plants

Reay, P.F.; Appl. Biochem. Div., Dep. Sci. Ind. Res., Palmerston North, New Zealand

J. Appl. Ecol. 9(2), 557-565; 1972

BIOACCUMULATION; PLANTS; AQUATIC PLANTS; TOXICITY; ARSENIC; WATER; NATURAL WATERS

GEOGRAPHICAL DESCRIPTION: New Zealand, Waikato River

Several aquatic plants were found to accumulate As from the Waikato River (New Zealand) to levels well above those associated with toxicity. The species examined differed in the concentrations to which they accumulated (As) and the average values ranged from 30-650 mg/kg of the dry weight. Accumulation was influenced by the amount of As in the water but not by the amount in the river and lake bottoms. The withdrawal of As from the river water by aquatic plants does not seem to markedly affect the discharge of As into the sea.

416
The Acute Toxicity of Some Heavy Metals Toward Benthic Organisms

Rehwoldt, R.; Lasko, L.; Shaw, C.; Wirhowski, N.; Environmental Science Program, Marist College, Poughkeepsie, NY

Bull. Environ. Contam. Tox. 10(5), 291-294; 1973

TOXICITY; METALS; BENTHOS; MERCURY; IONS; EGGS; ADULTS; WATER; RIVERS

TAXONOMY: CHIRONOMOUS; GAMMARUS

GEOGRAPHICAL DESCRIPTION: U.S. (NE), New York, Hudson River, Poughkeepsie

The acute toxicity of some heavy metals toward benthic organisms in the Poughkeepsie reach of the Hudson River was determined by use of standard TLm(24-96hr). The mercury ion is the most toxic ion studied and is more toxic toward the benthic organisms in this reach than toward the fish studied in the same area. With the exception of CHIRONOMOUS and GAMMARUS, benthic organisms tend to be more able to withstand heavy metal inputs than fish. Also, the eggs are less susceptible to inputs than adults.

417
A Hierarchy of Models for the Behavior of Mercury in the Ecosystem

ReinIger, P.; Prissel, M.J.; Poelstra, P.; Beek, R.

Part of Welsh, C.N. (Edited by). International Atomic Energy Agency Proceedings Series. Nuclear Techniques in Environmental Pollution. Symposium. 810p. Illus. Maps. Unipub, Inc.; New York, N.Y., U.S.A. 407-418; 1971

CHROMATOGRAPHY; TRANSPORT; SOILS; RADIOACTIVITY; MERCURY; MODELS; ECOSYSTEMS; COMPUTER SIMULATION

For locating the key questions in a particular pollution problem, a quantitative insight into the interrelationship of its various processes is necessary. This insight may be obtained by means of a mathematical model. The involved and dynamic nature of pollution problems demands models of a great complexity. Computer-simulation languages developed recently (Continuous System Simulation Languages) may be a great help in setting up and using such models. They have been employed by the authors to model chromatographic transport processes in soil in view of radioactive pollutants and salinity problems. In the Netherlands an interdisciplinary working group has been set up to study the behaviour of mercury and its compounds in the environment. The possibilities of designing a hierarchy of models for the quantitative description of this problem is illustrated and discussed. In such a hierarchy, each model may be developed and tested separately, but it is essential that the output (results) of a lower model may be used as input for a higher model. This point, and more general aspects of the simulation technique, are demonstrated by the example of two echelons of models dealing with the behaviour of mercury compounds in soil.

418
Transfer of Zinc-65 from Sediments by Marine Polychaete Worms

Renfro, W.C.; Int. Lab. Mar. Radioact., Int. At. Energy Agency, Monaco

Mar. Biol. (MBIOAJ), 21(4), 305-316; 1973

POLYCHAETES; WORMS; ZINC 65; UPTAKE; RADIOISOTOPES; SALTWATER; RELEASE; SEDIMENTS

419
The Persistence of Heavy Metals in Soils and Natural Vegetation Following Closure of a Smelter

Roberts, T.M.; Goodman, T.G.; Department of Botany, University College of Swansea, South Wales, U.K.

Presented at the Seventh Annual Conference on Trace Substances in Environmental Health, University of Missouri-Columbia Columbia, MO 65201; 1973, June 12-14

PERSISTENCE; ZINC; LEAD; SMELTERS; CADMIUM; CONTAMINATION; PLANTS; LEAVES; BIOACCUMULATION; TRACE SUBSTANCES; METALS; SOILS; MOSSES; RUNOFF; WIND; EROSION

TAXONOMY: HYPNUM CUPRESSIFORME var. FILIFORME; FESTUCA RUBRA

Permanent closure of a zinc/lead smelter located in the Lower Swansea Valley, South Wales in May 1971, resulted in a marked decrease of zinc, lead and cadmium contamination of leaves of FESTUCA RUBRA. In the absence of substantial metal fallout in the winter of 1971/72, metal accumulation in over-wintering leaves was much reduced compared with corresponding data for the winter of 1970/71. In contrast, quantities of metals in the epiphytic moss, HYPNUM CUPRESSIFORME var. FILIFORME reflected the past history of metal fallout, as the amounts in the living tissues decreased only slowly after closure of the smelter. The exchangeable levels of heavy metals in soils of open habitats fell after closure of the smelter as a result of runoff and wind erosion. Extrapolation of the soil data indicates a return to background levels within five years. In contrast, the rate of loss of exchangeable heavy metals from closed grassland communities is much slower which is in agreement with published data.

420
Transport and Depletion of Radionuclides in the Columbia River

Robertson, D.E.; Silker, W.B.; Langford, J.C.; Petersen, M.R.; Perkins, R.W.

Part of Radioactive Contamination of the Marine Environment, Proceedings of Symposium held by the International Atomic Energy Agency, Seattle, WA, July 10-18, 1972 (101-155), 786 p.; 1973

RADIONUCLIDES; TRANSPORT; DEPLETION; RIVERS; SEDIMENTS; AQUATIC BIOTA; IRON; IRON 55; ZINC; ZINC 65; EUROPIUM; EUROPIUM 152; EUROPIUM 154; COBALT; COBALT 60; MANGANESE; MANGANESE 54; SCANDIUM; SCANDIUM 46; ANTIMONY; ANTIMONY 125; CERIUM; CERIUM 144; CESIUM; CESIUM 137; PLUTONIUM; PLUTONIUM 239; RADIOACTIVE DECAY; SALTWATER; SCOURING

GEOGRAPHICAL DESCRIPTION: U.S. (NW), Washington, Hanford, Columbia River

The radionuclide transport and depletion processes in the Columbia River are being characterized following the closure of the last of the Hanford plutonium production reactors in January, 1971. Radionuclide concentrations are periodically being measured in river water, sediments and biota between Hanford and Bonneville Dam to determine the rates and mechanisms of the processes which govern the distribution and behaviour of the radionuclides in the Columbia River system. All the short-lived radionuclides in the river have now decayed, but some residual long-lived radionuclides have remained, being associated mainly with sedimentary deposits in the reservoir behind McNary Dam. The most abundant radionuclides remaining in the river are Fe 55, Zn 65, Eu 155, Co, 60, Eu 152, Eu 154, Mn 54, and Sc 46. Also present in much lower concentrations are Sb 125, Cs 137, Ce 144, and Pu 239. These radionuclides are tightly bound to the sediments and enter the river mainly by resuspension, especially during the high river flow in the spring and early summer. The depth distributions of radionuclides in sediment cores collected at various locations in the reservoirs behind McNary, The Dalles, and Bonneville dams are being measured to estimate radionuclide inventories, sediment resuspension and transport, and sedimentation rates in the river system. Because present concentrations of radionuclides in the river water are low, large volume water sampling (up to 1000 litres) is required and is being done at the four dam sites downstream from Hanford to determine radionuclide concentrations, physicochemical forms and transport in the river. Over 98% of the Columbia River radionuclides of Hanford origin which enter the river from bottom sediments are in particulate forms. The main mechanism for removing radioactivity from the river system other than by radioactive decay, is by scouring of surface sediments during high river flow, and their subsequent transport into the Pacific Ocean. The dissolution of sediment attached Columbia River radionuclides upon their entry into the marine environment is being studied by leaching Columbia River sediments with seawater. Since the net sediment deposition rate in the reservoir behind McNary Dam has, in the past, been greater than the scouring rate, it appears that eventually the major radioactive sediment deposits in the McNary reservoir will become covered by new, uncontaminated silt deposits.

421
Lead Output in Streamflow from a Watershed Ecosystem

Rolfe, G.; Edgington, J.; Dep. For., Univ. Illinois, Urbana, IL

Water Resour. Bull. (WARBAQ) 9(2), 372-5; 1973

LEAD; WATERSHEDS; AQUATIC ECOSYSTEMS; STREAMS; TRANSPORT; MODELS; MATHEMATICAL SOLUTIONS; TETRAETHYL LEAD; AUTOMOBILE EMISSIONS; SEDIMENTS

Investigations of the movements and effects of lead in an 86 square mile watershed ecosystem are currently in progress by an interdisciplinary team of scientists at the University of Illinois at Champaign-Urbana. The objectives of this study are to understand and mathematically model the movements and effects of lead in an ecosystem. The primary lead input into the system (2,340Kg/30 d) is tetraethyl lead from automobile exhaust. The main output channel for lead in the system is streamflow, including sediment associated lead. Analyses of samples from four stream gaging stations over a six months periods showed that lead output in urban vs. rural areas: 1. varies considerably in the dissolved / sediment ratio from 29:1 to 2:1, rural, 5:1 to 2:1; and 2. output is equal to about 70% input, rural 2-3% input. Both of these differences can be attributed to the relatively impervious urban surface area.

422
Lead Uptake by Elected Tree Seedlings

Rolfe, G.L.; Dep. Forest., Univ. Illinois, Urbana, Ill.

J. Environ. Qual., 2(1), 153-157; 1973

TREES; LEAD; ABSORPTION; SOILS; PHOSPHORUS; UPTAKE; HEAVY METALS

Most of the numerous investigations concerning lead in the environment have dealt with the lead concentrations in various environmental components. These investigations have failed to describe the movement of lead in the environment and factors influencing this movement. Several sources including soil, water, and air give rise to lead in plants. Soil as a source of lead is the concern of this study. The experiment was a completely random design in a factorial arrangement with eight tree species, five soil lead levels (0 to 600 ppm), three soil types, and two phosphate levels (0 to 336 kg/ha) replicated three times. Results indicate statistically significant levels of lead in the leaves, stems, and roots of all eight tree species with all treatment combinations except the control. Uptake was significantly affected by soil lead concentration with higher uptakes associated with higher soil lead levels. Lead uptake by plants was reduced by approximately half when high levels of soil P was present. Other soil factors had no significant effects on lead uptake in the study.

423
Modeling Lead Pollution in a Watershed--Ecosystem

Rolfe, G.L.; Chaker, A.; Melin, J.; Ewing, B.B.

Journal of Environmental Systems, 2(4), 339-349; 1972, December

LEAD; TRANSPORT; ACCUMULATION; WATERSHEDS; AQUATIC ECOSYSTEMS; CROPS; PASTURES; FORESTS; CITIES; AUTOMOBILE EMISSIONS; AIR; WATER; SOILS; PLANTS; ANIMALS; SEASONAL VARIATIONS; SPATIAL LOCATION; TERRESTRIAL ECOSYSTEMS; MODEL ECOSYSTEM

An interdisciplinary study is in progress at the University of Illinois at Urbana-Champaign under a grant from the National Science Foundation RANN Program. Objectives of the study include understanding and modeling the movemennts and effects of heavy metals (initially lead) in the environment. A model has been constructed which simulates the movements and predicts the accumulation points of lead in a 76-square mile watershed-ecosystem in Champaign County, Illinois. The model includes components of both aquatic and terrestrial ecosystems and represents the ecosystem by a network of nodes and branches where the nodes represent the components of the ecosystem in a general sense and the branches indicate possible transport mechanisms between nodes. Results of a two year simulation using a network of 36 nodes and 121 branches is presented The model provides a method for the study of pollutant transport and accumulation in ecosystems.

424
Chemistry of Phenylmercury Compounds in the Aquatic Environment

Rolfe, M.L.; Zepp, R.G.; Gordon, J.A.; Baughman, G.L.

Chemosphere No. 6, 273-278; 1972

PHENYLMERCURY; KINETICS; CLEAVAGE; DIPHENYLMERCURY; DEMERCURATION; WATER; PHENYLMERCURIC SALTS; PH; TEMPERATURE; AQUATIC ENVIRONMENTS; MERCURY

The kinetics of acid cleavage of diphenylmercury and phenylmercuric salts, mercuric-salt cleavage of diphenylmercury, and demercuration of phenylmercuric salts have been examined in water. Acidolysis of diphenylmercury in aqueous solution at 25 degrees C has a half-life of eight days at pH 4, the lowest pH commonly found in natural waters. Cleavage of phenylmercuric salts by acid is at least two orders of magnitude slower. Reactions of diphenylmercury with mercuric salts are strongly pH-dependent and may be important in acid natural waters. Demercuration of phenylmercuric salts is extremely slow even at 120 degrees C and is unimportant in the environmental mercury cycle.

425
Radioactivity in Juvenile Columbia River Salmon. Model to Distinguish Differences in Movement and Feeding Habits

Romberg, G.P.; Renfro, W.C.; Dep. Oceanogr., Oregon State Univ., Corvallis, Oregon

Trans. Amer. Fish. Soc. (TAFSAI), 102(2), 317-22; 1973

SALMON; RIVERS; FALLOUT; RADIOACTIVITY; PHOSPHORUS 32; ZINC 65; FISH; PHOSPHORUS; ZINC; MODELS; FRESHWATER

GEOGRAPHICAL DESCRIPTION: U.S. (NW), Washington, Columbia River

The P-32 specific activities and Zn-65 concentrations were measured in juvenile salmon collected from the Columbia River during winter and spring of 1969. An environmental uptake study involving marked juvenile chinook salmon indicated that P-32 specific activity values reach a maximum sooner than values for Zn-65 concentration. The uptake study also suggested a short lag period before hatchery fish released to the Columbia River began rapid uptake of P-32 and Zn-65. A graphical model based on P-32 specific activities and Zn-65 concentrations was constructed which allows fish to be classified and differentiated with regard to their past feeding of movement behavior. Use of the model indicated that some hatchery fish released to the river either had feeding behavior unlike other hatchery fish or were not in the Columbia River the entire time from release until collection. Application of the model to a sample of 24 unmarked juvenile salmon collected from the Columbia River revealed several different groups of fish.

426
Focus on Marine Ecology

Romeril, M.G.; Mar. Biol. Lab., Cent. Electr. Generating Board, Pawley, England

Chem. Brit. (CHMBAY) 9(3) 103-5; 1973

CHLORINE; POWER PLANTS; EFFLUENTS; NUTRIENTS; METALS; SALTWATER; MARINE ECOLOGY; IRON; COPPER; ZINC; CLAMS; MOLLUSCS; COCKLES

427
Detection of Molybdenum Enrichment in the Environment Through Comparative Study of Stream Drainages, Central Colorado

Runnells, D.D.

Paper presented at the 7th Annual Conference on Trace Substances in Environmental Health at Columbia, Missouri; 1973, June 12-14

MOLYBDENUM; ENRICHMENT; STREAMS; FRESHWATER; PLANTS; SOILS

GEOGRAPHICAL DESCRIPTION: U.S., Colorado

A major molybdenum deposit is being mined at Climax, CO. Significant quantities of dissolved molybdenum are released into Ten-Mile Creek from the deposit, either naturally or through man's activities. Ten-Mile Creek drains into Dillon Reservoir. Water from this reservoir is used for irrigation and at certain times of the year as drinking water in Denver. The upper Blue River flows parallel to Ten-Mile Creek, but drains an area which is only poorly mineralized and is not mined. By comparison of the content of molybdenum in the natural materials from these two drainages, it is clear that the concentrations found in a highly mineralized, disturbed area are much higher than those in a poorly mineralized, undisturbed area. A third study site in the alpine environment in Colorado consists of a mineralized, undisturbed area at Mt. Aetna in the southern Sawatch Range. Samples from Mt. Aetna demonstrate that the concentrations of molybdenum in water and plants in the alpine environment can be quite low, even when the soils contain high concentrations of the metal.

428
Geochemistry of Molybdenum

Runnells, D.D.; LeGendre, G.; Lindberg, R.; Brown, D.; Smith, E.; Harthill, M.; Katz, B.

Part of Transport and the Biological Effects of Molybdenum in the Environment, Progress Report, January 1, 1973 (p. 33-63) 375 p.; 1973, January 1

MOLYBDENUM; MINES; MOLYBDENUM MINES; URANIUM MINES; DRINKING WATER; INDUSTRIAL EFFLUENTS; SOILS; PLANTS; INDICATOR PLANTS; WILLOW; TREES; GEOCHEMISTRY; FILTRATION; DISSOLVED SOLIDS; PARTICULATES; ADSORPTION; WELLS; GROUND WATER; MOLYBDENOSIS; SYMPTOMS; DIARRHEA; HAIR LOSS; ALFALFA; SEDIMENTS; WASTE WATER; MOLYBDENUM REMOVAL; TOTAL; LEACHING; GLACIATION; UPTAKE; IRRIGATION; AVAILABILITY

Molybdenum concentration was determined in the streams and soils of Central Colorado near molybdenum mines, uranium mills, and control areas. Values sufficient to cause molybdenosis in cattle in certain areas were found. Alfalfa upon which cattle graze takes up molybdenum deposited from irrigation water. A considerable difference between available and total molybdenum in soils was common. In some areas the molybdenum may have been dispersed from ore deposits by glaciation. In water the molybdenum occurred almost entirely as dissolved solids. Molybdenum (up to 98 percent) was removed from water by adding ferric chloride in solution (up to 10%).

429
Response of Fresh-Water Protozoan Artificial Communities to Metals, When an Artificial Fresh-Water Protozoan Community was subjected to diffent Concentrations of Zinc, Copper, Chromium, Phenol, Lead

Ruthven, J.A.; Cairns, J.J., Jr.; Biol. Dep., Virginia Polytech. Inst., Blacksburg, VA

J. Protozool, (JPROAR), 20(1), 127-35; 1973

MANGANESE; COBALT; NITRIC ACID; PROTOZOA; ALUMINUM; ACETIC ACID; COPPER; ZINC; PHENOL; LEAD; FRESHWATER; MANGANESE; COBALT; NITRIC ACID; ACETIC ACID; ALUMINUM; TIN; HYDROCHLORIC ACID

TAXONOMY: PERANEMA TRICHOPHORUNC; ENGLENA GRACILIS

For 3 hr in a test system through which pond water flowed continuously, the percent survival of colonizing species fluctuated with the concentration of each toxicant. Protozoa appeared more resistant to PHOH, K2Cr2O7 and Cu than daphnia; however, some protozoa were more sensitive than daphnia to Zn, HNO3, and HCl. The median tolerance limit values for protozoa exposed to Cu and Zn for 24 hr were: 1.6 and 7.0 mg/l., respectively. Of the substances tested, Cu and Mn were the most toxic; PERANEMA TRICHOPHORUM and EUGLENA GRACILIS were generally the most resistant species.

430
A Revaluation of the Marine Geochemistry of Uranium

Sackett, W.M.; Ho, T.; Spalding, R.F.; Exner, M.E.

Part of Radioactive Contamination of the Marine Environment Proceedings of Symposium held by the International Atomic Energy Agency, Seattle, WA, July 10-14, 1972 (757-769) 786p.; 1973

SALTWATER; GEOCHEMISTRY; URANIUM; SEDIMENTS; SINKS; CARBONATES; HUMANS; PHOSPHATE; FERTILIZERS; SOILS; SILICEOUS OOZES

Approximately 10 exponent 15 ug/yr of dissolved uranium are being removed from the ocean by each of the generally accepted significant sinks for uranium-carbonate deposits and deep anoxic basin sediments. However, these sinks account for only 10% of the estimated present-day input of uranium. Possible explanations for this discrepancy are: (1) contemporary input values are too high owing to a significant contribution from man's effects, such as uranium input via phosphate fertilizers or world-wide cultivation leading to premature leaching of uranium from soils, or (2) there are other important uranium sinks such as the abundant siliceous oozes or continental shelf anoxic sediments.

431
Behavior of Trace Elements in Seawater and Marine Organisms

Saiki, M.

Proc. Jap. Conf. Radioisotop. No. 10, 298-301; 1972, April

ALGAE; AQUATIC ECOSYSTEMS; CERIUM 144; CESIUM 137; FALLOUT; FISH; MICROANALYSIS; NIOBIUM 95; QUANTITATIVE CHEMICAL ANALYSIS; RADIONUCLIDES; KINETICS; RADIONUCLIDE MIGRATION; RUTHENIUM 106; SEDIMENTS; STRONTIUM 90; TRACE ELEMENTS; TRACERS; ZIRCONIUM 95; RADIOECOLOGY; SALTWATER

432
Transport of Radionuclides in Lake and River Systems Flowing Through Areas Characterized by Precambrian Bedrock and Peat-Bogs

Salo, A.; Voipio, A.

Part of Radioactive Contamination of the Marine Environment, Proceedings of Symposium held by the International Atomic Energy Agency, Seattle, WA, July 10-14, 1972 (195-217) 786 p.; 1973

TRANSPORT; RADIONUCLIDES; LAKES; RIVERS; BEDROCK; PEAT BOGS; CONDUCTIVITY; PH; TURBIDITY; BICARBONATE; STRONTIUM; STRONTIUM 90; CESIUM; CESIUM 137; PHOSPHORUS; NITRATES; AMMONIUM; NITROGEN; SILICATES; SULFATES; CHLORIDE; IRON; ALUMINUM; MANGANESE; COPPER; ZINC; SODIUM; POTASSIUM; MAGNESIUM; CALCIUM; LAKES; RIVERS; SOILS; IONS; ELECTROLITES

GEOGRAPHICAL DESCRIPTION; Baltic Bay, Bonthnian Bay

Strontium-90 and caesium-137 were determined together with the discharge meter cubed/s and the following stable chemical components: conductivity, pH, colour, turbidity, HCO3, PO4-P, total-P, NO3-N, NH3-N, total-N, SiO3-Si, SO4-S, chloride, iron, aluminium, manganese, copper, zinc, sodium, potassium, magnesium and calcium in two lake and river systems discharging into the Bothnian Bay (Baltic Sea) in 1965-70. The water samples were taken monthly at one sampling station in the smaller (1330 km2) and at five stations in the larger (14315 km2) lake and river system. Deposition was collected at three stations. The ratio was calculated of the deposited amounts to the amounts that are transported concerning the above mentioned radionuclides and some stable components in both the catchment areas and the sub-regions of the lake and river systems. A factor analysis was used in an attempt to find the main factors affecting the behaviour of the different chemical components, especially that of the radionuclides strontium-90 and caesium-137. When interpreting the results of the factor analysis, the chemical factors, the quality of the ground, hydrological features and other possible environmental factors were taken into consideration. The regional differences are discussed. Special attention was paid to the annual changes in the factors affecting the behaviour of strontium-90 and caesium-137. The most obvious factors determining the systems are: (i) That determining the behaviour of the main electrolytes (Mg2+, Na+, K+, Ca2+, SiO3-Si, HCO3, Cl-). All these components have good correlations to the discharge (contact time with the ground?); (ii) The factor common to those variables which show annual variations in their deposition in the catchment areas, e.g. strontium-90; and (iii) A group of factors reflecting the quality of the soil, eventually characterized by the organic (younger) and inorganic (older) constituents of the soil.

433
Sorption of Copper on Lake Monona Sediments. Effect of NTA (Nitrilotriacetic Acid) on Copper Release From Sediments

Sanchez, I.; Lee, G.F.; Water Chem. Program, Univ. Wisconsin, Madison, Wis.

Water Res. (WATRAG), 7(4), 587-93; 1973

COPPER; SORPTION; SEDIMENT; NITRILOTRIACETIC ACID; NTA; LAKES; SULFIDES; ORGANIC COMPOUNDS

The results of this investigation on the factors controlling the binding capacity of copper by Lake Monona sediments have shown that this capacity is primarily related to the alkalinity (Ca, Mg carbonates present in the sediments). Apparently organics and sulfides play a minor role in binding copper to sediments; in the case of sulfides, most probably for reasons of low content rather than for reasons of solubility of cupric sulfides. Over very dilute copper solutions, sulfide in the sediment should control the binding mechanism. The sediments investigated show a relatively large binding capacity amounting to approximately 26 mg of copper being fixed per gram of dry sediments. The addition of large amounts of NTA to Lake Monona sediments resulted in an increase in the amounts of iron and manganese leached from the sediments. However, the copper released from the sediments decreased with increasing NTA. Extrapolation of the results obtained from Lake Monona sediments to other lakes should be done with caution. Lake Monona is a highly calcareous lake with large amounts of calcium carbonate present in the sediments. Studies would have to be conducted on non-calcareous lakes to determine whether or not similar behavior would be found with respect to the binding of copper to the sediments and the effects of NTA on copper release.

434
Uptake of Selenium by Aquatic Organisms

Sandholm, M.; Oksanen, H.E.; Pesonen, L.; Dep. Med., Coll. Vet. Med., Helsinki, Finland

Limnol. Oceanogr. (LIOCAH), 18(2), 496-9; 1973

SELENIUM; UPTAKE; PLANKTON; FISH; ALGAE; DAPHNIA; BIOCONCENTRATION

TAXONOMY; SCENEDESMUS DIMORPHUS; DAPHNIA PULEX

The Se content of aquatic organisms was lowest in aquatic plants, varying from 0.02 to 0.14 ppm (dry wt). Plankton samples contained from 1.1 to 2.4 ppm, fishes cultured in ponds 0.5 to 0.9 ppm, and fishes from natural environments 1.0 to 2.9 ppm. The phytoplankter, SCENEDESMUS DIMORPHUS, actively concentrated Se-73-selenomethionine, but neither actively nor passively concentrated inorganic selenite. The zooplankton, consisting mostly of DAPHNIA PULEX, absorbed Se-75 from selenite. In aquariums fish concentrated only a small amount of organic or inorganic Se directly from water, but did concentrate Se from food.

435
Adverse Effects of Cadmium on Brook Trout Testis and on In Vitro Testicular Androgen Synthesis

Sangalan, G.B.; Challora, M.J.; Fisheries Res. Board Canada, Halifax Lab, Halifax, Nova Scotia, Canada

Biol Reprod 9(4), 394-03; 1973

TROUT; CADMIUM; TESTIS; ANDROGEN; BIOSYNTHESIS; TOXICITY; HORMONES; FRESHWATER

436
Aquation of Transition Metal Acetates in Acetic Acid

Sawada, K.; Tanaka, M.; Fac. Sci., Nagoya Univ., Nagoya, Japan

J. Inorg. Nucl. Chem. (JINCAO), 35(7), 2455-64; 1973

TRANSITION; METAL ACETATES; AQUATION; MANGANESE; HYDRATION; COBALT; NICKEL; ZINC; COPPER; CRYSOSCOPY

Solubilities of manganese(II), cobalt(II), nickel(II), and zinc(II) acetates in acetic acid were measured at 25 C to investigate the aquation of these metal acetates. The equilibrium of copper (II) acetate is substituted by a water molecule in acetic acid: $Cu_2(OAc)_4(HOAc)_2+H_2O-Cu_2(OAc)_4(H_2O)(HOAc)+HOAc$. The constant for this equilibrium was estimated to be 0.6 plus or minus 0.3.

437
Natural 210Pb and 210Po in a Marine Environment

Schell, W.R.; Jokela, T.; Eagle, R.

Part of Radioactive Contamination of the Marine Environment, Proceedings of Symposium held by the International Atomic Energy Agency, Seattle, WA, July 10-18, 1972 (701-722) 786 p.; 1973

LEAD; LEAD 210; POLONIUM; POLONIUM 210; SEDIMENTS; SALTWATER; FALLOUT; EROSION; CRUSTACEA; SABLEFISH; MARINE ORGANISMS; TRACERS

TAXONOMY: ANOPLOPOMA FIMBRIA

A regional sampling program has been initiated to determine the existing levels of Pb 210 and Po 210 in sediment, organisms and water from different depths in a salt-water sound and a fresh-water lake. The collections have been made with plankton nets, midwater trawls, sediment corers, and a large volume water sampler consisting of 0.3 micron Millipore filters and Al2O3 sorption beds (200 to 2000 litres). The efficiency of collecting lead from fresh and salt water by the Al2O3 beds has been determined. The sample analysis was made using Po 208 tracer for yield determination and low background alpha spectroscopy which separates the energies of Po 208 from Po 210; the ingrowth and decay of Po 210 were used to determine Pb 210. Computer programs have been completed for data analysis, sorting, and retrieval. One interpretation of the early results of sample analysis from the fresh-water and salt-water environments is that the processes of erosion and leaching can contribute significantly to the concentration of Pb 210 and Po 210 in the aquatic environment. Regional differences are found which depend on the geological strata. Both the erosion process and the atmospheric fallout process must be considered as sources of these radionuclides in the aquatic environment. An unusually large concentration of Po 210 has been found in the liver of a sablefish, ANOPLOPOMA FIMBRIA; the zooplankton in the same region also had a high Po 210 concentration. The nektonic crustacea have the highest Po 210/Pb 210 ratio of the organisms collected at about 100. A program has been initiated for measuring naturally occurring radionuclide in the aquatic environment of the Puget Sound basin. Studies of the pathway of Po 210 and Pb 210 through the food chain illustrate the distribution of these radionuclides. The source of Pb 210 and Po 210 is from precipitation, erosion, and leaching; the distribution and concentration are shown in the analysis of the biota. It is apparent that the Po 210 is not supported during growth of organisms since the ratio of Po 210/Po 210 is greater than unity. The crustacea are found to have the largest ratio of Po 210/Pb 210, about 100. The high Po 210 concentration was observed in larger fishes whose food is these crustaceans. Part of this Po 210 could be assimilated directly from the water. Specific activity value for Pb210/microgram Pb, below those which are normally present, may be an indication of pollution in certain regions. The study is still in the early stages of development. A more complete data evaluation must await the results of samples collected and analyzed over a longer time period.

438
Fallout Mn 54 Accumulated by Bay Scallops ARGOPECTEN IRRADIANS (Lamarck) Near Beaufort, North Carolina

Schelske, C.L.

Part of Radioactive Contamination of the Marine Environment, Proceedings of Symposium held by the International Atomic Energy Agency, Seattle, WA, July 10-14, 1972 (331-345) 786 p.; 1973

MANGANESE; MANGANESE 54; BIOACCUMULATION; SCALLOPS; RADIOACTIVITY; MOLLUSCS; ESTUARIES; GILLS; MUSCLES; MANTLE; GONAD; VISCERA; SEAFOOD; HUMAN HEALTH

TAXONOMY: ARGOPECTEN IRRADIANS

GEOGRAPHICAL DESCRIPTION: U.S. (SE), North Carolina, Lamark

Bay scallops were collected in estuarine waters near Beaufort, North Carolina, during the period of January 1963 to June 1966 and analysed for gamma radioactivity originating from fallout. Most of the gamma radioactivity was Mn 54, with scallops containing 30 times more Mn 54 than other lamellibranch molluscs collected at the same time. Concentrations of Mn 54 were largest in December 1963 and October 1964 and declined after October 1964, with a half-life of approximately 240 d. Concentrations of Mn 54 in the 74 samples collected were a function of collection sites in the estuary, size of the scallops, and tissue type. Amounts of Mn 54 were determined in seven different tissues. Kidneys contained the greatest concentrations, about 100 times more than adductor muscle, gills, mantle, gonad, visceral mass, and liquid. Maximum concentrations in kidneys were 100 pCi/g wet weight. Kidneys are a small fraction of the total weight, so concentrations in the combined soft parts are about a factor of 100 lower than the kidney. Stable element content of scallop tissues was determined also, and kidneys again contained at least 100 times more stable manganese than any of the other tissues. Variations in specific activities (pCi Mn 54/microg Mn) among the different tissues were greater than could be explained by physical decay and possible turnover rates in the organism. Mechanisms of Mn 54 and stable manganese accumulation are postulated from data on specific activity of different tissues, mode of scallop feeding, and results of laboratory experiments in which scallops were fed phytoplankton labelled with Mn 54. These data are important because kidneys of bay scallops concentrate Mn 54 more than any other biological system known. Public health implications are minimized because only the adductor muscle is sold as seafood.

439
Ecological Implications of Fallout Radioactivity Accumulated by Estuarine Fishes and Mollusks

Schelske, C.L.; Great Lakes Research Div. Michigan Univ., Ann Arbor, MI; Center for Estuarine and Menhaden Research, National Marine Fisheries Service, Beaufort, NC

Contribution No. 000, Great Lakes Research Division, University of Michigan, Ann Arbor, MI. Atomic Energy Commission (COO-2003-9)

CERIUM 144; CESIUM 137; ESTUARIES; FALLOUT; FISH; MANGANESE 54; MOLLUSCS; MONITORING; RADIOECOLOGY; RUTHENIUM 106; TIME DEPENDENCE; ZINC 65; CERIUM; CESIUM; MANGANESE; ZINC; RADIOISOTOPES; CLAMS; OYSTERS; MUSSELS; SCALLOPS

TAXONOMY: MERCENARIA MERCENARIA; MODIOLUS DEMISSUS; CRASSOSTREA VIRGINICA; ARGOPECTEN IRRADIANS

Fallout radioactivity accumulated by estuarine organisms near Beaufort, North Carolina, was measured from October 1963 to October 1966. Sixteen species of fish were analyzed for fallout radioactivity. These fish were separated into four groups based on the predominant radioisotopes accumulated in the environment. One group contained cesium-137, another group manganese-54, another group cesium-137 and manganese-54, and a fourth group contained little or no measurable quantity of either radioisotope. Nektonic feeders comprised the group that contained cesium-137 and benthic feeders contained manganese-54. The results of these measurements suggest that the radioactivity accumulated by mollusks and fish reflects different ecological niches. Seven radionuclides were identified in the soft parts of hard clams, MERCENARIA MERCENARIA; marsh mussels, MODIOLUS DEMISSUS; American oyster, CRASSOSTREA VIRGINICA; and bay scallops, ARGOPECTEN IRRADIANS. Clams, mussels and oysters accumulated relatively large amounts of Ce-144 and Ru-106. The radioisotope present in greatest concentrations in oysters was zinc-65 and in bay scallops was manganese-54. Laboratory experiments on the accumulation of zinc-65 and manganese-54 confirmed these results.

440
Relation of Trace Metals to Human Health

Schroeder, H.A.; Darrow, D.K.

Environmental Affairs, 2(1), 222-236; 1972, Spring

TRACE ELEMENTS; HUMANS; HEALTH; INDUSTRY; ANIMALS; SALTWATER; LEAD; CADMIUM; TOXICITY; NICKEL; HYPERTENSION; EMPHYSEMA; CARCINOGENESIS; ANTIMONY; BERYLLIUM; BERYLLOSIS; MERCURY; METHYLMERCURY

The effects of various trace elements on human health have been reviewed in the light of annual industrial consumptions, natural abundances (on the earth's crust, in sea water, and in the contents of Reference Man) and changes in experimental animals fed low doses for life. Fourteen metals and two non-metals are essential for life or health of mammals. All but two are mined in large amounts, are abundant on the earth's crust, and are found in human tissues in sizeable quantities. Most of these metals are non-toxic to mammals in ordinary concentrations. Five metals occur in low abundances, are consumed industrially in sizeable amounts, occur in the body of man, and are toxic of themselves. Of these, lead and cadmium are prevalent in man. Nine metals have low orders of toxicity and occur at low crustal abundances. Eight have little or no toxicity, of which six are abundant. Metals in the environment of potential hazard to man are lead, by far the largest pollutant, cadmium, which may influence hypertension and emphysema, nickel as the carbonyl which is carcinogenic, antimony which is toxic, beryllium which can cause beryllosis, and methyl mercury which is highly toxic. At present levels of exposure, lead, cadmium, and possibly nickel are potentially hazardous to health. Only under special circumstances and in special compounds are a few other elements hazardous.

441
Trace Metals in Carbonate and Organic Rich Sediments

Segar, D.A.; Pellenbarg, R.E.; Rosenstiel Sch. Mar. Atmos. Sci., Univ. Miami, Miami, FL

Mar. Pollut. Bull. (MPNBAZ), 4(9), 138-142; 1973

TRACE METALS; WATER; SEDIMENTS; ORGANIC COMPOUNDS; CARBONATES

442
Mercury in Seals From Eastern Canada

Sergeant, D.E.; Armstrong, F.A.; Freshwater Inst., Fish. Res. Board Canada, Winnipeg, Manitoba

J. Fish. Res. Board Can. (JFRBAK), 30(6), 883-6; 1973

SEALS; MERCURY; DIET; SALTWATER; FOOD CHAINS

TAXONOMY: HALICHOERUS GRYPUS; PHOCA VITULINA; PHAGOPHILUS GROENLANDICUS; CYSTOPHORA CRISTATA

Mercury concentrations in seals of 4 species from eastern Canada were greatest in the liver (less than 387 ppb, usually 1-100 ppm), and lowest in blubber (0.1 ppm), with muscle levels of less than 0.16-2.35 ppm. The liver Hg/muscle-Hg ratios for the adults were greater than those for 2 freshwater fish species and 3 species of domestic animals exposed to Hg in their diet. Hg in the seals increased with age and varied with the position in the marine food web of the organisms they ate, and were higher for the grey (HALICHOERUS GRYPUS), Harbon (PHOCA VITULINA), and Hood (CYSTOPHORA CRISTATA) seals which ate large pelagic and benthic fish and cephalopods, than for Harp seals (PAGOPHILUS GROENLANDICUS) which ate small pelagic fish and crustaceans.

443
Transport of Lead in the Environment

Servant, J.; Lab. Phys. Aerosole Echanges Atmos., Univ. Paul Sabatier, Toulouse, Fr.

Part of Proceedings of International Symposium on Environmental Health Aspects of Lead, Amsterdam, Netherlands, October 2-6, 1972. Organized jointly by Commission of the European Communities, Directorate General Social Affairs-Health Protection Directorate and Environmental Protection Agency, EUR 5004 d-e-f. Luxemburg: Commission of the European Communities, Directorate General for Dissemination of Knowledge, Centre for Information and Documentation (26YVAJ), 155-64; 1973

LEAD; TRANSPORT; RAINWATER; LAKES; WATER; SOILS

444
Decline of Zn 65 in Marine Mussels Following the Shutdown of Hanford Reactors

Seymour, A.H.; Nelson, V.A.

Part of Radioactive Contamination of the Marine Environment, Proceedings of Symposium held by the International Atomic Energy Agency, Seattle, WA, July 10-14, 1972, (277-285), 786 p.; 1973

ZINC; ZINC 65; MARINE ORGANISMS; SALTWATER; PLUTONIUM; POWER REACTORS; ECOLOGICAL HALF-LIFE; MUSSELS; RADIONUCLIDES

TAXONOMY: MYTILUS EDULIS; MYTILUS CALIFORNIUS

GEOGRAPHICAL DESCRIPTION: U.S. (NW), Washington, Hanford, Columbia River, Pacific Ocean

The shutdown of the last of the eight original plutonium production reactors at the Hanford Atomic Plant in February 1971, eliminated the source of practically all the radionuclides in the Columbia River and in the plume of Columbia River water in the Pacific Ocean. Zinc-65, perhaps the most biologically important of the Hanford-produced radionuclides in the marine environment, continues to be present in both the biota and the water fifteen months after shutdown. The amounts of Zn 65 in mussels at the mouth of the Columbia River and along the Washington coast have been monitored since 1961, and data from these observations have been used as reference values to measure the loss of Zn 65 related to the shutdown of the reactors. The amount of Zn 65 in the soft tissues of MYTILUS EDULIS from the North Jetty at the mouth of the Columbia River declined from 40 pCi/g of dry tissue in February 1971, to 6 pCi/g, dry, in May 1972. The effective half-life for Zn 65 was calculated to be 130 d and the loss of Zn 65 by processes other than physical decay, in terms of half-life, was calculated to be 277 d. The latter value is called ecological half-life rather than biological half-life, since there is some uptake of recycled Zn 65 but at a rate less than the rate of loss of Zn 65 by biological processes. At North Head, 5 km north of the Columbia River, the amount of Zn 65 and Zn in M. CALIFORNIANUS and the rate of decline was less than comparable values for North Jetty mussels, although the specific activity values, micro Ci Zn 65/g Zn, for mussels from both locations, collected on the same day, were similar. The Zn 65 effective half-life value for North Head mussels was 149 d. The amount of Zn 65 in mussels from seven locations on the Washington Coast and in the Strait of Juan de Fuca, to a distance of 340 km from the Columbia River, declined in a regular manner in respect both to distance from the Columbia River and to time after reactor shutdown.

445
Polonium-210 and Lead-210 in the Hydrosphere

Shannon, L.V.; Cherry, R.D.; Div. Sea Fish., Sea Point, South Africa

Proc. Symp. Hydrogeochem.istry Biogeochem 1, 284-92; 1973

FOOD CHAINS; POLONIUM 210; HYDROSPHERE; LEAD; FISH; ISOTOPES; POLONIUM; BIOACCUMULATION; SALTWATER; LEAD 210; PHYTOPLANKTON; ZOOPLANKTON

Determinations gave average concentrations of Pb 210 and Po 210, respectively. Sea water(29) 0.038, 0.020 pCi/l: phytoplankton(4) 27, 76pCi/kg; zooplankton(13) 31, 380 pCi/kg; pelagic fish(6) 8, 1260 pCi/kg. The increase in Po 210 up the food chain is notable. Po 210 was found to be preferentially concentrated in fish liver(up to 1278 pCi/kg).

446
Stabilities of Some Heterocyclic Amine Complexes. II

Sharma, R.C.; Bhattacharya, P.K.; Fac. Sci., Maharaja Sayajirao Univ. Baroda, Baroda, India

J. Indian Chem. Soc. (JICSAH), 50(3), 232-3; 1973

NICKEL; METHYLPYRIDINE; COMPLEX; AQUEOUS SOLUTIONS; STABILITY; COLLIDINE; LUTIDIEN; PYRIDINE

In the present work the reactions between Ni(II) and di- and tri-methyl pyridines (2:4-lutidine, 2:6-lutidine and 2:4:6 -collidine) have been sutdied in aqueous solution. The experimental data reveals that the stabilities of the complexes are in the order of <4:6-lutidine couples less than 2:6-lutidine complex less than 2:4:6 -colludine complex which is in accordance with the basicities of the ligands (2:4-lutidine less than 2:6-lutidine less than <:4:6-collidine). Exact linear relationship, however, does not hold good. The extend of M-L phi interaction, differs depending on the number and position of the -CH3 group introduced in the ring. Litidine complexes are more stable than pyridine and picoline complexes as expected from higher basicities of the lutidines. With the increase in temperature the basicities of the ligands go down and there is corresponding decrease in the formation constants.

447
Uptake of Mercury by Chlorella and its Effect on Potassium Regulation

Shieh, Y.J.; Barber

Planta (BERL) 109(1) 49-60; 1973

MEMBRANE PERMEABILITY; POTASSIUM; MERCURY; UPTAKE; REGULATION; CCCP; DCCD; CYSTEINE

TAXONOMY: CHLORELLA PYRENOIDOSA

Addition of mercuric chloride at concentrations which resulted in an overall binding level of about 8 nmoles Hg/l packed cells and above caused a breakdown in the permeability of the cell membrane as indicated by a net efflux of internal K(+). Below this level in region of 2 nmoles Hg/lpacked cells the rate of K(+) transfer across the cell surface was stimulated without affecting the internal K(+) level. Maintainence of the stimulation was dependent both on time and dose. Enhancement of the rate of K(+) turnover was associated with a fast component of the inorganic mercury uptake which could be removed by washing with cysteine. The mercury stimulated K(+)/K(+) exchange was inhibited by low temperature, by the uncoupler CCCP and the energy transfer inhibitor DCCD. Overall binding concentrations of inorganic mercury below 0.5 nmoles/l packed cells had no effect on the K(+) transport system. In contrast to mercuric chloride, methyl mercuric chloride over similar concentration ranges did not seem to induce a breakdown in the permeability barrier or directly interact with the K(+)/K(+) exchange but more likely influenced the latter by inhibiting intracellular processes.

448
Icelandic Geothermal Activity and the Mercury of the Greenland Icecap

Siegel, B.Z.; Siegel, S.M.; Thorarisson, P.

Nature Vol. 241, p. 526; 1973, February 23

GEOTHERMAL ACTIVITY; ICECAPS; MERCURY; VOLCANOS; SEDIMENTS

In response to the controversey over mercury found in Greenland ice cores, information about natural sources and modes of dissemination of the element is needed. Atmospheric mercury can be introduced by degassing of fluid magmas, and release from fine ash, and long range transport of volcanic ejecta eastward from Iceland is well established. The presence of substantial mercury levels in deep North Atlantic sediments located S, SW, and W of Iceland may also reflect long term transport and fallout of Icelandic mercury in nearby waters. Whatever may be the significance of time -variable mercury levels, they cannot be viewed as evidence for human input when it is recalled that from the mid-17th century to the present, Iceland has recorded nearly 50 volcanic eruptions.

449
Metals as Pollutants in Air and Water, An Annotated Bibliography

Sinha, E.

Ocean Engineering Information Series Vol. 6; 1972

METALS; ATMOSPHERE; WATER; BIBLIOGRAPHY

450
Lead Accumulation within Nuclei of Moss Leaf Cells

Skaar, H.; Ophus, E.; Gullvag, B.M.; Department of Physics, Department of Botany, The University (NEHT), 7000 Trondheim

Nature 241,215-216; 1973

MOSSES; NUCLEUS; CELLS; BIOACCUMULATION; ELECTRON MICROSCOPY; CYTOPLASM

TAXONOMY: RYTIDIADELPHUS SQUARROSUS

It was postulated that as lead is used as a stain in routine electron microscopy the presence within cells of lead derived from pollution might by revealed directly from transmission electron micrographs, provided that the local concentration of the metal in the cell was high enough and that no heavy metal stains were used during initial preparation. As bryophytes are known to accumulate heavy metals in concentrations which are toxic for other groups of plants, mosses were chosen as the experimental material. Specimens of RYTIDIADELPHUS SQUARROSUS were cultivated in a greenhouse and watered once a day for three weeks with a series of lead acetate solutions. A comparison of electron micrographs from unstained polluted material with micrographs from leaf samples from control plants revealed electron-dense inclusions in the cells from the lead-treated samples while no such inclusions were found within the cells of control plants. Samples of R. squarrosus growing 250 m from a busy city road revealed electron dense particles within cell nuclei. X-ray analysis of the electron-dense inclusions confirmed that the particles contained lead. Other reas in teh cytoplasm which showed electron-dense precitates were also examined but except for one case, no lead could be demonstrated.

451
Effect of Molybdenum Phosphate Glasses Containing Trace Elements on the Productivity of SCENEDESMUS ACUTUS

Skarenkova, K.; Gabrovski, K.; Inst. Genet. Plant Breed., Sofia, Bulgaria

Dokl. Sel'Skokhoz. Akad., Sofia (DSKAA7), 6(1), 33-8; 1973

MOLYBDENUM; MOLYBDENUM PHOSPHATE; IRON; COBALT; COPPER; MANGANESE; ALGAE; BIOMASS; GROWTH; PH; TRACE ELEMENTS; NUTRITION

TAXONOMY: SCENEDESMUS ACUTUS

Growth promoting effects of 5 different 3-component Mo phosphate glasses on S. ACUTUS were studied. The Mn-containing (10% Mn(2) O(3)) glass at a concentration of 25-150 mg/l of medium enhanced the growth and at higher levels inhibited the growth. Maximum increase of 150% in biomass was obtained on the 5th day at 100 mg/l level. In the case of Co-containing (10% CoO) glass, up to 60 mg/l, algae yield increased, with maximum yield at 15 mg/l. The Cu-containing (10% CuO) glass enhanced growth by 120-180% at levels of 5-10 mg/l. The Zn-containing glass at a concentration of 10-20 mg/l increased growth by 120-130%. A concentration of 30 mg/l of Cu was toxic. Growth was increased by 115-118% by Fe-containing glass (30% Fe(2)O(3)) at a concentration of 5-20 mg/l. In all the tests, no significant pH change of the medium was noticed.

452
Particulate Metals in Waters of Sorfjord West Norway

Skei, J.M.; Price, N.B.; Calvert, S.E.

Ambio, 2(4), 122-124; 1973

LEAD; BIOACCUMULATION; SALTWATER; LEAVES; PLANTS; ELECTRON MICROSCOPY; MOSSES

TAXONOMY: RYTIDIADELPHUS SQUARROSUS

The purpose of the present investigation was to determine the levels of suspended particulate copper (Cu), zinc (Zn) and lead (Pb) in the waters of Sorfjord, West Norway, and to use this information to trace the dispersal pattern of metal-containing industrial waste which is discharged into the fjord at its southern extremity near the town of Odda. The investigation has shown that concentrations of these metals in fjord, esoecially Zn and Pb, are up to two or three times higher than in natural sea water. Metals have been detected in both surface and subsurface waters 40 km away from the area of metal discharge. Considering the hydrography and the relationship of Zn and Pb in different waters, it seems possible to draw the conclusion that two distinct bodies of contaminated water outflow from the fjord. However, during periods of high river runoff, the dispersal of metals in subsurface waters will be different, and at such times we predict that pollution of the inner fjord will be greatest.

453
Comparison of the Lethality of Various Combinations of Heavy Metals and Water Temperature to Juvenile Rainbow Trout

Slatkin, D.; Jones, K.; Geisler, P.; Wolf, A.; Fowler, J.; Kraner, H.; Cronkite, E.; Battelle Pacific Northwest Labs., Richland, WA

Battelle Pacific Northwest Labs., Richland, WA; BNWL-SA-4704; CONF-730505-6; Part of Thermal Ecology Symposium. Aiken, SC. 3 May 1973; 1973

TOXICITY; CHEMICAL POLLUTION; TEMPERATURE; FISH; SYNERGISM; ANTAGONISM; ADDITIVITY; THERMAL POLLUTION; NUCLEAR POWER PLANTS; AQUATIC ORGANISMS; METABOLIC RATE; BIOASSAY; PROPORTIONAL DILUTER; RAINBOW TROUT; CRAYFISH; DAPHNIA; GROWTH; REPRODUCTION; LETHALITY; MERCURY; CHLORINE; FRESHWATER

In the light of the combination of chemical and thermal water pollution potential of nuclear power plants, this study was undertaken to define the toxicity of heavy metals at various temperatures in rainbow trout. Using a 96h TL50 standard continuous flow bioassay, a two- or three-fold difference in resistance to the toxicant was seen depending on the ambient temperature at which the fish had been maintained.

454

Turnover and Vertical Transport of Zinc by the Euphausid MEGANYCTIPHANES NORVEGICA in the Ligurian Sea

Small, L.F.; Fowler, S.W.; Internat. Lab. Mar. Radioactivity, Internat. Atomic Energy Agency, Monaco

Marine Biol. 18(4), 288-290; 1973

TURNOVER; VERTICAL TRANSPORT; TRANSPORT; EUPHAUSID; PARTICIPATORY TURNOVER; SALTWATER; ZINC

TAXONOMY: MEGANYCTIPHANES NORVEGICA

455

Flux of Zinc Through a Macroplanktonic Crustacean

Small, L.F.; Fowler, S.W.; Keckes, S.

Part of Radioactive Contamination of the Marine Environment, Proceedings of Symposium held by the International Atomic Energy Agency, Seattle, WA, July 10-14, 1972 (437-452) 786 p.; 1973

FLUX; ZINC; PLANKTON; MACROPLANKTON; CRUSTACEA; MODELING; SALTWATER; LINEAR SYSTEMS; INGESTION

TAXONOMY: MEGANYCTIPHANES NORVEGICA

A simple, linear model has been employed for an heuristic examination of the flux of zinc through the euphausiid MEGANYCTIPHANES NORVEGICA in the Mediterranean Sea. The model is generated from the basic equation ke = Mu e + Lambda e, where ke is the rate of ingestion of particulate zinc by the euphausiid, Mu e is retention of the element in newly elaborated body tissue, and Lambda e is the rate of elimination of the element. For a first approximation, the ke term is assumed to apply only to ingestion of particulate zinc, though the model can also be made to incorporate direct uptake of zinc from solution. The ke term breaks down into ke = (QiPi), where Qi = zinc concentration in ingested food and Pi = ingestion rate. The Mu e term is equivalent to (QgPg), where Qg = zinc concentration in new tissue added in growth, and Pg = growth-rate. The Lambdae term, which really sets the flux of zinc through M. NORVEGICA, can be fractionated at Lambda e = (QfPf) + (QmPm) + (QcPc) + (QxPx) + Pe, where Qf, Qm, Qc, and Qx are zinc concentrations in faeces, moults, dead carcasses, and non-viable eggs, respectively, and Pf, Pm, Pc, and Px are the respective rates of production. The Pe term accounts for excretion of dissolved metabolic productions. Over the life span of M. NORVEGICA some of the terms are discontinuous (Px, for example), and all are non-linear. Therefore, we have selected "ecologically significant" segments of the life span (segments representing most of the impact on zinc flux, from biomass estimates), and have summed linear approximations of these selected segments. Using adult animals feeding and defecating for 12 h each day, maximum Lambda e estimates (126.61 ug Zn lost/g dry weight/day) plus maximum c estimates (4.38 ug Zn retained/g dry weight /day) yielded a maximum estimate for Ke (130.99 ug Zn ingested/g dry weight/day). Similarly, near-minimum estimates of Lambda e and Mu 3 gave a near-minimum estimate of Ke (51.22 ug Zn/g dry weight/day). The Zn concentration in the food of M. NORVEGICA was calculated to be approximately 400-500 ug Zn/g dry weight to satisfy the elimination and growth terms. Measured Zn concentration in "natural" foods of the euphausiid avaeraged 570 ug Zn/g dry, an estimate reasonably close to the calculated concentration. The Zn budget in M. NORVEGICA is thus adequately described, and indicates that faecal pellet deposition (QfPf) is the most significant term (representing over 90% of the Zn flux). Applicability of the above approach, and the most sensitive parameters, are discussed relative to other elements and other organisms.

456

Mercury in Sediments from the Thames Estuary

Smith, J.D.; Nicholson, R.A.; Moore, P.J.; Geochem. Div., Inst. Geol. Sci., London, Engl.

Environ. Pollut. (ENVPAP) 1973, 4(2) 153-7

MERCURY; SEDIMENTS; ESTUARIES; ATOMIC ABSORPTION SPECTROPHOTOMETRY

Unconsolidated surface sediments from the outer Thames estuary were analysed for mercury using a flameless atomic absorption technique. Sediment samples examined comprised fifteen which were freshly collected and twenty provided by the British Museum (Department of Mineralogy) from a collection assembled over the past forty-five years. Comparison of results for the two groups indicates that there has been little overall change in this period, but levels in these recent sediments are generally higher than those obtained for samples of London clay deposited in Eocene times (approximately 50 million years ago). Mercury contents of the sediments range from 0.012 to 0.550 ppm, with the higher concentrations usually occurring in sediments containing a high proportion of fine particles.

457

Analytical Handbook for the Determination of Arsenic, Cadmium, Cobalt, Copper, Iron, Lead, Manganese, Mercury, Nickel, Silver, and Zinc in the Marine and Estuarine Environments

Smith, R.G.; Windom, H.L.

Unpublished Manuscript; Technical Report Series No. 72-6, 62 p., Geogria Marine Science Center, University System of Georgia, Skidaway Island, Geogria; 1972, September

ANALYTICAL CHEMISTRY; ARSENIC; CADMIUM; COBALT; COPPER; IRON; LEAD; MANGANESE; MERCURY; NICKEL; SALTWATER; ESTUARIES

458

Geochemistry of Selenium in Deposits in the Northwestern Part of the Pacific Ocean

Sokolova, E.G.; Pilipchuk, M.F.; South. Sect., Inst. Oceanol., Gelendzhik, USSR

Geokhimiya (GEOKAQ), 10, 1537-1546; 1973

SELENIUM; GEOCHEMISTRY; BENTHONIC SEDIMENTS; OCEANS; FIXATION; IRON SULFIDE; ORGANIC COMPOUNDS; SEDIMENTS

459
Methylmercury: A Bacterial Degradation in Lake Sediments

Spangler, W.J.; Spigarelli, J.L.; Rose, J.M.; Miller, H.M.

Science 180, 192-193; 1973, April

METHYLMERCURY; BACTERIAL DEGRADATION; SEDIMENTS; GAS CHROMATOGRAPHY; MASS SPECTROMETRY; LAKES; BACTERIA; MICROORGANISMS; FRESHWATER

460
Northwest Fishery Center Research on Effects of Environmental Contaminants on Marine Organisms,: Reprint

Stansby, M.P.; Alverson, D.L.; National Marine Fisheries Service, Seattle, Wash. Northwest Fisheries Center

GPA 73(21) COM-73-50645-05-06-02; Report No. MRF-PAPER-978; Monitoring Agency Rept No. NOAA-73072305-2, 8 p.; 1973

FISH; AQUATIC ANIMALS; LIFE CYCLES; CONTAMINATION; BIOCHEMISTRY; SALTWATER; PHYSIOLOGY; ANIMAL DISEASES; MERCURY; PESTICIDES; POLLUTION EFFECTS

The authors set forth the plans developed by the members of the Northwest Fishery Center to conduct research on the effects of environmental contaminants on marine organisms. Their studies involve a three-pronged attack. At a very basic research level, chemists, biochemists,and biophysicists are looking into pathways within the fish or other marine organisms to learn how contaminants move about during different stages in the life history of the organisms. The nature of biochemical investigations, laboratory investigations in physiology and field research is briefly described.

461
Mercury Concentrations in Sediments of the Lake Erie Basin, Ohio

Stith, D.A.; Ohio Geol. Surv., Columbus, Ohio

Ohio, Div. Geol. Surv., Informa. Circ. (ODGCA9) No. 40, 1-14; 1973

MERCURY; SEDIMENT; LAKES

GEOGRAPHICAL DESCRIPTION: U.S., Ohio, Lake Erie Basin

462
Traces Metals in Cores from the Great Marsh, Lewes, Delaware

Strom, R.N.; Biggs, R.B.; Department of Geology, College of Marine Studies, University of Delaware, Newark, Delaware 19711

Department of Commerce Grant 2-35223; DEL-SG-12-72, CMS No. 2 GL-105; 1972, December

LEAD; ZINC; COPPER; CADMIUM; WATER; CHROMIUM; IRON; CORE SAMPLES; MARSHES; SEDIMENTS

Four twelve-foot cores and one eighteen-foot core were taken near Lewes, Delaware. Samples were taken at two foot intervals down the core beginning at two feet below land surface. The samples were analyzed for zinc, copper, chromium, iron, lead and cadmium. The levels of lead and cadmium were below the level of detectability by the methods used (i.e. less than 1 ppm in the sediment sample). Zinc showed a slight increase in average concentration with increasing depth. Copper and cadmium showed no significant changes with depth. There appears to be no significant difference in the metal concentrations between the less than 63 u and greater than 63 u fractions.

463
Chemical Basis for Homing of Atlantic Salmon (SALMO SALAR) to a Hatchery

Sutterlin, A.M.; Gray, R.; Fish. Res. Board Canada, Dep. Environ., St. Andrews, New Brunswick

J. Fish. Res. Board Can. (JFRBAK) 1973, 30(7) 985-9

SALMON; HOMING; COPPER; COPPER SULFATE; CHEMISTRY

Based on recoveries from traps situated at a hydroelectric dam and a hatchery 1500 m downstream, the return location of hatchery reared and wild Atlantic salmon is examined. During the fall runs of 1971 and 1972,97% of ascending wild salmon returned to the dam; only 3% were recovered at the hatchery. Despite the fact that the hatchery discharge contributed only 1/1000th of the river's flow, 67% of the hatchery-reared fish returned to the hatchery and 33% to the dam. Tank tests demonstrated a clear-cut preference by hatchery adults for diluted hatchery effluent vs. river water. Wild fish showed no-preference by hatchery adults for diluted hatchery effluent vs. river water. Wild fish showed no preference to either water. Well water, a component of hatchery effluent, was avoided by both hatchery and wild fish. Addition of CuSO(4) to preferred water altered its effectiveness.

464
Effect of Copper on Uptake of Diquat-14C by HYDRILLA

Sutton, D.L.; Haller, W.T.; Steward, K.K.; Blackburn, R.D.

Weed Sci.(WRESA6), 20(6), 581-3; 1972

DIQUAT; UPTAKE; HYDRILLA; COPPER; HERBICIDES; AQUATIC PLANTS; PLANTS; CARBON 14

TAXONOMY: HYDRILLA

465

465
Distribution and Background Levels of Mercury in Sediment Cores From Selected Wisconsin Lakes

Syers, J.K.; Iskandar, I.K.; Keeney, D.R.; Dep. Soil Sci., Univ. Wisconsin, Madison, Wis.

Water, Air, Soil Pollut. (WAPLAC), 2(1), 105-18; 1973

MERCURY; LAKES; SEDIMENTS; DISTRIBUTION; BACKGROUND

GEOGRAPHICAL DESCRIPTION: U.S. (N), Wisconsin, Madison

The vertical distribution of Hg in sediment cores from a range of hard- and soft-water lakes in Wisconsin was evaluated in terms of potential sources of Hg during the nineteenth and twentieth centuries. For the Madison lakes, the trends in Hg distribution were related to variations in sewage inputs during the last 80 yr. It is unlikely that either inputs of sewage or erosional products are responsible for the observed accumulation Hg in the most recent sediments from three lakes in northeastern Wisconsin. Background levels varied from 0.01 to 0.24 ppm of Hg (intact sediment basis) in precultural sediments from the Wisconsin lakes investigated. There was no consistent relationship between the concentration of Hg and other sediment components of potential importance in the retention of Hg.

466
Analytical Studies; Biochemical Studies

Thomas, C.C., Jr.; Massaro, E.J.

Part of Investigation of Heavy Metallic Pollutants in the Great Lakes Ecosystem, Quarterly Progress Report for the period ending March 3, 1972, 15 p. Toxic Materials Central File; 1972

MERCURY; CADMIUM; ZINC; COPPER; ARSENIC; CHROMIUM; SELENIUM; FISH; WALLEYE; SMELT; SLIMY SCULPIN; RAINBOW TROUT; METHYLMERCURY; UPTAKE; BIOLOGICAL HALF-LIFE; BLOOD; SPLEEN; KIDNEYS; LIVER; LENS; MUSCLES; RAIN; MERCURY

Assays of fish for mercury, cadmium, zinc, copper, arsenic chromium and selenium were made. Studies to identify the proteins finding mercury are continuing and the distribution and half life of mercury in various fish organs were studied further. Initially the blood and spleen have the highest concentrations, but the mercury in these organs clears quickly and, at the end of some months, most of the mercury is in the muscles (about half the dose or two-thirds of that remaining in the fish). Mercury builds up slowly in the brain but is released even more slowly. The half retention was approximately 200 days, but is was being released at an even slower rate at this time.

467
The Distribution of Mercury in the Sediments of Lake Ontario

Thomas, R.L.

Canadian Journal of Earth Sciences 9, 636-651; 1972

MERCURY; DISTRIBUTION; SEDIMENTS; LAKES; FRESHWATER; BIOCONCENTRATION

GEOGRAPHICAL DESCRIPTION: Canada, Lake Ontario

Total mercury has been analysed in the surface 3 cm of sediment taken from 287 sample stations on an 8 km grid on Lake Ontario during 1968. The mercury distribution shows well-defined trends which can be related to sediment type; the concentration of mercury increasing from the shallow nearshore coarse sediments outwards, into the central, deep-water basin sediments composed of fine silty clays and clays. The average concentration of mercury in the nearshore sediments is 355 ppb. Regions of high mercury concentration (in the order of 2000 ppb) occur along the southern margin of the main lake basin and in the western (Niagara) basin of the lake. The dispersion pathways of these two regions point to the Niagara River as the prime source of mercury input to Lake Ontario. Most of this mercury is believed to be of industrial origin. An additional area of high mercury concentration with values up to 20,000 ppb, occurs at the eastern end of Lake Ontario (Kingston Basin) in the region of the lake close to the outlet to the St. Lawrence River. These high values in organic-rich, fine sediments are likely related to processes of biological concentration. The concentrations of mercury observed in the recent sediments of Lake Ontario can be accounted for by an average minimum daily input of 125 lb (56.7 kg) of mercury of which an estimated 42 lb (19.0 kg) is of natural origin and the remaining 83 lb (37.6 kg) is from industrial sources. The vertical distribution of mercury in a selected sediment core suggests that industrial mercury input commenced about the turn of the century, rose rapidly to CIRCA 1943 and, since then, has shown a slow but continued rise to the time of core retrieval in 1970.

468
The Distribution of Mercury in the Surficial Sediments of Lake Huron

Thomas, R.L.

Can. J. Earth Sci., 19(2), 194-204; 1973

DISTRIBUTION; MERCURY; SEDIMENTS; WEATHERING; INDUSTRY; CYCLING

GEOGRAPHICAL DESCRIPTION: U.S.A., Lake Huron

Total mercury has been determined in 163 samples of the topmost 3 cm of sediment taken from Lake Huron during 1969. Total mercury values range from 58 to 805 ppb with a mean of 222 ppb and a standard deviation of 162 ppb. The mercury distribution in the lake sediments shows a trend for increasing concentration from nearshore and mid-lake shallow water, coarse sediment deposits outwards into the fine-grained sediment in the deeper water basins. The application of a quartz correction to compensate for the dilution by an inert constituent reveals two major anomalies of higher mercury concentration. The SAGINAW ANOMALY occurs in the southern basins of the lake and is believed to be due to the input of industrial mercury from Saginaw Bay; the BRUCE ANOMALY in the northeastern part of Manitoulin basin is believed to be due to the weathering of sulfide deposits with subsequent concentration in the lake sediments being related to major water circulation patterns in the lake. From statistical analysis the mercury is believed to be bound in the sediments predominantly adsorbed or complexed by organic matter with subsidiary adsorption by the surfaces of iron sulfides and hydrated iron oxide - inorganic phosphorus complexes.

469
Application of the Stainton Syringe Method to the Analysis of Mercury in Natural Waters

Thompson, J.A.; McComas, F.T.; Fish. Mar. Serv., Pac. Environ. Inst., West Vancouver, B.C., Canada, Canada

Environ. Lett. (ENLTAX), 5(3), 189-97; 1973

MERCURY; NATURAL WATERS; STAINTON SYRINGE METHOD; ANALYSIS; WATER

A relatively inexpensive, simple and precise method for the analysis of sub-nanogram quantities of mercury in natural waters is described. Through a combination of a solvent extraction procedure and a "cold-vapor" technique, standard deviations of plus or minus 0.0049 and plus or minus 0.0112 were obtained at the mean concentrations of 0.023 and 0.166 ng/ml respectively. Recoveries of 98% are reported.

470
Concentration Factors of Chemical Elements in Edible Aquatic Organisms

Thompson, Stanley E.; Burton, C. Ann; Quinn, Dorthy J.; Ng, Yook C.

UCRL-50164 (Rev. 1), UCRL-50548 (Rev. 1), Lawrence Laboratory, Livermore, CA. Bio-Medical Division, TID-4500, UC-48. October 10, 1972, p. 1-77; 1972, October 10

CONCENTRATION FACTOR; FOODSTUFFS; ELEMENTS; AQUATIC BIOLOGY; REVIEW

471
Environmental Geochemistry: Some Recent Studies in the United Kingdom

Thornton, I.; Webb, J.S.

Part of D. Hemphill (Ed.). Seventh Annual Conference on Trace Substances in Environmental Health, University of Missouri-Columbia, Columbia, MO 65201; 1973, June 12-14

GEOCHEMISTRY; AGRICULTURE; ESTUARIES; FISHERIES; GEOCHEMICAL RECONNAISSANCE; MOLYBDENUM; ZINC; MINING; SMELTERS; SEDIMENTS; OYSTERS; BOTTOM FAUNA; SALTWATER

GEOGRAPHICAL DESCRIPTION: United Kingdom; England; Wales

The paper outlines some recent applications of geochemical parameters to agriculture, estuarine fisheries and pollution studies and discusses the Group's current programme in environmental geochemistry in relation to the geochemical atlas of England and Wales. Examples are shown of the results of geochemical reconnaissance indicating both extensive molybdenum anomalies and multi-element 'low' patterns in relation to animal health, and anomalous patterns due to old mining and smelting activities which are also of potential agricultural significance. Contamination of zinc in waters and sediments has been related to the failure of oyster larvae in a hatchery in North Wales and base-line studies show wide geochemical variation in other estuaries used for oyster production. The effect of the disposal of sewage sludge on trace element distribution in waters and sediments has been studied in the Firth of Clyde and related to the distribution of bottom fauna.

472
Distribution of Zn, Fe, Mn, and Sr in Marine Fishes of Different Feeding Habits

Ting, R.; Puerto Rico Nuclear Center, Mayague

Puerto Rico Nuclear Center, Mayague, CONF-710510--P2, 709-720; 1971

BONES; DISTRIBUTION; FISH; INTESTINES; IRON; MANGANESE; MUSCLES; SKIN; STRONTIUM; ZINC; TISSUE DISTRIBUTION; SALTWATER

473
Sublethal Cytotoxic Effects of Mercuric Chloride on the Ciliate TETRAHYMENA PYRIFORMIS

Tingle, L.E.; Pavlat, W.A.; Cameron, I.L.; Med Sch., Univ. Texas, San Antonio, Tex.

J. Protozool. (JPRAR), 20(2) 301-4; 1973

MERCURY; TOXICITY; PROTOZOA; MERCURIC CHLORIDE

TAXONOMY: TETRAHYMENA PYRIFORMIS

Mercuric chloride at a sublethal concentration of 0.50 mg/l caused deleterious changes in T. PYRIFORMIS cell motility, activity of the water expulsion vesicles, and cell shape, whereas at a lower concentration (0.25 mg/l) it was without effect. The higher sublethal HgCl2 concentration elicited damage of several cell structures, and this damage persisted and accumulated with time up to 24 hr. at the lower HgCl2 concentration. There were extensive changes after 1-hr exposure involving primarily mitochondria; however, all major changes were repaired after 24 hr of constant exposure to HgCl2, indicating adaptation to the toxicant.

474
Losses of Zinc 65 to Inorganic Surfaces in Marine Algal Nutrient Medium

Tomlinson, P.D.; Renfro, W.C.; Department of Oceanography, Oregon State University, Corvallis, Ore. 97331

Envir. Sci. Technol. 6(12), 1001-1005; 1972, November

MARINE BIOTA; ADSORPTION; UPTAKE; INORGANIC SURFACES; MARINE PHYTOPLANKTON; ZINC 65; SALTWATER

The nature and magnitude of Zn-65 losses from a marine algal nutrient medium through adsorption to inorganic surfaces were examined. In the pH range 6.3-7.5, a precipitate formed in the medium. These particles accumulated up to 70% of the Zn-65 in the medium within 24 hr at pH values near 7.5 Zn-65 uptake at a pH of 6.3 was negligible. The filtered seawater base of the nutrient medium was used to study Zn-65 losses to glassware surfaces. The relationship between the percent adsorption of Zn-65 from a contained seawater sample and wetted-glass surface area/pipette sample volume was found to be linear for borosilicate glass volumetric pipettes in the size range tested (1-15 ml). At pH 8.0, glassware with surface area/sample volume ratios as small as those of 20-ml volumetric pipettes adsorbed 7-11% of the contained sample activity. Use of polypropylene apparatus was found to significantly reduce zinc losses. It was concluded that Zn-65 adsorption by inorganic surfaces could result in serious errors in measurements of Zn-65 uptake by marine phytoplankton.

475
Recovery of Heavy Metal Compounds by Microorganisms. II. Incorporation of Phenylmercuric and Mercuric Acetate Into Microorganisms Tolerant to Them

Tomoyeda, M.; Horitsu, H.; Azuma, T.; Fac. Agric., Gifu Univ., Gifu, Japan

Nippon Nogei Kagaku Kaishi(NNKKAA), 47(1), 51-5; 1973

MERCURY; BACTERIA; MERCURY COMPOUNDS; MICROORGANISMS; HEAVY METALS; ACTIVATED SLUDGE

TAXONOMY: PSEUDOMONAS OVALIS

A microorganism tolerant to both phenylmercuric acetate and mercuric acetate was found in activated sludge. It was identified as PSEUDOMONAS OVALIS. Both compounds were incorporated into the precipitate and the supernatant fractions obtained by the centrifugation of the cell homogenate at 26.000g for 15 min.

476
Heavy Metals in Fish from Scottish Waters

Topping, G.; Mar. Lab., Aberdeen

Aquaculture, 1(4), 373-377; 1973

HEAVY METALS; FISH; FOOD CHAINS; PLANKTON; FISH; COPPER; ZINC; CADMIUM; LEAD

GEOGRAPHICAL DESCRIPTION: Scotland (coast)

The concentration of four heavy metals (copper, zinc, cadmium and lead) has been measured in four species of commercial fish collected from Scottish waters. From the limited numbers of fish and areas examined there appears to be little difference in concentration of any one metal between areas for the same species. It is suggested however that there may be a difference in trace metal content of plankton feeding fish and bottom feeding fish.

477
Microbial Uptake of Lead

Tornabene, T.G.; Edwards, H.W.

Science, 176 (4041), 1334-1335; 1972

MICROORGANISM; UPTAKE; LEAD; LEAD COMPOUNDS

TAXONOMY: MICROCOCCUS LUTEUS; AZOTOBACTER SP

MICROCOCCUS LUTEUS and AZOTOBACTER sp. cells grown in broth in contact with a dialysis membrane containing lead bromide were found to immobilize 4.9 and 3.1 x 10(2) milligrams of lead per gram of whole cells, on a dry weight basis, respectively. Culture turbidity and cell count measurements on these and other cell cultures show that lead bromide, lead iodide, and lead bromochloride in concentrations approaching solubility limits have no detectable effect on overall growth rate and cell viability. Analyses of cellular subfractions reveal that fractions of cell wall plus membrane contain 99.3 and 99.1 percent of the lead found associated with MICROCOCCUS LUTEUS and AZOTOBACTER sp., respectively. The remainder is found associated with the cytoplasmic fractions.

478
Effects of Lead on Bacterial Membranes

Tornabene, T.G.; Edwards, H.W.

Part of Hemphill, D.D. (Ed.), Seventh Annual Conference on Trace Substances in Environmental Health, Held at Memorial Union, University of Missouri-Columbia, Columbia, MO, June 12-14, 1973; 1973

MEMBRANES; LEAD; GROWTH RATE; CELL VIABILITY; CYTOPLASM; LIPIDS; CELL MEMBRANES; CELL WALLS; CELLS; BACTERIA; MICROORGANISMS

Previous work shows that bacterial cells can take up substantial quantities of lead from solution without apparent effects on overall growth rate and cell viability. Lead retained by these whole cells is associated essentially completely with the cell wall and membrane, and very little reaches the cytoplasm. The present paper deals with interaction of lead with membrane lipids of M. LUTEUS. Effects of membrane lipids composition and structure upon lead retention is discussed.

079
Characterization of Bottom Sediments: Cation Exchange Capacity and Exchangeable Cation Status

Toth, S.J.; Ott, A.N.; Department of Soils and Crops, College of Agriculture and Environmental Sciences, Rutgers University, New Brunswick, NJ 08903

Environ. Sci. & Tech., 4(11), 935-939; 1970, November

SEDIMENTS; CATIONS; EXCHANGE CAPACITY; EXCHANGEABLE CATION STATUS; IRON; MANGANESE; RIVERS; ESTUARIES; FRESHWATER

Two parameters, cation exchange capacity (CEC) and exchangeable cation status (ECS), were used to characterize bottom sediments collected from rivers, bays, and freshwater impoundments. It was necessary to investigate the effect of drying on CEC and exchangeable Fe and Mn to arrive at satisfactory modifications of soil techniques used for these parameters. Wide variations were obtained in CEC and ECS values for the sediments. CEC and ECS values may be utilized for determining saltwater intrusions and pollution effects.

080
Water Quality and Fish Life Below Sewage Outfalls

Tsai, Chu-Fa

Trans. Amer. Fish. Soc., 102(2), 281-292; 1973, April

WATER QUALITY; FISH; SEWAGE OUTFALLS; CHLORINE; TURBIDITY; SLUDGE; SPECIES DIVERSITY

GEOGRAPHICAL DESCRIPTION: U.S. (E), Virginia, Maryland, Pennsylvania

Comparative studies of water quality and fish species diversity in stream locations immediately above and below the outfalls of 149 secondary sewage treatment plants were made in Virginia, Maryland, and Pennsylvania. Sewage chlorine and turbidity increment resulting from sludge were found to be major causative factors for fish species diversity reduction below the outfalls.

081
Trace Element Trapping in Pteropod Tests

Turekian, K.K.; Katz, A.; Chan, L.; Dep. Geol. Geophys., Yale Univ., New Haven, Conn.

Limnol. Oceanogr. (LIOCAH), 18(2), 240-9; 1973

IRON; PTEROPOD; PLANKTON; TRACE ELEMENTS; OCEANS; SALTWATER; CERIUM; LANTHANUM; SAMARIUM; EUROPIUM; THORIUM; SCANDIUM; CHROMIUM; COBALT; ANTIMONY; SELENIUM

GEOGRAPHICAL DESCRIPTION: Jorden, Gulf of Aqaba; U.S. (NE), New York, Long Island Sound

Pteropod tests from the Gulf of Aqaba and the South Atlantic Ocean and "bulk" (soft tissue) plankton samples from Long Island Sound were analyzed by instrumental neutron activation analysis (INAA) for 11 trace metals (Fe, Ce, La, Sm, Eu, Th, Sc, Cr, Co, Sb, Se) to study the trapping and transport mechanisms for these metals in the oceans and the capability of pteropods to modify the composition of seawater during this process. The internal correlations among these metals strongly suggest that a finely particulate (less than 0.2 m) authigenic iron-rich phase (hydrated oxide or phosphate) is trapped by both the soft and hard tissues of plankton and that this phase is the major carrier of several of the trace metals. Assuming that the iron-rich floc-trapping mechanism is applicable to all pelagic calcareous tests, then the downward flux of iron and associated trace elements carried by these tests can be assessed. To the precision of current knowledge about the transport and dissolution of calcium carbonate in deep water, this assumption leads to the conclusion that the iron and the associated trace elements have residence times in the deep water of the same order of magnitude as that of the deep water itself.

082
Distribution of Zirconium, Titanium, Nickel, Cobalt, Lead, Copper, and Other Elements in the Surface Layer of Recent Deposits in Lake Balkhash

Turovskii, D.S.; Lubchenko, I.Y.; Cherkasova, E.V.; Geol. Inst. Moscow, USSR

Litol. Polez. Iskop (1), 47-55; 1973

SEDIMENTS; LAKES; ZIRCONIUM; TITANIUM; NICKEL; COBALT; LEAD; COPPER; DISTRIBUTION; GALLIUM; VANADIUM; CHROMIUM; IRON; MANGANESE; PHOSPHORUS; MOLYBDENUM; CARBON; ORGANIC COMPOUNDS; TRACE ELEMENTS; ACCUMULATION

The majority of the elements studied came from suspended matter carried into the lake by the Ili River. Four groups of elements can be distinguished, which, in the order of increasing geochemical mobility, are (1) Zr and Ga; (2) Ti, V, and Cr; (3) Fe, Mn, P, Cu, Pb, Co, and Ni; and (4) Mo and C. Distribution of the elements is governed by the hydrodynamics of the basin, resulting in enrichment of the finest sediments with elements of group (3). Zr accumulates in the coastal sands, while the maximum concentration of group (2) occurs in coarse and also in small size aleurites.

483
Heavy Metals Pollute Nature, May Reduce Productivity

Tyler, G.

Ambio, 1(2), 52-59; 1972, April

ZINC; COPPER; CADMIUM; CHROMIUM; NICKEL; VANADIUM; FOSSIL; FUELS; LEAD; IRON; MANGANESE; ATOMIC ABSORPTION SPECTROPHOTOMETRY; CALCIUM; MAGNESIUM; POTASSIUM; SODIUM; PHOSPHORUS; SULFUR; ACCUMULATION; MOSSES; ION EXCHANGE; GEOGRAPHIC VARIATIONS; HEAVY METALS; COMPLEXES; LICHENS; LITTER; HUMUS; GRASSES; SEDGES; HERBS; UPTAKE; ROOTS; SPRUCE NEEDLES; RAIN; PEATS; CONCENTRATION; CHELATION; DECOMPOSITION RATE; MOLYBDENUM; DEFICIENCY; BARKS; TWIGS; LEAVES; PLANTS; WATER; TREES

Mosses and lichens accumulate heavy metals from rain or dry deposition by ion exchange. Atomic absorption spectrophotometry is a fast and sensitive method for analyzing for heavy metals. Other plants accumulate heavy metals through the roots, transfer a part to the shoots, and then after wilting and litter formation accumulate more by ion exchange. Some plants are superficially rooted in the heavily polluted, acid humus layer and have a considerable uptake of heavy metals. In peat bogs the author has found cadmium up to 5.1 parts per million dry weight and lead up to 180. He speculates that such concentrations may lead to a reduced decomposition rate, which will lead to increased litter, minerals bound in unavailable form and therefore reduced production. This accumulation could be made available all at once by clear cutting or by forest fires or it could be lost to the ground water. There could also be other effects, e.g., an increase in copper and zinc may enhance production by providing micronutrients.

484
Mercury as a Hydrospheric Pollutant. 1. Accumulation and Excretion in TAPES DECUSSATUS L.

Unlu, M.Y.; Heyraud, M.; Keckes, S.

Part of Ruivo, M. (Ed.), Marine Pollution and Sea Life. Food and Agriculture Organization of the United Nations, Conference held in Rome Italy, December 9-18, 1970. Fishing News (Books) Ltd., 110 Fleet Street London, EC4A 2JL England, (p. 292-5) 623 p.; 1972

RADIONUCLIDES; TISSUES; TISSUE DISTRIBUTION; MERCURY; MERCURY 203; MERCURY CHLORIDE; BIOACCUMULATION; EXCRETION; TRACERS; BIOLOGICAL HALF-LIFE; BIVALVES

TAXONOMY: TAPES DECUSSATUS

Mercury-203 chloride was incorporated in bivalves from sea water solution, in food (PHAEODACTYLUM culture) and by injection into the foot muscle. Accumulation from sea water was quite rapid. By the first two methods the biological half life was 1-2 weeks, but it was much longer for the injected material (of the order of a year or more). The distribution of the mercury is given for each group for a time period of 62 days. Much of the mercury was in the visceral organs in all 3 cases.

485
Uptake of Mercury by Caged Rainbow Trout (SALMO GAIRDNERI) in the South Saskatchewan River

Uthe, J.F.; Atton, F.M.; Royer, L.M.; Freshwater Inst., Fish. Res. Board Canada, Winnipeg, Manitoba

J. Fish. Res. Board Can. (JFRBAK), 30(5), 641-50; 1973

MERCURY; RETENTION; RAINBOW TROUT; FISH; RIVERS; UPTAKE; METHYLMERCURY

TAXONOMY: SALMO GAIRDNERI

When rainbow trout (S. GAIRDNERI) were held in cages in the South Saskatchewan River following curtailment of mercury discharges to the river, a rapid uptake of Hg by the fish occurred during the first warm summer period (1970) with much less uptake during the rest of the year. A second summer experiment (1971) produced no significantly different results suggesting that a long-term contamination existed within this river system. Analyses showed that the bulk of Hg present in the fish carcasses was present as methylmercury.

486
Distribution of Certain Trace Elements in Marine Sediments Surrounding Vulcano Island (Italy)

Valette, J.M.; Cent. Rech. Sedimentol. Mar., Cent. Univ., Perpignan, France

Ores Sediments, Int. Sedimentol. Congr., 8th,, 321-37; 1973

TRACE ELEMENTS; SEDIMENTS; FUMAROLE; SALTWATER; DISTRIBUTION; WATER

GEOGRAPHICAL DESCRIPTION: Italy, Vulcano Island

487
Accumulation of Certain Trace Elements in Marine Organisms from the Sea Around the Cape of Good Hope

Van As, D.; Fourie, H.O.; Vleggaar, M.

Part of Radioactive Contamination of the Marine Environment, Proceedings of Symposium held by the International Atomic Energy Agency, Seattle, WA, July 10-14, 1972 (615-623) 786 p.; 1973

ACTIVATION ANALYSIS; ALGAE; ANTIMONY; AQUATIC ECOSYSTEMS; CESIUM; CHROMIUM; COASTAL WATERS; COBALT; CRUSTACEA; FISH; IRON; MANGANESE; METABOLISM; MOLLUSCS; NUCLEAR POWER PLANTS; QUANTITATIVE CHEMICAL ANALYSIS; RETENTION; SEAFOOD; SALTWATER; STRONTIUM; TISSUES; TRACE ELEMENTS; UPTAKE; ZINC

TAXONOMY: PORPHYRA CAPENSIS; ECKLONI MAXIMA; ULVA SPP.; SUHRIA VITATTE; HALIOTIS MIDAE; DONAX SERRA; MYTYLIS MERIDIONALIS; JASUS LILANDII

GEOGRAPHICAL DESCRIPTION: South Africa, Cape of Cape Hope, Capetown

An investigation of the recipient capacity of the sea for radioactive effluent from a site on the west coast of South Africa, 25 km north of Cape Town, necessitated the determination of concentration factors for those nuclides which would probably be present in the effluent of the proposed nuclear installations. Stable element analyses were done for these corrosion elements which are known to have high accumulation factors and which have induced radioactive isotopes of long half-lives, e.g., Cr, Fe, Zn, Co, Mn and Sb, as well as for the stable counterparts of the fission products strontium-90 and cesium-137. Various methods of sample preparation e.g., freeze drying, dry and wet ashing, and of sample analyses, e.g., atomic absorption and neutron activation, were used in parallel and the results compared. The marine organisms which are either regularly consumed or which may have future economic importance were investigated. These species included algae (PORYPHYRA CAPENSIS, ECKLONIA MAXIMA, ULVA spp., SUHRIA VITATTE), Molluscs (HALLOTIS MIDAE, DONAX SERRA, MYTILUS MERIDIONALIS) and Crustacea (JASUS LALANDII), as well as various line and pelagic fishes of commerical importance. Analyses were normally performed on the edible parts of the species only. With regard to coastal and off-shore waters, measurements of the soluble and particulate fractions of these elements were made and different techniques of sample storage and sample preparation, e.g., deep freezing and freeze-drying, were compared.

488
Radioisotope Techniques in Delineation of the Environment Behavior of Cadmium

Van Hook, R.I., Jr.; Blaylock, B.; Bondietti, E.; Francis, C.; Huckabee, J.W.; Reichle, D.; Sweeton, F.; Witherspoon, J.; Oak Ridge National Lab., TN

Part of Joint IAEA/WHO/FAO Symposium on Nuclear Techniques in Comparative Studies of Food and Environmental Contamination, Helsinki, Finland, August 27-31, 1973; IAEA/SM-175/22; CONF-730817-2.; 1973

CADMIUM; CADMIUM 109; DISTRIBUTION; ECOSYSTEMS; FOOD CHAINS; PLANTS; SEDIMENTS; SOILS; TOXICITY; TRACERS; TRANSPORT; BIOCONCENTRATION; MICROCOSMS; FIELD STUDIES; ASSIMILATION; TURNOVER; WATER

Radioisotope techniques are being developed and utilized at Oak Ridge National Laboratory (ORNL) for evaluating the environmental behavior of toxic elements such as cadmium in aquatic and terrestrial ecosystems. Tracer techniques using Cd-109 in microcosm, field plot, and stream systems are providing information on biogeochemical cycling and distribution of cadmium in the environment. Parameters being measured include adsorption capacity for cadmium in mineral soils and sediments; uptake rates of cadmium in various plants species from both soils and nutrient solution as affected by pH, competing cations, and chemical form of cadmium; and distribution of cadmium in various components of both aquatic and terrestrial ecosystems following application of Cd-109 to soil, vegetation, or directly to streams. Food chain parameters being estimated with Cd-109 include uptake, assimilation, and turnover by both aquatic and terrestrial organisms. Information obtained in these radiotracer studies is providing insight into the behavior of cadmium in aquatic and terrestrial ecosystems, especially transport rates of cadmium and potential biomagnification or dilution in food chains. The factors which influence the incorporation of cadmium into vegetative material as well as those affecting residence time in ecosystems have been identified. Use of Cd-109 also has permitted evaluation of a cadmium specific electrode as a tool for rapid assay of free cadmium ions in soil solutions.

489
Uptake and Loss of Zinc-65 and Cobalt-60 by the Mussel MYTILUS EDULIS L.

Van Weers, A.W.

Part of Radioactive Contamination of the Marine Environment, Proceedings of Symposium held by the International Atomic Energy Agency, Seattle, WA, July 10-14, 1972 (385-400); 786 p.; 1973

AQUATIC ECOSYSTEMS; AUTORADIOGRAPHY; BIOLOGICAL HALF-LIFE; COBALT 60; COBALT; GASTROINTESTINAL TRACT; KIDNEYS; MOLLUSCS; RADIOECOLOGY; RADIONUCLIDES; KINETICS; RADIONUCLIDE MIGRATION; RETENTION; SALTWATER; TISSUES; UPTAKE; ZINC 65; ZINC

TAXONOMY: MYTILIS EDULIS

The uptake of zinc-65 and cobalt-60, directly from seawater, by the mussel MYTILUS EDULIS L. and the subsequent loss of the radionuclides in non-radioactive seawater were studied with animals kept unfed during the experiments. Concentration factors measured for the radionuclides for periods up to 60 d are much lower than the values for the stable elements, which range from 3000 to 11000 for zinc and from 1200 to 4500 for cobalt in the soft parts. The pattern of loss is described by loss from two relatively short-lived components and one long-lived component the relative importance of the latter increasing with the length of the preceding uptake period. The biological half-life of the long-lived component ranges from 48 - 60 d for zinc-65 and from 57 - 72 d for cobalt-60. As shown by autoradiography, zinc-65 is accumulated to a high extent in the kidney and cobalt-60 both in the kidney and the digestive gland. It is concluded that, as far as uptake of zinc-65 and cobalt-60 directly from seawater is concerned, both the relatively slow accumulation and the subsequent loss will reduce the risk of contamination of mussels following incidental releases of these radionuclides in coastal waters.

490
Dynamics of /Sup 65/Zn in Benthic Fishes and Their Prey Off Oregon

Vanderploeg, H.; Oregon State Univ., Corvallis.

Oregon State Univ., Corvallis, RLO--2227-T-12-37; 1973, June

ANNELIDS; CRUSTACEA; DIFFUSION; FISH; GEOGRAPHY; MATHEMATICAL SOLUTIONS; MOLLUSCS; RADIOECOLOGY; SALTWATER; RADIONUCLIDES; KINETICS; SEASONAL VARIATIONS

The intra- and interspecific differences of zinc-65 specific activity in benthic fishes on the continental shelf off Oregon during 1970-1971 are examined. The dynamics of zinc-65 specific activity in the fishes are shown to be governed by a basic equation which applies generally to any radionuclide accumulated through the food chain. Evidence is presented that suggests that zinc-65 was in a form more available to the food chain than stable zinc in seawater. The dynamics of zinc-65 SA in the fishes are useful for understanding some aspects of the fishes' ecology. A theoretical framework is set up for determination of energy flow in free-living populations of fishes and other animals from their specific activity dynamics. Geographical patterns in zinc-65 specific activity in the benthic fishes and their prey are shown useful for deducing the migratory habits of the fishes. Migration or its absence is suggested for some fishes for which no literature is available.

491
Rate of Zinc Uptake by Dover Sole in the Northeast Pacific Ocean - Premininary Model and Analysis

Vanderploeg, H.; Oregon State Univ., Corvallis

Oregon State Univ., Corvallis; CONF-710501--P2; p. 840-848; 1971

BIOLOGICAL MODELS; FISH; POPULATIONS; RADIOACTIVE WASTES; RADIOACTIVITY; RETENTION; UPTAKE; ZINC; ZINC 65; SALTWATER; SOLE

492
Arsenic in the Lipid Extracts of Marine Invertebrates

Vaskovsky, V.E.; Korotchenko, O.D.; Kosheleva, L.P.; Levin, V.S.

Comp. Biochem. Physiol. B. Comp. Biochem., 41(4), 777-784; 1972

LIPIDS; ARSENIC; INVERTEBRATES; SALTWATER; THIN-LAYER CHROMATOGRAPHY; SAPONIFICATION

TAXONOMY: ANNELIDA; MOLLUSCA; ASTEROIDEA

The quantitative contents of As in the lipid extracts of 27 species of marine invertebrates, related to various systematic groups, were determined. Arsenic was found in the lipids of the representatives of all phyla. ANNELIDA, MOLLUSCA and ASTEROIDEA had the highest arsenic content whereas Spongia had the lowest. The lipids of animals of the same species with different habitats had a different As content. Thin-layer chromatography was used to compare As-containing substances obtained from various organisms. Animals from different groups had different As-containing compounds. The main portions of As-containing substances saponify.

493
Toxicological and Food-Technological Problems of Methylmercury in Fish

Vercruysse, A.; Hansart, D.L.; Lab. Farmacognosie, Fytochem. Toxicol., Vrije Univ. Brussel, Sint-Genesius-Rode, Belgium

Farm. Tijdschr. Belg. (FMTBB2), 50(4), 272-290; 1973

REVIEW; MERCURY; FISH; METHYLMERCURY; TOXICOLOGY; FOOD; CONTAMINATION

494
The Crayfish, ORCONECTES VIRILIS, as an Indicator of Mercury Contamination

Vermeer, K.

Can. Field Nat., 86(2), 123-125; 1972

CRAYFISH; MERCURY; BIOLOGICAL INDICATORS; CONTAMINATION; LAKES; BIOCONCENTRATION

TAXONOMY: OCONECTES VIRILIS

The crayfish, O. VIRILIS, is a good indicator of Hg contamination in different water bodies. Crayfish muscle contained 3 times as much Hg as the remaining body. Mercury levels did not differ significantly in samples collected from various parts of the shore of a highly contaminated lake.

495
Mercury in Aquatic Birds at Clay Lake, Western Ontario

Vermeer, K.; Armstrong, F.A.; Hatch, D.R.; Can. Wild. Serv., Edmonton, Alberta

J. Wildl. Manage. (JWMAA9), 37(1), 56-61; 1973

MERCURY; MUSCLES; BIRDS; CRAYFISH; DUCKS; GULLS; GOLDENEYES; MERGANSERS; BIOCONCENTRATION; TEALS; AQUATIC BIRDS

TAXONOMY: LARUS ARGENTATUS; ANAS PLATYRHYNCHOS; ANAS DISCORS; BUCEPHALA CLANGULA; MERGUS MERGANSER; LOPHODYTES CUCULLATUS; ORCONECTES VIRILIS

GEOGRAPHICAL DESCRIPTION: Canada, Ontario, Clay Lake

Total mercury levels ranging from 2 to 16 ppm in eggs did not appear to affect the hatching and fledging of herring gulls (LARUS ARGENTATUS). Mercury levels in breast muscles of 5 American pidgeons (MARECA AMERICANA), 16 mallards (ANAS PLATYRHYNCHOS), 17 blue-winged teals (ANAS DISCORS), 21 common goldeneyes (BUCEPHALA CLANGULA), 17 common mergansers (MERGUS MERGANSER), and 7 hooded mergansers (LOPHODYTES CUCULLATUS) averaged 0.5, 6.1, 6.5, 7.8, 6.8, and 12.3 ppm respectively at Clay Lake 4-6 weeks prior to the hunting season in 1971. Methyl mercury in five ducks ranged from 69 to 99 percent of total mercury. Crayfish (ORCONECTES VIRILIS) muscle contained the highest mercury levels of food items found in esophagi and stomachs of ducks; the high values in breast muscles of hooded mergansers are likely related to their feeding on crayfish.

496
Temperature-Salinity Stress and Mercury Uptake in the Fiddler Crab

Vernberg, W.B.; O'Hara, J.; Belle W. Baruch Coastal Res. Inst., Univ. of South Carolina, Columbia, S.C.

J. Fish. Res. Board Can. (JFRBAK), 29(10), 1491-4; 1972

MERCURY; UPTAKE; CRAB; STRESS; TEMPERATURE; SALINITY; MERCURY 203; TOXICITY

Uptake of Hg-203 was determined in gill and hepatopancreas tissue from fiddler crabs (UCA PUGILATOR) maintained under six temperature-salinity regimes. Although the total mercury was relatively constant under all experimental conditions, the percent of mercury in each of the tissues was markedly different. At higher temperatures the crabs seem able to transport mercury from gill tissue to the hepatopancrease more effectively than at lower temperatures. This could be a factor in the toxicity of mercury to fiddler crabs at low temperature.

497
The Synergistic Effects of Temperature, Salinity, and Mercury on Survival and Metabolism of the Adult Fiddler Crab, UCA PUGILATOR

Vernberg, W.B.; Vernberg, J.

Fishery Bulletin, 70(2), 415; 1972, April

FIDDLER CRAB; SYNERGISM; TEMPERATURE EFFECTS; SALINITY EFFECTS; MERCURY; SURVIVAL; METABOLISM; GILLS; HEPATOPANCREAS; GREEN GLAND; CRAB

TAXONOMY: UCA PUBILATOR

In a study undertaken to determine the effect of a sublethal concentration of mercury on the metabolism of adult fiddler crabs, gill tissues were found to be the major site of Hg concentration. Lesser amounts accumulated in the hepatopancreas and green gland. Metabolic rates were affected by prolonged Hg exposure both under optimum environmental conditions and under temperature and salinity stress.

498
Determination of the Mode of Deposition of Elements in Natural Solution

Volkov, G.A.; Shakhbazova, L.N.

Izv. Vyssh. Ucheb. Zaved., Geol. Razved. 16(5), 111-17; 1973

COPPER; WATER; DEPOSITION; NATURAL WATERS; ARSENIC COMPOUNDS; ARSENIC; MERCURY; CARBON DIOXIDE; IONS; CHLORINE; SULFATES; SODIUM; POTASSIUM; CALCIUM; MAGNESIUM; FLUORINE; BICARBONATE; THERMODYNAMICS

Thermodynamic data are presented to study the modes of migration and deposition of Cu, As, and Hg in the CO2-rich waters of Dzhili-Su in the northern Caucasus. The concentration of Cl-, SO 4(-2), CHO3(-), Na plus + K plus, Ca 2 plus, Mg 2 plus, F(-), Cu, As, and Hg in the waters was determined. Cu is deposited as easily dissociated carbonate molecules and only a sixth of total Cu is deposited as Cu(2 plus) cations. Hg is deposited as Hg(2 plus) and as HgCl4(2-) The As is present as AsO4(3-), HAsO4(2-), H2AsO4-, and H3AsO4.

499
A Continuous Culture of Desulfovibrio on a Medium Containing Mercury and Copper Ions

Vosjan, J.H.; Van Der Hoek, G.J.

Neth. J. Sea Res., 5(4), 440-444; 1972

CONTINUOUS CULTURE; MERCURY; COPPER; MICROORGANISMS; TOXICITY; GROWTH

TAXONOMY: DESULPOVIBRIO

The effects of the toxic metals Hg and Cu on the growth of DESULPOVIBRIO in a continuous culture was studied. It appeared that in such a culture the metals are continually rendered harmless by the precipitation of metal suphides, while in batch cultures in the same medium no growth takes place. The overflow of the continuous culture no longer contains any toxic metal, as is proved by microbial growth occurring after addition of some substratum. Microbiological processes could be used to render toxic metals innocuous, to remove them from polluted water, and to fix them as sulphides.

500

500
The Use of Fish Movement Patterns to Monitor Zinc in Water

Waller, W.T.; Cairns, J., Jr.

Water Research, New York, 6(3), 257-269; 1972, March

ZINC; FISH; MOVEMENT; STRESS; DETECTION; TURBIDITY; WATER

The feasibility of using fish movement patterns measured by light beam interruption for continuous monitoring of response to zinc was investigated. The apparatus does not interfere with fish movement and detects premortal aberrations in movement caused by zinc. Detection of stress occurs in sufficient time to permit survival of test fish if stress conditions are reversed at time of detection. The lowest concentration of zinc detected during a 96-h exposure was between 3.64 and 2.98 mg per liter zinc (2 plus). The system's range of effective measurement as related to turbidity is discussed.

501
Mercury in Fish, Sediments, and Water in Lake Oahe, South Dakota

Walter, C.M.; Environmental Protect

J. Water Pollution Control Federation, 45(10), 2203; 1973, October

FISH; SEDIMENTS; WATER; MERCURY; PIKE; WALLEYE; LAKES

GEOGRAPHICAL DESCRIPTION: U.S., South Dakota, Lake Oahe

Analyses of total mercury content were made for fish, sediment, and water samples collected in several locations in Lake Oahe, S.D., and its tailwaters. Mercury concentrations equal to or exceeding 0.5 mg/kg occurred in 30 of 225 fish samples tested. Higher concentrations were found mostly in predatory game fishes, primarily northern pike and walleye, from the Cheyenne River arm.

502
Mercury Concentration in Surface Sediments as Related to Water Masses in Western Lake Erie

Walters, L.J.; Herdendorf, C.E.; Dept. Geol., Bowling Green State Univ., Bowling Green, Ohio

Compass Sigma Gamma Epsilon, 50(4), 5-10; 1973

MERCURY; SEDIMENTS; LAKES; FRESHWATER

503
Levels of Molybdenum in Milk and its Relation o Levels in Cattle Feeds and Irrigation Water

Ward, G.M.

Part of Transport and the Biological Effects of Molybdenum in the Environment, Progress Report, January 1, 1973 (p. 176-186) 375 p.; 1973, January 1

MOLYBDENUM; MILK; FEEDS; IRRIGATION WATER; DRINKING WATER; SAMPLING; HAY; SILAGE; SOILS; DAIRIES; FOOD CHAINS

Description of the food-chain relationships of molybdenum with emphasis on milk have been more difficult than anticipated. The original postulate was that agricultural areas utilizing irrigation water with higher levels of molybdenum would produce feed with higher levels and in turn milk with higher levels. The concept is probably correct but conclusive evidence for this relationship have not been obtained readily. It was thought that the milk tank trucks which collect milk from specific areas would readily spot the farming areas with the highest concentration. However, a closer look at the milk pick-up operation and dairy farm management systems soon destroys this illusion. The reasons are that (1) milk is picked up from most farms on alternate days, as a result each truck in essence has two routes; (2) farms are added and dropped from particular routes frequently for a variety of reasons; (3) the variation is herd size is great (30-400 cows) meaning that one or two farms may have a grossly disproportionate effect on the mean level found for the truck. Added to these variables are those associated with feeding systems. Some dairies, usually the largest ones, produce very little or none of the feed for their herds. For these reasons tank truck samples may be used to locate farms that may have high levels of molybdenum in the milk but for environmental studies of molybdenum movement the emphasis will have to be on individual farms. The tank truck surveys, of course, provide a rapid estimate of the molybdenum intake through milk by a metropolitan population.

504
Molybdenum Concentrations in Tissues of Rainbow Trout In SALMO GAIRDNERI and Kokanee Salmore ONCORHYNCHUS NERKA from Waters Differing Widley In Molybdenum Content

Ward, J.V.

J. Fish. Res. Board Can., 30(6), 841-842.; 1973, June

TRACE ELEMPNTS; DETECTION LIMIT; X-RAY FLUORESCENCE ANALYSIS; MUSCLES; BONES; ALGAE; NITROGEN FIXATION; TOXICITY; LIVER; KIDNEYS; SKIN; FISH; ANALYSIS; MOLYBDENUM; ACCUMULATION FACTORS; WATER; BIOACCUMULATION

TAXONOMY: SALMO GAIRDNERI; ONCORHYNCHUS NERKA

SALMO GAIRDNERI and ONCORHYNCHUS NERKA were procured from three waters. Dillon Reservoir had approximately 300 ppb molybdenum in its waters; Eleven Mile Reservoir had approximately 6 ppb; Cline's Fish Hatchery waters were below the limits of detection. Water samples were measured spectrophotometrically. Various fish organs were removed, ashed, and analyzed for molybdenum using x-ray fluorescence to determine accumulation factors (concentration in wet organ/concentration in water). Fish organs from the high (300 ppb) molybdenum water had mean accumulation factors of less than 1.0 with the exception of S. GAIRDNERI stomachs (1.1) and O. NERKA bone (1.1). Fish organs from the low (6 ppb) molybdenum water had mean accumulation factors ranging from 1.7 in muscle to 24.4 in bone. Fish organs from the water with trace amounts of molybdenum had absolute concentrations ranging from 5-118 ppb. Muscle was consistently the lowest in molybdenum; bone was generally the highest. The organs of O. NERKA generally exhibited lower molybdenum concentrations than the organs of S. GAIRDNERI. All fish organs analyzed exhibited an inverse relationship between the ambient concentration and the accumulation factor; thus it appears as if the accumulation factors for molybdenum in salmonids are biologically determinant. There was no significant correlation of molybdenum concentration with age; this agrees with research on terrestrial animals.

505
Cycling of Radionuclides in Columbia River Biota

Watson, D.G.; Cushing, C.P.; Coutant, C.C.; Templeton, W.L.

Can. J. Zool. 51(2) 143-150; 1973

CYCLING; RADIONUCLYDES; CHROMIUM 51; CONTAMINATION; FISH; FLOW RATE; ISOTOPE RATIO; TEMPERATURE; PHOSPHORUS 32; PLANKTON; REACTORS; COOLING SYSTEMS; ZINC 65; SEASONAL VARIATIONS; CHROMIUM; PHOSPHORUS; RIVERS; WATER

GEOGRAPHICAL DESCRIPTION: U.S. (NW), Washington, Columbia River

A study of the cycling of six radionuclides in Columbia River biota was initiated in February 1966 to define the interspecies and seasonal variations in concentrations. These data were related to major ecological factors such as light, temperature, flow, and stable element concentrations. Concentrations of radionuclides in Columbia River water are generally inversely proportional to flow levels, with highest values in winter and lowest in summer. This is related to dilution by seasonal runoff. 32P, 65Zn, and 51Cr were the elements present in highest concentrations in the biota. Levels followed a pattern of high levels in winter and low values in summer. This relationship was particularly apparent in those organisms with high surface to volume ratios whose dominant mode of uptake is adsorption. The influence of the seasonal run-off overwhelmed the beneficial effects of seasonal changes in light and temperature in spring. The magnitude of seasonal changes decreased in the higher trophic levels. Concentration factors (CF) were highest of the biologically important radionuclides 32P and 65Zn and were highest in the primary producers. CFs decreased in higher tropical levels.

506
Distribution and Tissue Retention of Mercury-203 in the Goldfish (CARASSIUS AURATUS)

Weisbart, M.; Dep. Biol., Wayne State Univ., Detroit, Mich.

Can. J. Zool., 51(2), 143-150; 1973

TISSUES; MERCURY; METABOLISM; GOLDFISH; MERCURY 203; DISTRIBUTION; RETENTION; BIOLOGICAL HALF-LIFE

TAXONOMY: CARASSIUS AURATUS

Goldfish injected intraperitoneally with Hg-203(NO(3)(2) lost mercury at an apparent constant rate resulting in a biological half-life of 568 h. Correlated with this loss was a linear increase in the amount of mercury in the water. The mercury-203 content in the tissues displayed four different responses. (1) Gall bladder, gonad, and spleen tissues showed no significant regressions. (2) Eye, kidney, and intestinal tissue manifested significant losses of mercury, but the rate of loss was not significantly different from that of the body as a whole. (3) Gill, heart, skin, and swim bladder tissues lost mercury at rates faster than the body as a whole. (4) Brain, liver, muscle, and head kidney tissues showed no significant losses of mercury.

507
Geothermal Mercury Pollution in New Zealand

Weissberg, B.G.; Zobel, M.G.R.; Chemistry Division, D.S.I.R., Lower Hutt

Bull. Environ. Contam. Tox., 9(3), 148-155; 1973

GEOTHERMAL DISCHARGES; TROUT; SEDIMENTS; ADSORPTION; CORE SAMPLES; ATOMIC ABSORPTION SPECTROPHOTOMETRY; MERCURY; FRESHWATER; WATER

GEOGRAPHICAL DESCRIPTION: New Zealand, North Island, Waikato River

Rainbow and brown trout and sediments from Waikato River lakes and some of the Rotorua lakes in New Zealand's North Island were sampled and analyzed by flameless atomic absorption technique. These waters drain from thermal areas not associated with mercury ore deposits. Sediment core samples, obtained from water depths of up to 33m were also sampled and analyzed. The results indicate much higher concentrations of mercury in trout living in waters receiving considerable geothermal discharges than in trout living in similar waters receiving little or no geothermal discharges. The concentrations of mercury in sediments showed no apparent variation with increasing depth (i.e., age) of sediments.

508

508
Behavior of Cesium-134, Strontium-85, and Zinc-65 Radionuclides Released to Water Basins. Study on an Experimental Laboratory Model.

Weissbuch, M.; Clain, L.; Botezatu, E.; Freund, S.; Avaravarei, I.; Public Health Med. Res. Inst., IASI, Roma

Part of Health Phys. Probl. Intern. Contam., Proc. IRPA (Int. Radiat. Prot. Ass.) Eur. Congr. Radiat. Prot., 2nd (27FKAY), 421-430, Bujdoso, E. (Ed.), Akad. Kiado, Budapest, Hungary; 1973

RADIONUCLIDES; ACCUMULATION; WATER; SEDIMENTS; CESIUM 134; MODELS; RELEASE; STRONTIUM 85; ZINC 65; LABORATORY MODEL

The accumulation of Cs 134, Sr 85, and Zn 65 in bed sediments of the Danube and Siret basins and in the Bicaz Reservoir was studied using exptl. lab. models. Most of the Zn 65 and Cs 134 and 80% of Sr 85 are retained by the Danube sediment. Acidification decreases the accumulation of all of the radionuclides in the sediment. Alky. promotes the accumulation of Sr 85, with no effect on Zn 65.

509
Methylmercury as Percentage of Total Mercury in Flesh and Viscera of Salmon and Sea Trout of Various Ages

Westoo, G.; Food Lab., Natl. Sweden Food Adm., Stockholm, Sweden

Science (SCIEAS), 181(4099), 567-8; 1973

METHYLMERCURY; MERCURY; FISH; SEA TROUT; SALMON; SALTWATER; AGE

TAXONOMY: SALMO SALAR; SALMO OCLA

Total mercury in the flesh of salmon (SALMO SALAR) (1- to 7-year old) and sea trout (SALMO OCLA) (1- and 2-year-old) increased with age and averaged 93% methylmercury irrespective of age. In the viscera of 1- and 2-year old salmon and sea trout methylmercury constituted only 26-67% of the total Hg, also irrespective of age. Thus, the proportion of methylmercury to total Hg did not increase in salmon or sea trout (muscle plus viscera) with age.

510
Occurrence and Transport of Arsenic in the Upper Sugar Creek Watershed, Charlotte, North Carolina

Wilder, H.R.; U.S. Geol. Surv., Raleigh, N.C.

U.S., Geol. Surv., Prof. Pap. (XIPPAW), (No. 800-D), 205-10; 1972

ARSENIC; TRANSPORT; STREAM FLOW; WATERSHEDS; SEWAGE TREATMENT

GEOGRAPHICAL DESCRIPTION: U.S. (SE), North Carolina, Charlotte, Fort Mill, Upper Sugar Creek Watershed

During the months of June and July 1971, the U.S. Geological Survey made a special study of the occurrence and transport of arsenic in the Sugar Creek, S.C., drainage area. It was found, during the week of June 29-July 5, that despite the fact that no known disposal of arsenic wastes had taken place in over 3 months, total arsenic concentrations ranging from 115 to 260 mg/l were still entering the tributary Irwin Creek through a sewage treatment plant, down from 1,100 mg/l in October 1970. The most contaminated phase of the aqueous system was suspended solid material in the treated sewage, which contained arsenic in amounts of 24,400 to 500,000 mg/kg by weight. Arsenic was found to be concentrating in the streambed materials, which, on June 28, contained concentrations of from 7,000 to 15,000 mg/kg. On July 29-31, 1971, samples were taken at Sugar Creek near Fort Mill, S.C., during a minor flood. These samples showed that during the flood most of the arsenic was being transported in the suspended-sediment phase and that arsenic discharge closely paralleled total suspended-sediment discharge. On February 25, 1972, dried sludge from storage beds at the treatment plant contained as much as 1,700,000 mg/kg/s 870.000 mg/kg/sb and 120,000 mg/kg Cr.

511
Mercury in the Marine Environment. Concentration in Sea Water and in a Pelagic Food Chain

Williams, P.M.; Weiss, H.V.; Inst. Mar. Resour., Univ. California, La Jolla, Calif.

J. Fish. Res. Board Can.(JFRBAK), 30(2) 293-5; 1973

MERCURY; ZOOPLANKTON; SALTWATER; FOOD CHAINS; SEDIMENTS

GEOGRAPHICAL DESCRIPTION: U.S. (W), California, San Diego

Mercury in seawater, in a pelagic food chain, and in bottom sediment was determined at a single station 830 km southeast of San Diego, California. The concentration of mercury in zooplankton slightly increased with depth of collection. The mercury content in almost all of the higher trophic levels of organisms collected at greater depths was indistinguishable from the concentration of mercury in zooplankton at these depths. Mercury concentration in the seawater column was essentially constant below 100 m and significantly higher at the surface. This vertical profile of mercury content is not ascribable to biological activity.

512
Transport of Trace Metals to the Atlantic Ocean by Three Southeastern Rivers

Windom, H.L.; Beck, K.C.; Smith, R.

Southeastern Geology, 12, 169; 1971

RIVERS; SALTWATER; FRESHWATER; TRANSPORT; TRACE METALS; IRON; MANGANESE; RUNOFF; SEDIMENTS; ACCUMULATION; ESTUARIES

Composition of trace metals in solution in estuaries of three southeastern rivers are similar. Dissolved iron and possibly manganese decrease in concentration going from fresh to saline waters owing to precipitation. The composition of trace metals in suspended sediment from the estuaries of the three rivers differs, suggesting a relationship to the composition of the respective drainage basin. The total amount of trace metals transported to the Atlantic in both solution and suspension by these rivers appears to be insufficient to supply more than about 100 Km2 of average Atlantic deep sea sediment. River runoff appears to be inadequate to explain the trace metal accumulation of North Atlantic deep-sea sediments.

504
Molybdenum Concentrations in Tissues of Rainbow Trout In SALMO GAIRDNERI and Kokanee Salmore ONCORHYNCHUS NERKA from Waters Differing Widley In Molybdenum Content

Ward, J.V.

J. Fish. Res. Board Can., 30(6), 841-842.; 1973, June

TRACE ELEMENTS; DETECTION LIMIT; X-RAY FLUORESCENCE ANALYSIS; MUSCLES; BONES; ALGAE; NITROGEN FIXATION; TOXICITY; LIVER; KIDNEYS; SKIN; FISH; ANALYSIS; MOLYBDENUM; ACCUMULATION FACTORS; WATER; BIOACCUMULATION

TAXONOMY: SALMO GAIRDNERI; ONCORHYNCHUS NERKA

SALMO GAIRDNERI and ONCORHYNCHUS NERKA were procured from three waters. Dillon Reservoir had approximately 300 ppb molybdenum in its waters; Eleven Mile Reservoir had approximately 6 ppb; Cline's Fish Hatchery waters were below the limits of detection. Water samples were measured spectrophotometrically. Various fish organs were removed, ashed, and analyzed for molybdenum using x-ray fluorescence to determine accumulation factors (concentration in wet organ/concentration in water). Fish organs from the high (300 ppb) molybdenum water had mean accumulation factors of less than 1.0 with the exception of S. GAIRDNERI stomachs (1.1) and O. NERKA bone (1.1). Fish organs from the low (6 ppb) molybdenum water had mean accumulation factors ranging from 1.7 in muscle to 24.4 in bone. Fish organs from the water with trace amounts of molybdenum had absolute concentrations ranging from 5-118 ppb. Muscle was consistently the lowest in molybdenum; bone was generally the highest. The organs of O. NERKA generally exhibited lower molybdenum concentrations than the organs of S. GAIRDNERI. All fish organs analyzed exhibited an inverse relationship between the ambient concentration and the accumulation factor; thus it appears as if the accumulation factors for molybdenum in salmonids are biologically determinant. There was no significant correlation of molybdenum concentration with age; this agrees with research on terrestrial animals.

505
Cycling of Radionuclides in Columbia River Biota

Watson, D.G.; Cushing, C.E.; Coutant, C.C.; Templeton, W.L.

Can. J. Zool. 51(2) 143-150; 1973

CYCLING; RADIONUCLIDES; CHROMIUM 51; CONTAMINATION; FISH; FLOW RATE; ISOTOPE RATIO; TEMPERATURE; PHOSPHORUS 32; PLANKTON; REACTORS; COOLING SYSTEMS; ZINC 65; SEASONAL VARIATIONS; CHROMIUM; PHOSPHORUS; RIVERS; WATER

GEOGRAPHICAL DESCRIPTION: U.S. (NW), Washington, Columbia River

A study of the cycling of six radionuclides in Columbia River biota was initiated in February 1966 to define the interspecies and seasonal variations in concentrations. These data were related to major ecological factors such as light, temperature, flow, and stable element concentrations. Concentrations of radionuclides in Columbia River water are generally inversely proportional to flow levels, with highest values in winter and lowest in summer. This is related to dilution by seasonal runoff. 32P, 65Zn, and 51Cr were the elements present in highest concentrations in the biota. Levels followed a pattern of high levels in winter and low values in summer. This relationship was particularly apparent in those organisms with high surface to volume ratios whose dominant mode of uptake is adsorption. The influence of the seasonal run-off overwhelmed the beneficial effects of seasonal changes in light and temperature in spring. The magnitude of seasonal changes decreased in the higher trophic levels. Concentration factors (CF) were highest of the biologically important radionuclides 32P and 65Zn and were highest in the primary producers. CFs decreased in higher tropical levels.

506
Distribution and Tissue Retention of Mercury-203 in the Goldfish (CARASSIUS AURATUS)

Weisbart, M.; Dep. Biol., Wayne State Univ., Detroit, Mich.

Can. J. Zool., 51(2), 143-150; 1973

TISSUES; MERCURY; METABOLISM; GOLDFISH; MERCURY 203; DISTRIBUTION; RETENTION; BIOLOGICAL HALF-LIFE

TAXONOMY: CARASSIUS AURATUS

Goldfish injected intraperitoneally with Hg-203(NO(3)(2) lost mercury at an apparent constant rate resulting in a biological half-life of 568 h. Correlated with this loss was a linear increase in the amount of mercury in the water. The mercury-203 content in the tissues displayed four different responses. (1) Gall bladder, gonad, and spleen tissues showed no significant regressions. (2) Eye, kidney, and intestinal tissue manifested significant losses of mercury, but the rate of loss was not significantly different from that of the body as a whole. (3) Gill, heart, skin, and swim bladder tissues lost mercury at rates faster than the body as a whole. (4) Brain, liver, muscle, and head kidney tissues showed no significant losses of mercury.

507
Geothermal Mercury Pollution in New Zealand

Weissberg, B.G.; Zobel, M.G.R.; Chemistry Division, D.S.I.R., Lower Hutt

Bull. Environ. Contam. Tox., 9(3), 148-155; 1973

GEOTHERMAL DISCHARGES; TROUT; SEDIMENTS; ADSORPTION; CORE SAMPLES; ATOMIC ABSORPTION SPECTROPHOTOMETRY; MERCURY; FRESHWATER; WATER

GEOGRAPHICAL DESCRIPTION: New Zealand, North Island, Waikato River

Rainbow and brown trout and sediments from Waikato River lakes and some of the Rotorua lakes in New Zealand's North Island were sampled and analyzed by flameless atomic absorption technique. These waters drain from thermal areas not associated with mercury ore deposits. Sediment core samples, obtained from water depths of up to 33m were also sampled and analyzed. The results indicate much higher concentrations of mercury in trout living in waters receiving considerable geothermal discharges than in trout living in similar waters receiving little or no geothermal discharges. The concentrations of mercury in sediments showed no apparent variation with increasing depth (i.e., age) of sediments.

508
Behavior of Cesium-134, Strontium-85, and Zinc-65 Radionuclides Released to Water Basins. Study on an Experimental Laboratory Model.

Weissbuch, M.; Clain, L.; Botezatu, E.; Freund, S.; Avaravarsi, I.; Public Health Med. Res. Inst., IASI, Rome

Part of Health Phys. Probl. Intern. Contam., Proc. IRPA (Int. Radiat. Prot. Ass.) Eur. Congr. Radiat. Prot., 2nd (27FRAY), 821-830, Bujdoso, E. (Ed.), Akad. Kiado, Budapest, Hungary; 1973

RADIONUCLIDES; ACCUMULATION; WATER; SEDIMENTS; CESIUM 134; MODELS; RELEASE; STRONTIUM 85; ZINC 65; LABORATORY MODEL

The accumulation of Cs 134, Sr 85, and Zn 65 in bed sediments of the Danube and Siret basins and in the Bicaz Reservoir was studied using exptl. lab. models. Most of the Zn 65 and Cs 134 and 80% of Sr 85 are retained by the Danube sediment. Acidification decreases the accumulation of all of the radionuclides in the sediment. Alky. promotes the accumulation of Sr 85, with no effect on Zn 65.

509
Methylmercury as Percentage of Total Mercury in Flesh and Viscera of Salmon and Sea Trout of Various Ages

Westoo, G.; Food Lab., Natl. Sweden Food Adm., Stockholm, Sweden

Science (SCIEAS), 181(4099), 567-8; 1973

METHYLMERCURY; MERCURY; FISH; SEA TROUT; SALMON; SALTWATER; AGE

TAXONOMY: SALMO SALAR; SALMO OCLA

Total mercury in the flesh of salmon (SALMO SALAR) (1- to 7-year old) and sea trout (SALMO OCLA) (1- and 2-year-old) increased with age and averaged 93% methylmercury irrespective of age. In the viscera of 1- and 2-year old salmon and sea trout methylmercury constituted only 26-67% of the total Hg, also irrespective of age. Thus, the proportion of methylmercury to total Hg did not increase in salmon or sea trout (muscle plus viscera) with age.

510
Occurrence and Transport of Arsenic in the Upper Sugar Creek Watershed, Charlotte, North Carolina

Wilder, M.R.; U.S. Geol. Surv., Raleigh, N.C.

U.S., Geol. Surv., Prof. Pap. (XIPPAW), (No. 800-B), 205-10; 1972

ARSENIC; TRANSPORT; STREAM FLOW; WATERSHEDS; SEWAGE TREATMENT

GEOGRAPHICAL DESCRIPTION: U.S. (SE), North Carolina, Charlotte, Fort Mill, Upper Sugar Creek Watershed

During the months of June and July 1971, the U.S. Geological Survey made a special study of the occurrence and transport of arsenic in the Sugar Creek, S.C., drainage area. It was found, during the week of June 29-July 5, that despite the fact that no known disposal of arsenic wastes had taken place in over 3 months, total arsenic concentrations ranging from 115 to 260 mg/l were still entering the tributary Irwin Creek through a sewage treatment plant, down from 1,100 mg/l in October 1970. The most contaminated phase of the aqueous system was suspended solid material in the treated sewage, which contained arsenic in amounts of 28,400 to 500,000 mg/kg by weight. Arsenic was found to be concentrating in the streambed materials, which, on June 28, contained concentrations of from 7,000 to 15,000 mg/kg. On July 29-31, 1971, samples were taken at Sugar Creek near Fort Mill, S.C., during a minor flood. These samples showed that during the flood most of the arsenic was being transported in the suspended-sediment phase and that arsenic discharge closely paralleled total suspended-sediment discharge. On February 25, 1972, dried sludge from storage beds at the treatment plant contained as much as 1,700,000 mg/kg/s 870,000 mg/kg/sb and 120,000 mg/kg Cr.

511
Mercury in the Marine Environment. Concentration in Sea Water and in a Pelagic Food Chain

Williams, P.M.; Weiss, H.V.; Inst. Mar. Resour., Univ. California, La Jolla, Calif.

J. Fish. Res. Board Can. (JFRBAM), 30(2) 293-5; 1973

MERCURY; ZOOPLANKTON; SALTWATER; FOOD CHAINS; SEDIMENTS

GEOGRAPHICAL DESCRIPTION: U.S. (W), California, San Diego

Mercury in seawater, in a pelagic food chain, and in bottom sediment was determined at a single station 830 km southeast of San Diego, California. The concentration of mercury in zooplankton slightly increased with depth of collection. The mercury content in almost all of the higher trophic levels of organisms collected at greater depths was indistinguishable from the concentration of mercury in zooplankton at these depths. Mercury concentration in the seawater column was essentially constant below 100 m and significantly higher at the surface. This vertical profile of mercury content is not ascribable to biological activity.

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Composition of trace metals in solution in estuaries of three southeastern rivers are similar. Dissolved iron and possibly manganese decrease in concentration going from fresh to saline waters owing to precipitation. The composition of trace metals in suspended sediment from the estuaries of the three rivers differs, suggesting a relationship to the composition of the respective drainage basin. The total amount of trace metals transported to the Atlantic in both solution and suspension by these rivers appears to be insufficient to supply more than about 100 Km2 of average Atlantic deep sea sediment. River runoff appears to be inadequate to explain the trace metal accumulation of North Atlantic deep-sea sediments.

513
Arsenic, Cadmium, Copper, Mercury, and Zinc in Some Species of North Atlantic Finfish

Windom, H.; Stickney, R.; Smith, R.; White, D.; Taylor, F.

J Fish Res Board Can., 30(2), 275-279; 1973

LIVER; MUSCLES; ARSENIC; COPPER; MERCURY; CADMIUM; ZINC; FINFISH; SALTWATER

TAXONOMY: CHONDRICHTHYS; OSTEICHTHYS

Arsenic, cadmium, copper, mercury, and zinc analyses of 91 individuals representing 35 species of North Atlantic finfish (CHONDRICHTHYS and OSTEICHTHYS) indicate that these metals occur at similar levels in both inshore and offshore species. CHONDRICHTHYS and OSTEICHTHYS have similar concentrations of all the metals, excepting arsenic which is higher in CHONDRICHTHYS. Analyses of various tissues in CHONDRICHTHYS reveal higher metal concentrations in the liver except for mercury which was higher in muscles.

514
Evaluations of Stream Pollution and Trace Substance in the New Lead Belt of Missouri

Wixson, B.G.; Bolter, E.; The University of Missouri-Rolla, Rolla, MO

Part of D.D. Hemphill (Ed.). Fifth Annual Symposium on Trace Substances in Environmental Health, University of Missouri-Columbia (143-152); 1972

STREAMS; LEAD; MINING; TRACE SUBSTANCES; MILLS; EFFLUENTS; WATER; QUALITY; COPPER; ZINC; ALGAE; ALGAL BLOOMS; CARBON DIOXIDE; PHOSPHATE; NITROGEN; BENTHOS; BACTERIA; MICROORGANISMS

GEOGRAPHICAL DESCRIPTION: U.S., Missouri (SE), New Lead Belt, Viburnum Trend

Stream pollution studies have been carried out in the Viburnum Trend or "New Lead Belt" of S.E. Missouri to evaluate the effects of trace substances in wastes from lead-zinc mining operations. Data were collected to evaluate the character of individual wastes and to study the effectiveness of stabilization lagoons in treating milling effluent discharges into area streams. Mine discharge water, milling operations, combined mine-mill effluent and lagoon system effluent, were sampled. Water quality samples were also taken in streams below the mine lagoons and were compared with those from control sites located on unpolluted streams. Biological, chemical and physical parameters were evaluated, along with trace metal determinations of lead, zinc and copper. Potential pollutional characteristics were determined at all sampling sites, with special emphasis on the concentration of trace substances by excessive algal growths. Studies of mine effluent entering streams have indicated that mining wastewaters contain carbon dioxide and sufficient phosphorus to combine with nitrogen present in the stream water and cause undesirable benthic growths in bacterial-algal mats. Background concentrations of lead, zinc and copper rarely exceeded 20 ppb (parts per billion) in streams; however, concentrations up to 1,000 ppb have been determined in settling ponds. Recommendations are presented for the effective control of trace substances associated with wastewater from the lead-zinc mining industry in southeast Missouri.

515
An Investigation of Environmental Pollution by Lead and Other Heavy Metals from Industrial Development in Southeastern Missouri

Wixson, B.G.; Tranter, W.H.

Progress Report, Dept. of Civil Engineering, Environmental Research Center, NSF-RANN New Lead Belt Project, University of Missouri-Rolla, 13pp.

LEAD; COPPER; ZINC; ATMOSPHERE; SOILS; INDUSTRY; MINING; MILLS; REMOTE SENSING; EFFLUENTS

GEOGRAPHICAL DESCRIPTION: U.S., Missouri (SE), New Lead Belt

An interdisciplinary investigation of environmental pollution is underway in the New Lead Belt area of southeastern Missouri to determine the effect of lead, zinc, copper, cadmium and other heavy metals. The preliminary results for the air, soil and water investigations are presented and the planned future investigations are discussed with emphasis on applications of remote sensing to monitor the environment.

516
The Flux of Mn, Fe, and Zn in an Estuarine Ecosystem

Wolfe, D.A.; Cross, F.A.; Jennings, C.D.

Part of Radioactive Contamination of the Marine Environment, Proceedings of Symposium held by the International Atomic Energy Agency, Seattle, WA, July 10-14, 1972 (159-175) 786 p.; 1973

MANGANESE; IRON; ZINC; RADIONUCLIDES; ESTUARIES; FISH; CRUSTACEA; PLANKTON; SEDIMENTS; INFAUNA; MACROINVERTEBRATES; EPIBENTHOS; TEMPERATURE; SALINITY; PH; RUNOFF; MARINE BIOTA; WATER

GEOGRAPHICAL DESCRIPTION: U.S. (SE), North Carolina, Newport River

Cycling of radionuclides in estuarine ecosystems involves a complex network of interactions among sediments, dissolved components, biota, and fluctuating environmental variables, e.g. temperature, salinity, and pH. Accurate prediction of the distribution of radionuclides in the various components requires a thorough understanding of the flux of stable elements through the system. Efforts to model the fluxes of Mn, Fe and Zn through and within coastal plain estuaries of southeastern United States of America are described. Data have been derived mainly from extensive study of the Newport River estuary, a North Carolina embayment of about 31 km2 receiving run-off from a total watershed area of about 380 km2. Trace metals have been analysed on a seasonal basis in water, sediments, and dominent organisms from several locations in this ecosystem. Ecological studies by colleagues at the Center have produced estimates of seasonal variability and biomass for the major primary producers, zooplankton, and the dominant species of macroinvertebrates (infauna and epibenthos) and fish. Since the estuary is shallow (less than 1 m at mean low tide), flushing is dominated by the semidiurnal tide (0.8 m amplitude), and except during periods of very heavy rain, run-off has little effect. Major imports of Mn, Fe and Zn to the estuary consist of suspended and dissolved species in the run-off, sediment bed-load, tidal inputs, and the late winter-spring immigration of fish and crustaceans. Major exports are tidal flushing of dissolved and suspended trace metals (including plankton), the autumn emigration of fish and crustaceans, and commercial harvest of fish and shellfish. Despite the high productivity and low run-off in the Newport River estuary, physical processes dominate the total annual budgets of these metals. Biological transport processes were most important in the case of Zn, for which commercial harvest and emigration may account for more than 10% of the annual input from the watershed. The complexities of progressing from this static "annual budget concept" to a dynamic model of trace metals flow through the trophic structure of Newport River estuary is discussed.

517
Cycling of Elements in Estuaries

Wolfe, D.A.; Rice, T.R.; National Marine Fisheries Service, Beaufort, N.C., Atlantic Estuarine Fisheries Center

Fishery Bulletin, 70(3), 959-72; 1972

ESTUARIES; RADIONUCLIDES; CYCLING; SEWAGE; ACCUMULATION; SALT WATER; TRACE ELEMENTS; ESSENTIAL TRACE ELEMENTS; CALCIUM; MAGNESIUM; POTASSIUM; SODIUM; COBALT; COPPER; IRON; MANGANESE; ZINC; ALUMINUM; MOLYBDENUM; SILICON; VANADIUM; CESIUM; CHROMIUM; NICKEL; RUBIDIUM; STRONTIUM; TIN; ANTIMONY; ARSENIC; BARIUM; BERYLLIUM; BISMUTH; CADMIUM; LEAD; MERCURY; SELENIUM; SILVER; THORIUM; SEDIMENTS; DISSOLVED ORGANIC COMPLEXES; SUSPENDED PARTICULATES; POLYCHAETES; CHELATES; EDTA; COMPLEXES; COBALAMIN; BIOMASS; ADSORPTION; ION EXCHANGE; ZINC 65; RAIN; RUNOFF; TIDAL FLUSHING; SEASONAL VARIATIONS; PHOSPHORUS; NITROGEN; PH; SALINITY; NUTRIENTS; CESIUM 137; RUTHENIUM 106; OYSTERS; FISH; CONCENTRATION FACTOR; ASSIMILATION; UPTAKE; MODELS

Meaningful evaluation of the ecological stresses imposed by man's release of heavy metals or radioisotopes into estuaries requires an improved understanding of the interactions between the waste materials and the functional components of the ecosystem. The types of information required for the development of useful models for the cycling of contaminant metals (both radioactive and stable) in estuarine ecosystems are reviewed. With particular reference to the coastal plain estuaries of the southeastern United States, the major reservoirs of those metals, the mechanisms and pathways of elemental transformation and rates of elemental turnover among reservoirs, and the responses of these processes and reservoirs to environmental change are discussed. A conceptual systems model is presented as the preliminary phase in the development of dynamic mathematical models of elemental cycling.

518
A Progress Report on Mercury

Wood, J.M.

Environment, 14(1), 33-39; 1972, January

MERCURY; ARSENIC; SEWAGE; FUNGICIDES; METHYLMERCURY; DISCHARGE; METHYLATION; FISH; METHYLMERCURY; HALF-LIFE; ANALYTICAL METHODS; ATOMIC ABSORPTION SPECTROPHOTOMETRY; NEUTRON ACTIVATION ANALYSIS; GAS CHROMATOGRAPHY; SEWAGE TREATMENT; FERTILIZERS; RUNOFF; DREDGING; WATER QUALITY; LEGAL ASPECTS; MICROORGANISMS

The mercury problem is now well defined: There are huge amounts of inorganic mercury remaining in sediments, which is slowly being converted to methyl mercury, even after the discharge of mercury has been greatly reduced. Further, methyl mercury compounds are still used as fungicides in the U.S., but not in Sweden. The companies involved and the locations of the more serious pollution are given. The author calculates that less than 0.2 percent of the mercury in sediments has been converted and that approximately 500 years would be required to clean the system by biological methods. He mentions other possibilities, such as dredging (which he says redistributes the contamination and did not help at Minamata), covering the sediments and improving water quality so the microbial populations decrease. The author and his students studied the methylation process. Carbon, nitrogen, phosphates and trace metals provide food for the microorganisms and this determines their population level. The rate of methylation depends on the concentration of inorganic mercury and the population level of microorganisms. Poor sewage treatment and runoff from overfertilization have made the situation worse. Fish take up the methyl mercury in food and from the water. Methyl mercury has a half-life in fish of 800-1000 days in fish (flounder, perch, pike, eels). Thus, the accumulation can increase significantly even at a rather low intake. The author is critical of some of the analytical work and decisions. Flameless atomic absorption is cheap but gives lower values. The author prefers neutron activation as being far more accurate. Further, the author prefers a direct analysis for methyl mercury, e.g. by gas chromatography rather than total mercury, since this is the critical compound. While there is some mercury of natural origin being methylated, industrial pollution has greatly magnified the problem in recent years. The author discusses legal aspects in the U.S. and Canada.

519
Mechanisms for Methylation of Mercury in the Environment

Wood, J.M.; Penley, M.W.; DeSimones, R.E.

Part of Technical Report No. 137, Mercury Contamination in Man and his Environment, International Atomic Energy Agency, Vienna, Austria (p. 49-66), 181 p.; 1972, July

MERCURY; CONTAMINATION; METHYLATION; COENZYMES; NUTRIENTS; METHYLCORRINOIDS; METHYLCOBALAMIN; ENZYMES; MERCURY COMPOUNDS

A complex paper on the methylation of mercury. Methylation can proceed under both aerobic and anaerobic conditions and the rate is greater where pollution and nutrients lead to an abundant population of the suitable bacteria.

520
Persistence and Reactions of Carbon 14-Cacodylic Acid in Soils

Woolson, E.A.; Kearney, P.C.

Environmental Science and Technology, 7(1), 47-50; 1973, January

ARSENIC; CACODYLIC ACID; SOILS; PERSISTENCE; CARBON 14; CARBON; AVAILABILITY; ARSINE; ALKYL ARSINE; DEGRADATION; EXTRACTANTS; SOLUBILITY; BIODEGRADABILITY

Carbon-14-labeled cacodylic acid (hydroxydimethylarsine oxide) was prepared by reacting 14carbon-methyl iodide with methyl dichloroarsine. Concentrations of 1, 10, and 100 parts per million of cacodylic acid were established in three soils of varying iron and aluminum content. At 2, 4, 8, 16, 24, and 32 weeks, soils were analyzed for 14Carbon and total arsenic in the water-soluble (ws), calcium (Ca), iron (Fe), and aluminum (Al) fractions. Initially, cacodylic acid was distributed in the following fractions: ws is greater than > Al is greater than Fe is greater than Ca. After 32 weeks, the distribution was ws is greater than Al is greater than Fe is greater than Ca. In contrast, inorganic arsenate (5+) was largely present in the Fe and Al fractions. Cacodylic acid persistence was a function of soil type and after 32 weeks the following amounts of 14carbon were recovered in each soil type by combustion: Christiana (23%), Hagerstown (53%), Lakeland (62%). A decrease in both total 14carbon and total arsenic occurred in all soils with time. A pungent garlic odor was detected in soils receiving 100 parts per million, suggesting the production of a volatile alkyl arsine. The loss of arsenic suggests that one route of cacodylic acid loss from aerobic and anerobic soils is by alkyl arsine volatility. Degradation under aerobic conditions also occurred by cleavage of the carbon--As bond, presumably yielding CO2 and AsO4(3-). This degradation is presumably due to microbiological action.

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521
Mussels and Barnacles as Indicators of the Variation of Mn 54, Co 60, and Zn 65 in the Marine Environment

Young, D.R.; Folson, T.P.

Part of Radioactive Contamination of the Marine Environment, Proceedings of Symposium held by the International Atomic Energy Agency, Seattle, WA, July 10-14, 1972 (633-649) 786 p.; 1973

MUSSELS; BARNACLES; BIOLOGICAL INDICATORS; MANGANESE; MANGANESE 54; COBALT; COBALT 60; SALTWATER; THERMONUCLEAR TESTING; FALLOUT; COASTAL WATERS

TAXONOMY: MYTILUS CALIFORNIANUS; MYTILUS EDULIS

The intertidal byssal mussel MYTILUS CALIFORNIANUS and the oceanic gooseneck barnacle LEPAS ANATIFERA are efficient indicators of spatial and temporal changes in levels of three radiometals in the marine environment. LEPAS specimens collected from the northeastern Pacific during the first half of 1960 demonstrated oceanic-to-coastal ratios of Mn 54, Co 60, and Zn 65 fallout from the 1961-1962 thermonuclear tests of approximately 3:1, 4:1, and 2:1, respectively. Caesium-137 in the surface layers of the two sectors (whose centres lie about 1500 and 300 km west of San Diego) also showed a 3:1 oceanic-to-coastal enhancement of fallout from this source. MYTILUS specimens collected during 1963-64 along the northeastern Pacific Coast showed a fairly uniform distribution of Mn 54 and Co 60 between latitudes 46 and 29 north, but dramatically reflected the point source of Hanford-produced Zn 65 emanating from the mouth of the Columbia River. Relatively high zinc-65 concentrations, possibly related to this source, were detected in MYTILUS from northern Baja California MYTILUS, the ecological half-times of the three nuclides observed in the invertebrates between mid-1963 and late 1964 at specific intertidal, coastal, and oceanic platforms were consistent with radioactive decay rates. This suggests an approximate equilibrium between input and removal of these radiometals in the mixed layer. Mussel and barnacle tissue-to-seawater enrichment factors for the three nuclides exceed 1000. In MYTILUS 4 to 6 cm in length, size variations had no significant effect on nuclide concentration, but 70% of the Co 60 and Zn 65 soft-tissue radioactivity was located in the kidneys and digestive glands of this organism. Bay mussels (M. EDULIS) taken from the coastal surf zone showed concentrations similar to those in M. CALIFORNIANUS, but M. EDULYS in two nearby bays had lower values. Intertidal coastal mussels and gooseneck barnacles recently collected from 14 California stations indicate average 1971 "baseline concentrations" of Mn 54, Co 60, and Zn 65 of 0-5, 0-4, and 0-11 pCi/wet kg, respectively.

522
Mercury Concentrations in Dated Varved Marine Sediments Collected Off Southern California

Young, D.R.; Johnson, J.N.; Soutar, A.; Issacs, J.D.; South. California Coastal Water Res. Proj., El Segundo, Calif.

Nature (London) (NATUAS), 244(5414), 273-5; 1973

MERCURY; SEDIMENTS; SALTWATER

GEOGRAPHICAL DESCRIPTION: U.S., California (S. Coast)

523
Effect of Copper and Silver Ions on Algae

Young, R.G.; Lisk, D.J.

J. Water Pollut Control Fed. 44(8), 1972 1643-1647

FISH; TOXICITY; ALGICIDE; GROWTH; INHIBITION; ALGAE; COPPER; SILVER; SYNERGISM

TAXONOMY: EUDORINA PEDIASTRUM

This study explores the possibility of synergism between Cu and Ag in the control of algal blooms on the theory that if such action does occur, total ions with recognized toxicity to fish and other wildlife would effect control of some algal species. In this work 0.3mg/l copper or copper-silver mixture was lethal to all blue-green algae tested. The green algae were more resistant, however. The copper silver combination was slightly more effective than copper alone under the conditions used, but will be of questionable utility in the field when increased risk to desirable fish and the economic factor of the cost of silver salts are considered.

524
Prediction of Incipient Lethal Levels of Copper to Juvenile Atlantic Salmon in the Presence of Humic Acid by Cupric Electrode

Zitko, P.; Fisheries Research Board of Canada

Bull. Env. Contam. Tox., 10(5), 265; 1973, November

LETHALITY; SURVIVAL; COPPER; AGE; SALMON; HUMIC ACIDS; LIGNOSULFONATES; PULP MILLS; EFFLUENTS; COMPLEXES; INDUSTRY; ORGANIC COMPOUNDS; CUPRIC IONS; SALTWATER

The toxicity of copper to juvenile Atlantic salmon in the presence of humic acid is described. The incipient lethal levels of copper are predicted from the potential of a cupric ion selective electrode. This technique might be extended to other copper-complexing substances such as lignosulfonates, pulp mill effluents in general, and various organic compounds.

525
Release of Heavy Metals from Sediment by Nitrilotriacetic Acid NTA

Zitko, V.; Carson, W.V.; Biol. Stn., St. Andrews, New Brunswick

Chemosphere 1(3), 113-118; 1972

HEAVY METAL RELEASE; SEDIMENTS; NITRILOTRIACETIC ACID; NTA; COPPER; IRON; ZINC; CADMIUM; MERCURY; ION EXCHANGE; FISH; RIVERS; MINING

Cupric, zinc and ferric ions are released from aquatic sediments by nitrilotriacetic acid (NTA). Model experiments indicate that cadmium and mercuric ions behave similarly. Concentration of NTA as low as 1.0 mg1(-1) produces in some cases measurable release of these ions. The release of heavy-metal ions is somewhat depressed by increased water hardness. In model experiments with ion exchange resins NTA affects only ions bound to carboxyls and has no effect on ions bound to sulfo groups. Widespread use of NTA would result in NTA concentrations in the order of 10-20 mg1(-1) in surface waters. Since even low concentrations of NTA release heavy-metal ions from sediments, direct discharge of NTA into surface waters should be limited as much as possible. For the same reason, the use of NTA as a fish-protecting agent in rivers affected by base-metal mining pollution is not recommended. These studies were conducted on the sediments in the Northwest Miramichi River and its tributary, the Tomogonops River, New Brunswick, Canada, which drain a base-metal mining area.

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Methylmercury in Freshwater and Marine Fishes in New Brunswick, in the Bay of Fundy and on the Nova Scotia Banks

Zitko, V.; Finlayson, B.J.; Wildish, D.J.; Anderson, J.M.; Kohler, A.C.

Fish Res Board Can 28(9), 1285-1291; 1972

FISH; SALTWATER; INDUSTRY; ATMOSPHERE; FRESHWATER; MERCURY; METHYLMERCURY; EELS; PICKEREL; WHITE PERCH; YELLOW PERCH; BROOK TROUT; ATLANTIC SALMON

In only two cases was the level of methylmercury in marine fish above 0.13 parts per million. Fresh water fish ranged from approximately 0.1 to 1 or 2 parts per million. Some of the freshwater sampling locations were near industrial activity; others suggested pollution by airborne mercury. Methyl mercury in eels from one New Brunswick lake has not changed over 46 years, so some of the elevated levels may be natural.

527
Active Phase of Assimilation of Plutonium 239 by the Marine Algae ASCOPHYLLUM NODOSUM

Zlobin, V.S.; Zlobin, V.

Polyar. Nauch.-Issled. Proekt. Inst. Morsk. Ryb. Khoz. Okeanogr., No. 29, 169-175(1971).; 1973

ALGAE; AMMONIUM COMPOUNDS; BIOLOGICAL EFFECTS; CADMIUM COMPOUNDS; CHLORIDES; CYANIDES; INHIBITION; PLUTONIUM 239; RADIONUCLIDES; KINETICS; RESPIRATION; UPTAKE

A study was made of the problem of accumulation of Pu 239 by the brown alga Ascophyllum nodosum during suppression of cell respiration. As the inhibitors the author used sodium cyanide in a concentration of 1 10E-4 M, ammonium chloride 10 mM and 100 mM and cadmium chloride 2 mM. It was established that they cause a increase in the Pu 239 accumulation factors in dependence on the substrate on which the act. A study was made of the mechanism of his phenomenon and it was possible to establish the dependence of the intensity of cell respiration and the accumulation factor. The article gives hypotheses on the means and methods by which Pu 239 in a colloidal state penetrates through the cell membrane.

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